ESSAYS ON TURKEY'S WHEAT EXCHANGES, THE TURKISH COTTON MARKET INTEGRATION, AND EFFICIENCY OF THE ISTANBUL STOCK EXCHANGE

By

CUMHUR BÜGÜK

Bachelor of Science
Ankara University
Ankara, Turkey
1991

Master of Science
Texas Tech University
Lubbock, Texas
1996

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Thesis Approved:

B. Wade Brorsen

Thesis Adviser

Daniel A. Tilley

Kim B. Anderson

Jeanne S. Hall

Alfred Landoni

Dean of the Graduate College

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Chapter I

SELLER AND BUYER SATISFACTION AND PARTICIPATION IN TURKEY'S WHEAT EXCHANGES

Abstract

This study uses data from a survey of wheat sellers and buyers in four different exchanges in Turkey to gain a better understanding of customer satisfaction with the current exchange system and factors that influence exchange participants' decisions to choose exchanges over other ways of selling wheat. The descriptive and econometric results indicate that most sellers and buyers have a few problems with the current system. The major dissatisfaction with exchanges are prices and fees. The Tobit model results suggest that there is a great potential for accepting a new grading system and accepting legally enforceable warehouse receipts because sellers and buyers those most concerned about warehouse receipts use the exchanges the least.

Keywords: wheat exchanges, survey, grading, warehouse receipt, Tobit

Introduction

The agricultural sector in Turkey has great importance, both technically and socio-politically. Agriculture is 16% of GNP and agricultural products are 11% of total exports (World Bank). Field crops are grown in 88% of total utilized agricultural area, 21.5 million hectare. The subdivision of field crops area are 75% grains, 10% pulses, 7% industry plants and 8% others. Wheat is the one of the major grains produced in Turkey. The production level in 1999 was 18 million metric tons (DIE).

The agricultural commodity sector in Turkey is beset with high uncertainty because of the production, organization of the marketing system, and government policies of agricultural industry. Production is generally characterized by a large number of small farms, mostly family farms. Most farmers are not financially strong, and they do not have organized commodity boards that help them in various stages of production and marketing activities. Hence, producers are highly dependent on government subsidies and commodity purchasing programs.

As indicated by Jang (1992), to encourage farmers to increase production without taking the necessary steps to organize the marketing system will have a harmful effect. Turkey's grain marketing system has developed slowly because there are only underdeveloped commodity exchanges to encourage competition. Most wheat moves through the system in bulk and is marketed by the growers to the purchasers such as Turkish Grain Board (Toprak Mahsulleri Ofisi, TMO), commodity exchanges, wheat processors, and middlemen who best meets their needs for a rapid cash payment and

reasonable price. Significant public procurement by State Economic Enterprises (SEEs) continues for the most important crops. A large portion of agriculture has been protected with TMO purchasing 25% of wheat at harvest and providing considerable storage.

While the government has trade controls and is heavily involved in production and marketing through subsidies and support price policies, the results were largely negative for both the agriculture sector and the national economy. Some of these policies created barriers to Turkey's closer integration with the European Union. Turkey is seeking to reduce government interventions in the economy and to join the European Union. Before being accepted, Turkey must get inflation under control and free various sectors of its economy. One of the reasons the government is unwilling to disengage from direct price support is the perception that the private sector is not able to adequately fill this role. This task might be accomplished by commodity exchanges.

The commodity exchanges are nonprofit organizations. They are quasi-government agencies in that they have considerable independence yet they are essentially owned by the Turkish government. They were established through a government-mandated registration fee program that allows them to operate as exchanges performing agricultural spot-trading cash auctions.

In the exchanges, absence of uniform grades and standards have hampered the development of marketing and resulted in materialized trade that increases marketing costs. Deficiencies in the existing legal procedures would be a major problem for organized trading. Absence of adequate warehouses and its legislation to serve farmers to store their grain with fee and the lack of negotiable warehouse receipts and grades and standards may have limited commodity trading.

Fortunately, the Turkish government as well as farmers and traders have realized the need for greater marketing efficiency for wheat. Several changes are being considered by the Ministry of Industry and Trade in conjunction with the World Bank. Wheat marketing liberalization continues to be a high priority. The Turkish government has been trying to increase the functions of commodity exchanges for wheat and other commodities recently. The plan is to end TMO intervention. This would force other sectors to absorb storage and marketing functions. One of the largest sectors is government owned exchanges. These exchanges will face increased competition from private exchanges and private treaty transactions.

Before investing huge amounts in these exchanges, there is a need to evaluate user satisfaction with the current situation in exchanges and the need for change. The effect of any policy reform depends on how economic actors react to it. In the case of the wheat marketing modernization, the success depends on how traders, farmers and processors can adapt themselves to the new marketing system and whether the private sector can fulfill the retreat of the public sector from direct involvement in marketing.

The primary goal of this study was to provide wheat industry participants with insight regarding the problems of the current exchange system has. With this information, exchange participants and Turkish government agencies can evaluate and improve the existing system of trading in the exchanges before a significant amount of investment is carried for further developments.

To achieve these goals, the survey and the Tobit analysis concentrated on the following objectives:

- Determine sellers and buyers satisfaction with the current exchanges trading system,
- Determine the key factors that influence sellers and buyers decisions to participate in exchanges.

Wheat Production, Utilization and Marketing in Turkey

Turkey is the eleventh largest producer of grain in the world (World Bank, 1998). Wheat accounts for 16 % of the value of all crops in Turkey and is grown in over 50 of Turkey's 73 provinces (World Bank, 1998). The amount of production was 18.5 million tons in 1998/99 (USDA). About 17.1 million metric tons were used domestically (Table 1). Turkey exports wheat in the forms of wheat flour and pasta products to Azerbaijan, Georgia, Iraq, Libya, and surrounding countries. Turkey ranks second, behind the European Union, in world flour exports (Atli and Niernberger, 1999). The three largest wheat provinces, which produce more than one million tons, are Konya, Ankara, and Adana (Figure 1).

Turkey has been experiencing a significant change in the marketing environment in terms of political, economic and technological aspects in recent years. The main purposes of marketing modernization are price stabilization and lower marketing margins to promote producers and consumers. The high marketing costs seem to be caused mostly by poor efficiency in marketing functions, including loading, unloading, transportation, storage, grading, processing, information and government intervention.

Figure 1. Map of Turkey

Source: University of Texas map library web site (http://www.lib.utexas.edu/Libs/PCL/Map_collection/middle_east_and_asia/Turkey.jpg)

The central role of the government in terms of the production, sale and distribution of agricultural products is to build a regulatory framework that encourages individuals and firms to make decisions that will maximize their overall profitability (Jacobsen et al., 1995). Turkey has a long history of government intervention in the domestic markets for agricultural commodities. Domestic producers prices have been supported through two main mechanisms, government support purchasing and border protection. The government usually acts through a state economic enterprise, Turkish Grain Board (TMO).

The main objective of TMO is to protect both the producer and consumers by playing a market-balancing role. TMO prepares and applies quality criteria that will be the base of intervention, purchasing condition of products, supplement premium or reductions. TMO sets the maximum purchasing price for grains by considering production costs, current inflation rates, world and domestic prices etc. The Turkish Grain Board purchases wheat only from producers. TMO's impact on commodity marketing has expanded recently from buying 1,355,463 ton in 1994 to 4,207,884 tones in 1999 which results in controlling market prices (Turkish Grain Board).

Commodity exchanges also play a role in grain marketing in Turkey. There are about 19 exchanges engaged in trading wheat. The most active exchanges in the grain markets are located in Edirne, Eskisehir, Konya and Polatli. Eskisehir and Polatli trade about 200,000 tons of wheat annually, while Konya trades approximately 400,000 tons (World Bank, 1998). Up to 50% of the grain produced in the immediate regions around the exchanges is traded through these exchanges (World Bank).

Currently, exchanges function as a spot market where the commodity is brought to the location and, upon sale delivered to the purchaser for payment. Producers bring their wheat by truck or wagon to be auctioned at the exchange before and during the day's trading session. The wheat is hand-probed in several locations to provide about a 2-kg sample. Since the exchange does not provide grading and testing of wheat before trading, the sample is brought to the processing area of the exchange where a registration form for tax and exchange form for name identification, estimated quantity, variety, production location, etc. are completed. The producer goes to the area overlooking the trading floor to wait for the wheat to be auctioned. The sample is divided with a portion retained and the remainder placed in a sample pan with a copy of the form. Queuing for auction is by arrival time and when prior offers have been auctioned, the sample pan is carried around by exchange assistants to the trading tables for traders to take a portion and examine it visually before starting the bidding. The buyer judges the quality of the wheat by looking, smelling, and or biting the wheat. Each buyer has a subjective quality estimate that is less accurate than what modern technology can provide. When bidding is completed, producers are contacted (in the producer area), and the offer is accepted or rejected and the documents taken to the clearing area. If the producer rejects the offer, there is no transaction and they take wheat elsewhere to be sold. If the producer accepts, the trade is posted on the exchange board. The purchaser contacts the seller and gives directions to the warehouse location where the wheat is to be unloaded. There can be several methods of payment for this transaction, but immediate cash is the most preferred. Any disputes are handled by the exchange through an established procedure. The proposed new marketing system would project a grade analysis of each sample on

the screen. Such a system would provide more accurate information and save the time of distributing handfuls of wheat to buyers.

Survey Procedures

A baseline survey conducted in late 1998 elicited buyers and sellers' satisfaction with the current system of wheat exchanges, and deficiencies with the current system. This survey was conducted as a part of a marketing development project funded by the World Bank and the Turkish Ministry of Trade and Industry. The survey was not designed on a random sampling basis. Thus the characteristics of this sample may not be representative of all farmers and traders in these areas. The survey can be found in the appendix.

The project objective is to conduct research to gain greater understanding of exchange users' satisfaction with the current system:

- to increase the marketing efficiency of grains through the selected commodity exchanges by introducing improved systems of price discovery, dematerialized trade, and regulatory oversight,
- to demonstrate the benefits resulting from increased private commodity marketing, and
- to provide a model for development of private exchanges, and impetus for government to withdraw from its intervention in the commodity marketing.

The survey was conducted in five commodity exchanges: Konya, Eskisehir, Edirne, Polatli and Sanli Urfa. Via personal interview, each of 256 buyers and sellers was asked questions about economic, institutional and personal characteristics.

Seller and buyer satisfaction was traced with three subgroups of questions. First, the participants' satisfaction was indicated by the perception of the quality of services from the exchange relative to the associated costs and by a qualitative comparison of on- and off exchange trading. The users included farmers, traders, processors, and warehouses. Services such as market reporting system (prices and volume), determination of grades and standards for commodities (clear, understandable, and effective), warehouse receipts (regulatory agencies, common instrument, and enforcement), execution of transactions, arbitration of differences, contract enforcement, fees, ability to locate buyers and sellers in a timely manner, and satisfaction with the negotiated prices were considered in determining the participants satisfaction. The information was collected through questionnaire of two types: short form and long form. The short form was widely distributed to users to determine the general indices of satisfaction. A long form was used to obtain more specific information from a smaller sample size. Second, the area from which the users of the participating exchanges come was analyzed. The concern was evaluated about attraction of users from a decreasing size of geographical area, no change, or increasing size of geographical area. Third, the type of users was reviewed.

In this analysis, the sample is divided into the "buyers" and the "sellers" across the exchanges using the survey data. Thus, the responses from the five exchanges can be compared. To identify statistically significant differences in buyers and sellers' response patterns across the exchanges, a chi-square "contingency" test is reported. The chi-square test of independence is a test of statistical significance used to assess the

likelihood that an observed relationship differs significantly from that which could have occurred by chance.

The Tobit Model

To perform their duties in marketing, wheat buyers and sellers have to make numerous decisions. Some of these decisions relate to the adoption of new marketing alternatives. One of the appropriate models to analyze this type of decision problem is the qualitative response model.

Just and Zilberman suggest that an appropriate technology adoption model should incorporate both the discrete decision of whether or not to adopt (out of exchange market use) and the continues decision of how much of total resources (measured here as percentage of total amount of wheat sold) to allocate to the adoption activity. Thus, the dependent variable (Y) used is the percentage of wheat sold out of the exchanges that can not take on values below zero. Many farmers in the sample did not sell their wheat outside the exchanges; thus, Y has a truncated normal distribution and Tobin Maximum Likelihood estimation is required (Tobin, 1958; Amemiya, 1973; McDonald and Moffitt, 1980). The dependent variable in this sample also has an upper limit of 100.

The Tobit model originates from the work of Tobin (1958) and has been extensively used to estimate the determinants of demand for a variety of consumer goods including automobiles and holidays (Tobin, 1958). This model assumes that many variables have lower (or upper) limits and takes this limiting value for a substantial number of respondents.

Tobit is preferred to ordinary least square (OLS) estimation because OLS estimation based on a censored sample with a limited dependent variable would yield

inconsistent estimates. Even in cases where non-adopters were included and a regression equation was specified so as to accommodate the limit values of the dependent variable the parameter estimates would still be biased and inconsistent since the clustering of observations at 100 would violate the OLS assumption of a continuous dependent variable (Goldberger, 1964). Specifying the adoption variable in binary forms (1 if adopt off-exchanges, 0 otherwise) also has some defects since the chosen methodology provide no information on the intensity of use. For example, a buyer or seller may buy or sell 10 percent of their wheat while others may sell or buy 100 percent of their wheat. By the binary method of analysis both are regarded as adopters.

Tobit coefficients are estimated by maximum likelihood. Unlike the OLS case, the value of a Tobit coefficient does not represent the expected change in the dependent variable given a one-unit change in an explanatory variable.

The Tobit model measures both seller and buyer's probability of adoption to off-exchange market (the decision to adopt) and the intensity of use (the effort to continue using the off-exchange market once adopted). McDonald and Moffitt (1980) explain the Tobit effects can be decompose into a) changes in the probability of being above the limit, and b) changes in the value of the dependent variable if it is already above the limit. Given such a decomposition, we can use the means of the explanatory variables to calculate the elasticity of adoption and elasticity of intensity once adoption occurs.

Adopting the notation of McDonald and Moffitt, the model is:

$$\begin{aligned} Y_i &= X_i\beta + \varepsilon_i \quad \text{if } X_i\beta + \varepsilon_i > 0 \\ &= 0 \qquad\quad \text{if } X_i\beta + \varepsilon_i \le 0 \\ & \qquad\quad i = 1, ..., N \end{aligned} \tag{1}$$

where

X = a vector of explanatory variables,

β = a vector of unknown coefficients (Tobit coefficients),

ε = a vector of independent and identically distributed normal random variables assumed to have zero mean and constant variance, and

N = number of observations.

The expected value of Y in the model is given as:

$$E(Y)=X\beta F(z)+\sigma f(z),$$

where $z=X\beta/\sigma$, $f(z)$ is the unit normal density, and $F(z)$ is cumulative normal distribution function.

The expected probability of being above a certain value once adoption occurs is given as:

$$E(Y^*)=X\beta+f(z)/F(z)$$

The relationship between the expected value of all observations $E(Y)$, the expected value conditional on being the limit $E(Y^*)$, and the probability of being above the limit $F(z)$ is represented as:

$$E(Y)=F(z)E(Y^*),$$

To calculate the marginal effects of the explanatory variables and to decompose the total effect we differentiate the following:

$$\partial E(Y)/\partial X=F(z)[\partial E(Y^*)/\partial X]+E(Y^*)[\partial F(z)/\partial X] \qquad (2)$$

where, $\partial E(Y^*)/\partial X$ represent the effects of the variable X on the intensity[1] of use and $\partial F(z)/\partial X$ is the effects on the probability of adoption[2]. By manipulating the above equation (multiplying both side by $X/E(Y)$) we can calculate the total elasticity of change due to changes in the level of any of explanatory variables. The adoption elasticity in this study can be decomposed into a) the change in the elasticity of the use intensity of off-exchanges, and b) the change in the probability of being as adopter. The elasticity equation is:

$$\{\partial E(Y)/\partial X\}\bar{X}/E(Y)=\{\partial E(Y^*)/\partial X\}\bar{X}/E(Y^*)+\{\partial F(z)/\partial X\}\bar{X}/F(z), \quad (3)$$

where $\bar{X}$ is the mean of an independent variable.

Empirical Model Specification

To find why sellers (buyers) tend to sell (buy) wheat in the off-exchange market, several factors were hypothesized to influence their decisions. The models for sellers and buyers were respectively specified in equation (4) and (5) as follows:

$$\begin{aligned} OUTEXCHUSE = {} & \beta_0 + \beta_1 ESKISEHIR + \beta_2 KONYA + \beta_3 EDIRNE + \beta_4 URFA \\ & + \beta_5 TRANSPORT + \beta_6 CREDITUSE + \beta_7 STORAGE \\ & + \beta_8 PRICEDIFF + \beta_9 WARECEIPT + \beta_{10} QUALITYDIFF \\ & + \beta_{11} GRADING + \beta_{12} LEGAL + \beta_{13} EDUCATION \\ & + \beta_{14} AGE + \varepsilon \end{aligned} \quad (4)$$

$$\begin{aligned} OUTEXCHUSE = {} & \beta_0 + \beta_1 ESKISEHIR + \beta_2 KONYA + \beta_3 EDIRNE + \beta_4 URFA \\ & + \beta_5 TRANSPORT + \beta_6 CREDITUSE + \beta_7 PRICEDIFF \\ & + \beta_8 WARECEIPT + \beta_9 GRADING + \beta_{10} LEGAL \\ & + \beta_{11} EDUCATION + \beta_{12} AGE + \varepsilon \end{aligned} \quad (5)$$

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[1] $\partial E(Y^*)/\partial X_i = \beta_i\left[1 - zf(z)/F(z) - f(z)^2/F(z)^2\right]$

[2] $\partial F(z)/\partial X_i = f(z)\beta_i/\sigma$

The dependent variable, OUTEXCHUSE (percentage of wheat sold bought outside the exchanges), was obtained as the response to the question, "What percentage of your purchase/sales are completed at exchanges?" The percentage amount of wheat sold and bought outside the exchanges were calculated by subtracting the wheat sold in exchanges from 100. Polatli exchange is eliminated from exchange group for dummy variable estimation purposes.

Explanatory variables expected to influence buyers and sellers decisions about marketing alternatives are economic, social and institutional factors and these are defined as follows:

ESKISEHIR : 1 if individual is in the Eskisehir exchange; 0 otherwise;

KONYA : 1 if individual is in the Konya exchange; 0 otherwise;

EDIRNE : 1 if individual is in the Edirne exchange; 0 otherwise;

URFA : 1 if individual is in the Urfa exchange; 0 otherwise;

TRANSPORT : Transportation to the exchange limits my ability to use it (1 = Strongly disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, 5 = Strongly agree);

CREDIT : Credit use (1 = yes, 0 = otherwise);

STORAGE : Use of storage (1 = yes, 0 = otherwise);

GRADING : An accurate grading system would encourage me to use exchanges (1 = Strongly disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, 5 = Strongly agree);

PRICEDIFF : I receive (pay) higher (lower) price by selling (buying) outside of exchanges, sellers (buyers) (1 = Strongly

disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree,

5 = Strongly agree);

QUALITYDIFF : My wheat is higher quality than wheat traded in the exchanges (1 = Strongly disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, 5 = Strongly agree);

WARECEIPT : A legally enforceable warehouse receipt system encourage me to use exchanges (1 = Strongly disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, 5 = Strongly agree);

LEGAL : Adequacy of legal arrangements in exchanges (1 = Adequate. 2 = No idea, and 3 = Inadequate);

EDUCATION : To what degree educational level of respondents' affects exchange use (1 = Illiterate, 2 = Read and write, 3 = Primary school, 4 = Secondary school, 5 = High school, 6 = University);

AGE : Age of respondents

1 if ages between 1-30

2 if ages between 31-40

3 if ages between 41-50

4 if ages between 51-60

5 if ages between 61-70

Producers growing high-quality wheat and having the ability to deliver to a choice of markets will favor the flourmill, if the base price is relatively close to TMO's

intervention price. This is because of potentially higher cash payment if the wheat meets the mill's quality requirements. It is expected that farmers who produce higher quality wheat are less likely to participate outside the exchanges than producers who sell their wheat to TMO.

The difference between exchange and outside prices can alter farmers' decision on out of exchange market use. If an outside price, such as TMO intervention price is higher (lower) than the price established in exchanges, there is a tendency for farmers to increase (reduce) the amount of wheat they sold outside the exchanges.

Since young buyers and sellers tend to be more flexible in their decisions, and adapt new marketing alternatives more readily, it is expected that they will be less willing to use out of the exchange markets than their older counterparts.

The higher the education level of a person the greater would be use of exchanges rather than outside market. A person who has higher education understands the benefits of using exchanges and creating opportunities by exercising trading practices.

The availability and condition of a transportation system has positive or negative impacts on farmers and buyers incentives to use outside of exchanges. Improved transportation may increase buyers and sellers' exchange use, and reduce their off-exchange participations.

Existence of a legal system is necessary for execution of contracts between parties and to safeguard buyers and sellers. A well-defined legal system may encourage people to switch from outside markets to exchanges in trading of commodities.

Because of limited financial resources of farmers, the need for credit becomes very important for farmers' use of exchanges. Farmers mostly sell their commodity to

TMO or middlemen immediately after harvest because of immediate cash needed to cover expenses for wheat production and individual expenses.

On farm storage facilities allow producers greater flexibility in marketing. After harvest, producers may use on-farm storage facilities to participate in exchanges rather than selling outside the exchanges. Short-term storage also can be used to capture an expected seasonal price increase that is greater than storage cost.

Availability of a grading system will provide greater information and help producers and buyers to communicate. Seller and buyer who concerns about the nonexistence of a uniform grading system are expected to reduce their participation in the exchanges.

Being able to use warehouse receipts in the manner improves efficiency in marketing and financing commodities. Purchasers of the commodity can accept the receipt as delivery of a product of the listed grade or classification. Nonexistence of warehouse receipt system may cause seller and buyer who concern about lack of warehouse receipts system to less participate in the exchange and more outside the exchanges.

Empirical Results

Descriptive Results

Tables 2 and 3 report the chi-square test results for each selected question by exchange category. Chi-square tests rejected the null hypothesis that there are no differences between the sellers and buyers' responses about a legally enforceable warehouse receipt system, grading, fairness, transportation, quality difference, and price

difference. All of the questions resulted in different patterns of agreement across the exchanges. Table 4 reports the chi-square for legal procedures in the exchanges. The null hypothesis that there are no differences among responses across the exchanges is rejected for sellers, but not for buyers. The results, reported in Table 5 indicate that the responses across the exchanges about government intervention are not different for buyers but different for sellers.

Currently exchange users are satisfied with many aspects of the exchanges. For example, as reported in Table 6, 89 % of the buyers and 69% of sellers agreed that buyers and sellers are treated fairly at the exchanges. Other aspects of the exchanges with which those users have few problems are storage costs, availability of parking facilities, weight of their commodities, and storage space availability (Table 7), registration procedures (Figure 4), and the sufficiency of buyers and sellers in the exchanges Figure 9 and 10.

The major source of dissatisfaction is prices. Most sellers do not think that prices reflect the true value of their product. For example, as reported in Table 6, 68% of sellers agreed that the prices they receive from outside markets are higher than exchange wheat prices. Most buyers also agreed that they find better prices when they buy directly from farmers. The finding of sellers thinking prices are too low and buyers thinking prices are too high may be more psychological than real. If better prices were available elsewhere, why were they buying and/or selling at the exchange that day? Many users are also concerned that large buyers or large sellers have too much influence on exchange price determination, and they are also concerned that the tax they pay in the exchanges is high (Figure 3). On the other hand, most of the buyers and sellers agreed that the prices at the exchanges are determined competitively.

Sellers currently sell 66% of their wheat through the exchanges. Buyers buy 79% of their wheat through the exchanges. Many aspects related to exchanges and outside markets influenced choices of affiliating with exchanges versus TMO. As reported in Figure 5, currently, 52.2% of buyers and 57.9% of sellers prefer TMO to exchanges in their marketing activities. Figures 6 and 7 show that 66.2% of sellers and a large number of buyers, 23.3% indicated that price difference is most important in affecting the degree of satisfaction with exchange use versus TMO. As Figure 8 shows, most sellers and buyers stated that the way outside markets work is the reason for different prices.

The answers to several questions in Table 6 and 7 suggest the likely acceptance of both grading and warehouse receipts. The first requirement for success is that present institutions must be able to preserve property rights. Figure 2 shows that the most frequent response was that legal procedures were sufficient. Sellers have few fears of not being paid. Table 7 reports that about half of buyers are concerned about not receiving the product they purchase. While there is still room for improvement, the legal institutions necessary to preserve property rights do seem to be present.

As seen in Table 7, users seem quite interested in a warehouse receipt system. Transportation costs and distance to the exchanges was a concern of many sellers. The vast majority of buyers and sellers agreed that a warehouse receipt system would encourage them to use the exchanges.

Tables 6 and 7 report that a successful warehouse receipt system and uniform grading can encourage sellers and buyers to increase their exchange use. Sellers especially, as well as buyers, agreed that a fair wheat grading system would encourage

them to use the exchange. Thus buyers and seller appear to desire a fair and accurate grading system and legally enforceable warehouse receipts.

Figure 11 reports that most of the sellers, 81.9% favor of government control on exchanges. As seen in Figure 12 and Table 9, the majority of sellers indicated that the state should control exchanges in terms of price. Table 9 reports that most buyers indicated the government should not control exchanges because the exchanges have their own management and power. Most of the sellers believe that producers would benefit the most when state intervenes on exchanges while most buyers stated that nobody gains from the state intervention (Figure 13). As reported in Figures 14 and 15, a majority of sellers and half of buyers indicated that state intervention affects their exchange use.

Market information plays a vital role in a fair marketing system. Producers generally are not in a favorable situation to have access to market information, other than from traders. Figures 17 and 18 report that most sellers and buyers believe that getting price information from exchanges is more important than any other sources. However, a portion of sellers still relies on other sources such as middlemen and friends whose information may be biased. As seen in Figure 19, a majority of sellers and buyers indicated that exchanges inform them about regional and country wheat prices while many respondents said that exchanges do not provide world wheat prices. According to Table 10, respondents believe that the most important reason for not getting sufficient price information from exchanges is a lack of communication network in exchanges.

Figure 20 reports that trading activities for wheat mostly occur immediately after harvest. As seen in Figure 21, the need for money and supply and demand conditions are main reason to purchase wheat after harvest for sellers and buyers, respectively. The

difference between two participants in terms of purchasing time of wheat might be because of credit use since as seen in Figure 22, half of sellers and a few buyers use credit. Another reason for buyers to purchase wheat immediately after the harvest might be due to selling their purchases directly to the third parties since as seen in Figure 16, 81 percent of buyers directly sell their purchases to the third parties.

Tobit Estimation Results

Columns 1 of Tables 11 and 12 present the estimated coefficients from equations (4) and (5) to explain sellers and buyers' preference of out of exchange market. Based on statistically significant coefficients, the results indicate that economic, institutional, and personal-characteristic variables are important in explaining the sellers and buyers' choice of out of exchange market and exchanges as a marketing channel.

In terms of the exchange differences, sellers at Eskisehir, Konya and Urfa are less likely to adapt and use off-exchange market than sellers in Polatli. Sellers at Edirne are more likely to use off-exchange market than those in Polatli. The results reported in Table 12 indicate that the buyers in the exchanges at Eskisehir, Edirne and Konya are less likely to use off-exchange market than those in Polatli while buyers at Konya use more out of exchange market.

Variables credit use (CREDITUSE), desirability of warehouse receipt system (WARECEIPT), quality differences between wheat sold in exchanges and off-exchange markets (QUALITYDIFF), transportation (TRANSPOR), and education levels (EDUCATION) have significant effects on sellers' probability of adoption and intensity of off-exchange use. Although price difference (PRICEDIF) was hypothesized to affect

sellers' affiliation with the exchanges, the results showed that price difference is not a significant factor.

The results of the Tobit model can be used to identify the effects of changes in an explanatory variable on the adoption and intensity of off-exchange use. McDonald and Moffitt (1980) present a Tobit decomposition approach to separate two effects. The two effects are: changes due to likelihood of new adoption, and expected changes in intensity of adoption by those who have already adopted. In this study the total adoption, 0.686 is decomposed to give probability of 0.337 and 0.349 for new adoption and intensity of outside of exchange use, respectively. The decomposition of the effects is important to identify the influence of adoption determinants on the sequential stages of adoption, i.e., to adopt or not to adopt and then to continue using the outside of exchange markets.

Table 11 also presents the elasticity of decomposition for changes in the explanatory variables. Total elasticity of a change in the level of any of the variables consists of two effects: elasticity of expected use intensity (E_1) and elasticity of adoption probability (E_2).

Adding the two effects will give us the total elasticity. The computed elasticities indicate that marginal changes in the independent variables listed increase the probability of adoption more than intensity of exchanges use (E_1). Elasticites of adoption probabilities (E_2) are relatively larger than E_1. Overall the elasticity estimates in Table 11 reflect inelastic ($E < 1$) response to changes in the adoption variables.

Education has the highest impact on off-exchange use intensity and probability of adoption with total elasticity values of – 0.300. This value is divided into – 0.128 and

- 0.172 for elasticity of intensity and probability of adoption, respectively. A negative sign indicates that a 10 percent change in education level of sellers are expected to result in about a 3 percent decrease in off-exchange use intensity and adoption. Since the percentage of wheat sold in the off-exchange markets was derived from percentage of wheat sold in the exchanges, this also indicates an increase on adoption and intensity of exchange use. The implications of these estimates are useful to evaluate proposed policy changes affecting economic and institutional variables used in this study. For instance, as seen from Figure 23, most sellers and buyers attended only primary schools. If the education level of buyers and sellers can be improved, they would be more willing to use exchanges. There could be also a need to target sales programs award people with little education.

A legally enforceable warehouse receipt system also significantly affects off-exchange market use intensity and probability of adoption. The positive signs for elasticities of adoption and intensity indicate that those most concerned about warehouse receipts use the exchanges the least. Other variables, transportation, credit use, and quality difference between the wheat sold in exchanges and off-exchanges are also important.

For buyers, as shown in Table 12, the variable price difference between the wheat sold in exchanges and that in off-exchange market (PRICEDIFF), transportation (TRANSPORT), and age of respondents (AGE) affect buyers' decision on participating in the off-exchange markets. Elasticites of adoption probabilities (E_2) are relatively smaller than elasticity of expected use intensity E_1. Although the variable, price difference is not a significant factor affecting sellers' participation in off-exchange

market, it has an impact on buyers' incentives to use off-exchange market. It has a total elasticity of 0.711. This elasticity can be divided into 0.429 for elasticity of intensity of use and 0.282 for elasticity of probability of adoption, respectively. The total elasticity of 0.711 indicates that a 10 percent increase in the price difference between the exchanges and off-exchange market in favor of the off-exchange market is expected to result in a 7.11 percent increase in use of off-exchange market and decrease the exchange uses.

Transportation is an important factor affecting buyers' decision to use off-exchange market with a total elasticity of 0.366. A positive coefficient indicates that transportation to the exchange limits their ability to use exchanges and increase the percentage of wheat they sold in the off-exchange market. Age also affects buyers off-exchange use. A negative total elasticity of –0.204 indicates that a 10 percent increase in a respondent' age is expected to result in a 2 percent decrease in buyers' off-exchange use.

Summary and Conclusions

This study sought to gain a better understanding of customer satisfaction with the current exchange system and factors that influence exchange participants' decisions to choose exchanges or off-exchange market such as TMO. The data are from a survey of wheat sellers and buyers in five different exchanges in Turkey.

The major dissatisfaction with exchanges is prices. Both sellers and buyers indicate that they find better prices by exercising trading activities outside of exchanges. Most sellers and buyers indicated that a uniform grading and legally enforceable warehouse receipt system would encourage them to use exchanges. Most sellers and buyers also stated that there is an insufficiency of available technology in exchanges to

disseminate the price and other commodity related information that sellers and buyers desire to have for their marketing activities. Unlike buyers, mostly sellers are not opposed to government intervention because they think that government intervention benefits them. Results also indicate that immediate cash needs of sellers is the main reason for them to sell wheat without waiting for a better price that they might find by storing their wheat.

Tobit model results also confirm the results of descriptive statistics indicating that price difference, transportation, legally enforceable warehouse receipt system, educational level, and ability to use credit affect buyers and sellers' affiliation with the exchanges versus off-exchange markets.

The results of both descriptive statistics and the Tobit model suggest that there is a great potential for accepting a new grading system and accepting legally enforceable warehouse receipts. Unlike many developing countries, Turkey appears to have a sufficient legal system and trust in exchanges necessary to implement such changes.

Before spending a significant amount of money on marketing development projects for grains, the information in this study may allow producers, processors, traders, and the Turkish government to have more knowledge about the existing problems in the current exchange system and factors that impact participants' decision to choose exchanges or off-exchange market as a marketing channel.

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APPENDIXES

Table 1. Wheat Production and Utilization in Turkey (Thousand Metric Ton/Ha.)

Years	Consumption	Production	Imports	Exports	Ending Stock
1994/95	15180	14700	530	1860	700
1995/96	16120	15500	2020	1080	1200
1996/97	16340	16000	2380	1000	2500
1997/98	16550	16000	1450	1500	2200
1998/99	16600	18000	1600	3000	2550
1999/00	16000	16500	1500	1500	2150

Source: DIE (Devlet Istatistik Enstitusu, Turkish State Institute of Statistics)

Table 2. Sellers' Response Distribution For the Wheat Exchanges at Eskisehir, Polatli, Konya, Edirne and Sanli Urfa

Questions	Exchanges	Responses					Chi-square
		SD	D	U	A	SA	
My wheat is higher quality than wheat traded at the exchange	Eskisehir	2	3	5	10	15	61.40**
	Polatli	0	3	0	7	1	
	Konya	3	7	4	12	13	
	Edirne	9	0	0	0	18	
	Sanli Urfa	0	0	4	5	1	
Transportation to the exchange limits my ability to use it	Eskisehir	7	14	0	8	5	42.07**
	Polatli	0	1	0	5	4	
	Konya	7	12	0	10	9	
	Edirne	12	0	0	14	2	
	Sanli Urfa	1	9	0	1	1	
Buyers and sellers at the exchange are treated fairly	Eskisehir	3	3	3	16	10	49.70**
	Polatli	0	2	0	2	4	
	Konya	8	6	2	13	10	
	Edirne	14	0	0	2	12	
	Sanli Urfa	0	1	0	12	2	
I receive a higher price by selling wheat away from exchanges	Eskisehir	5	5	0	13	12	51.80**
	Polatli	1	5	1	2	2	
	Konya	7	3	3	9	15	
	Edirne	9	0	2	1	15	
	Sanli Urfa	0	7	0	2	1	
A warehouse receipt system, legally enforceable would encourage me to use the exchange	Eskisehir	6	1	3	14	11	36.92**
	Polatli	1	0	0	3	5	
	Konya	4	4	4	9	18	
	Edirne	0	0	1	16	11	
	Sanli Urfa	0	2	5	6	0	
An accurate and fair wheat grading system would encourage me to use the exchanges	Eskisehir	0	0	1	17	17	51.18**
	Polatli	1	0	0	9	1	
	Konya	0	1	1	8	29	
	Edirne	0	0	0	7	21	
	Sanli Urfa	0	0	2	12	1	

Note: Asterisk (*) indicates significant difference at the .001 level. Response categories are defined as follows: SA = strongly agree, A = agree, U = uncertain, D = disagree, SD = strongly disagree.

Table 3. Buyers' Response Distribution For the Wheat Exchanges at Eskisehir, Polatli, Konya, Edirne, and Sanli Urfa

Questions	Exchanges	Responses SD	D	U	A	SA	Chi-square
Transportation to the exchange limits my ability to use it	Eskisehir	7	2	0	3	2	29.83**
	Polatli	0	2	0	2	1	
	Konya	24	13	1	8	5	
	Edirne	8	0	0	0	0	
	Sanli Urfa	2	10	0	1	1	
Buyers and sellers at the exchange are treated fairly	Eskisehir	0	1	1	6	6	26.07*
	Polatli	0	1	0	3	1	
	Konya	1	6	0	17	29	
	Edirne	0	0	0	1	7	
	Sanli Urfa	0	1	0	13	2	
I pay a lower price by buying directly from farmers	Eskisehir	2	4	1	3	5	37.78**
	Polatli	1	7	0	2	0	
	Konya	14	7	4	13	13	
	Edirne	1	0	0	4	2	
	Sanli Urfa	0	11	0	2	2	
A warehouse receipt system, legally enforceable would encourage me to use the exchange	Eskisehir	3	2	2	4	4	33.43**
	Polatli	0	0	0	4	1	
	Konya	8	1	6	16	17	
	Edirne	0	0	0	1	7	
	Sanli Urfa	0	1	5	6	0	
An accurate and fair wheat grading system would encourage me to use the exchanges	Eskisehir	0	0	0	7	8	43.90**
	Polatli	1	0	0	9	0	
	Konya	1	3	1	14	33	
	Edirne	0	0	0	1	7	
	Sanli Urfa	0	0	2	13	1	

Note: Asterisks (*) and (**) indicate significant difference at the .05 and .001 levels, respectively. Response categories are defined as follows: SA = strongly agree, A = agree, U = uncertain, D = disagree, SD = strongly disagree.

Table 4. Buyers and Sellers' Response Distribution for the Legal Procedure in the Wheat Exchanges at Eskisehir, Polatli, Konya, Edirne and Sanli Urfa

Group	Exchanges	Responses			Chi-square
		Adequate	Inadequate	No idea	
SELLERS	Eskisehir	11	11	12	13.95*
	Polatli	9	2	0	
	Konya	18	10	9	
	Edirne	16	9	3	
	Sanli Urfa	8	2	5	
BUYERS	Eskisehir	7	5	3	10.98
	Polatli	10	0	0	
	Konya	31	15	7	
	Edirne	6	2	0	
	Sanli Urfa	10	3	4	

Notes: Asterisk (*) indicates significant difference at the 0.1 level. The null hypothesis of responses are not different across the exchanges is rejected for sellers but not for buyers.

Table 5. Buyers and Sellers' Response Distribution for the question of should Government Control the Wheat Exchanges at Eskisehir, Polatli, Konya, Edirne and Sanli Urfa

		Responses			
Group	Exchanges	Yes	No	No idea	Chi-square
SELLERS	Eskisehir	28	5	0	16.67*
	Polatli	1	0	0	
	Konya	35	4	0	
	Edirne	24	3	1	
	Sanli Urfa	7	7	1	
BUYERS	Eskisehir	5	9	1	5.12
	Polatli	0	4	0	
	Konya	24	26	3	
	Edirne	4	4	0	
	Sanli Urfa	8	8	1	

Notes: Asterisk (*) indicates significant difference at the 0.05 level. The null hypothesis of responses are not different across the exchanges is rejected for sellers, but not for buyers.

Table 6. Responses of Buyers and Seller about Effects of Price on Exchange Use

Questions	Group	Responses SD	D	U	A	SA
I use the price reported at the exchange to negotiate prices in off-exchange transactions	S	9	23	2	35	48
	B	12	8	2	27	44
Exchange prices are lower than those I receive	S	15	15	7	19	61
	B	24	29	6	19	15
Wheat price information is difficult to interpret because grading is not done	S	3	19	17	35	44
	B	8	14	2	37	30
Wheat price information from the exchange is accurately reported	S	8	9	7	43	50
	B	1	2	3	37	48
Wheat price information form at the exchange is available when I need it	S	4	7	15	45	47
	B	3	1	2	38	46
Prices at exchange are determined competitively	S	9	14	3	51	41
	B	2	6	0	35	50
Prices at exchange would be easier to evaluate if product were graded	S	0	17	0	31	70
	B	3	5	3	37	45
Prices at the exchange accurately reflect the true value of the products bought and sold	S	42	33	2	24	17
	B	5	12	4	42	29
Off-exchange transaction price information is available when I need it	S	13	27	2	29	46
	B	3	4	1	35	50
Large seller at the exchange can set the price they receive	S	27	10	3	26	51
	B	32	18	2	21	18
The large buyer at the exchange set the price paid	S	8	4	3	30	66
	B	6	2	3	16	14
I receive a higher price by selling wheat away from the exchange	S	22	16	6	24	43
I pay a lower price by buying directly from farmers	B	17	23	5	23	22

Notes: S = sellers and B = buyers. Response categories are defined as follows:
SA = strongly agree, A =agree, U = uncertain, D = disagree, SD = strongly disagree

Table 7. Responses of Buyer and Seller about Exchange Facilities and Procedures

Questions	Group	Responses SD	D	U	A	SA
Transportation to the exchange limits my ability to use it	S	27	34	0	35	18
	B	41	25	1	13	8
The exchange is too far away from my farm/processing plant to be useful	S	13	22	5	37	37
	B	34	29	4	13	7
Storage cost at exchange are fair	S	7	9	25	35	41
	B	2	5	4	47	34
A warehouse receipt system that is legally enforceable would encourage me to use the exchange	S	9	7	13	47	40
	B	11	4	13	28	28
If I sell at the exchange I am concerned that I will not be paid for my product	S	56	22	3	13	16
If I buy at the exchange I am concerned that I will not receive my product	B	23	20	3	27	18
Fees charged at the exchange are too high given the service received	S	25	32	7	31	16
	B	23	35	8	16	11
Parking facilities are not sufficient at the exchange	S	19	21	1	20	55
	B	19	19	1	20	30
Buyers and sellers at the exchange are treated fairly	S	25	10	5	45	33
	B	1	8	1	38	44
Products are accurately weighted at the exchange	S	1	4	3	47	64
	B	1	2	0	29	62
An accurate and fair wheat grading system would encourage me to use the exchange	S	1	0	4	46	68
	B	1	3	3	37	49
My wheat is generally higher quality than wheat traded at the exchange	S	14	10	12	28	48
	B	2	10	10	20	7
Storage space is generally easily obtained at the exchange	S	10	7	21	20	9
	B	10	6	10	28	21

Notes: S = sellers and B = buyers. Response categories are defined as follows:
SA = strongly agree, A =agree, U = uncertain, D = disagree, SD = strongly disagree

Table 8. Sellers and Buyers' Responses about Benefits of Spot Marketing

Responses	Sellers	Buyers
	% of total sellers and buyers	
Do not know	1.6	2.3
Immediate selling of commodity	10.9	6.8
There is no lost	3.1	2.3
Easy to sell and buy	14.1	18.2
Provide cash needs immediately	46.9	25.0
Quick price determination	4.7	4.5
Traders gain when price is low	4.7	9.1
Producers gain when the price is appropriate	7.8	6.8
Provide active marketing	4.7	18.2
Better quality	1.6	6.8

Table 9. The Responses of Buyers and Sellers for Whether the State Should Control the Exchanges

Responses	Sellers	Buyers
	% of total sellers and buyers	
All the commodities are known	1.1	1.5
State should support producers	9.7	7.6
No trust for government	4.3	9.1
Control in terms of price	31.2	4.5
Exchanges have their own management	12.9	34.8
Exchanges act freely	15.1	7.6
Balance between sellers and buyers	3.2	3.0
Provide rules	15.1	15.2
State wants to deal with commodities	0	1.5
State has already control on exchanges	1.1	3.0
Control in terms of quality	1.1	1.5
Some restricted support by state	1.1	3.0
Tax rules	1.1	3.0
Exchanges are already in duty	0	3.0
State-exchanges communication supported	1.1	3.0

Table 10. The Responses of Buyers and Sellers for Why the Exchanges Do Not Provide Price Information

Responses	Sellers	Buyers
	% of total sellers and buyers	
Regional Price Information		
Distance to exchanges	21.4	0
Lack of communication network	57.1	50.0
We learn ourselves	7.1	0
I am not interested in	0	25.0
Lack of employees	14.3	0
Price Information in Turkey		
Exchanges do not know	16.1	0
Distance to exchanges	12.9	18.2
Lack of communication network	35.5	27.3
Lack of knowledge	3.2	18.2
Product capacity	6.5	9.1
I am not interested in	22.6	27.3
Price information in the World		
Exchanges do not know	4.8	0
Distance to exchanges	3.2	3.3
Lack of communication network	50.0	80.0
Lack of knowledge	16.1	3.3
Product capacity	0	0
I am not interested in	25.8	13.3

Table 11. Estimated Tobit Model, Adoption and Intensity of Seller' Out of the Exchange Market Use in Turkey

Independent Variable	Estimate	Asymptotic t-value	Mean	Elasticities	
				E_1[a]	E_2[b]
Constant	1.604	1.476	1.000		
Eskisehir	-0.417*	-2.812	0.288	-0.014	-0.019
Konya	-0.122	-1.074	0.312	-0.004	-0.006
Edirne	0.356	-0.333	0.224	0.009	0.012
Urfa	-0.100	0.948	0.056	-0.001	-0.001
Transport	-0.277*	-2.224	2.381	-0.076	-0.102
Credituse	0.603*	2.768	1.445	0.100	0.134
Storage	0.130	0.612	1.654	0.025	0.033
Pricediff	-0.112	-0.984	2.290	-0.029	-0.039
Wareceipt	0.346*	2.289	2.636	0.105	0.141
Qualitydiff	0.251*	1.918	2.454	0.071	0.095
Grading	-0.061	-0.237	2.954	-0.021	-0.028
Legal	0.139	0.686	0.481	0.008	0.010
Education	-0.308*	-2.812	3.627	-0.128	-0.172
Age	-0.133	-1.363	2.681	-0.041	-0.055

Notes: Asterisk (*)indicates statistical significance at the 0.05 level. The null hypothesis is that beta is significantly different from zero. The expected value of all observation, $E(Y)$=33.70 equal to the expected value conditional on being above limit ($E(Y^*)$ = 11.96) times probability of above the limit ($F(z)$ = 0.686). At the sample means, the value of the density function ($f(z)$ = 0.355) while the value of z is 0.487. sigma = 3.356. The effect of the explanatory variable X on the intensity use equal to $dE(Y^*)/dX_i = \beta_i\left[1 - z\,f(z)/F(z) - f(z)^2/F(z)^2\right] = 038\beta_i$.

[a] E_1 is elasticity of intensity and equal to $(dEy^*/dX_i)(\overline{X}/Ey^*)$

[b] E_2 is elasticity of adoption and equal to $(dF(z)/dX_i)(\overline{X}/F(z))$

Table 12. Estimated Tobit Model, Adoption and Intensity of Buyers' Out of Exchange Market Use in Turkey

Independent Variable	Estimate	Asymptotic t-value	Mean	Elasticities	
				E_1[a]	E_2[b]
Constant	-1.873	-0.808	1.00		
Eskisehir	-0.806	-0.726	0.144	-0.025	-0.016
Konya	0.984	1.187	0.509	0.106	0.070
Edirne	-0.631	-0.564	0.115	-0.015	-0.010
Urfa	-1.455	-1.309	0.105	-0.032	-0.021
Transport	0.542**	2.643	2.048	0.221	0.145
Credituse	0.886	1.578	0.663	0.048	0.032
Pricediff	0.460**	2.511	3.663	0.429	0.282
Wareceipt	0.173	0.838	0.278	0.134	0.088
Grading	0.103	0.308	2.557	0.062	0.041
Legal	-0.615	-1.237	4.388	-0.083	-0.054
Education	0.220	1.007	2.788	0.122	0.080
Age	-0.394*	-1.677	4.346	-0.123	-0.081

Notes: Asterisks (*) and (**) indicate statistical significance at the 0.10 and 0.01 levels, respectively. The expected value of all observation, $E(Y)$=23.32 equal to the expected value conditional on being above limit ($E(Y^*)$ = 28.46) times probability of above the limit ($F(z)$ = 0.819). At the sample means, the value of the density function ($f(z)$ = 0.262) while the value of z is 0.916. Sigma = 2.300. The effect of the explanatory variable X on the intensity use equal to $dE(Y^*)/dX_i = \beta_i\left[1 - z\,f(z)/F(z) - f(z)^2/F(z)^2\right] = 060\beta_i$.

[a] E_1 is elasticity of intensity and equal to $(dEy^*/dX_i)(\overline{X}/Ey^*)$

[b] E_2 is elasticity of adoption and equal to $(dF(z)/dX_i)(\overline{X}/F(z))$

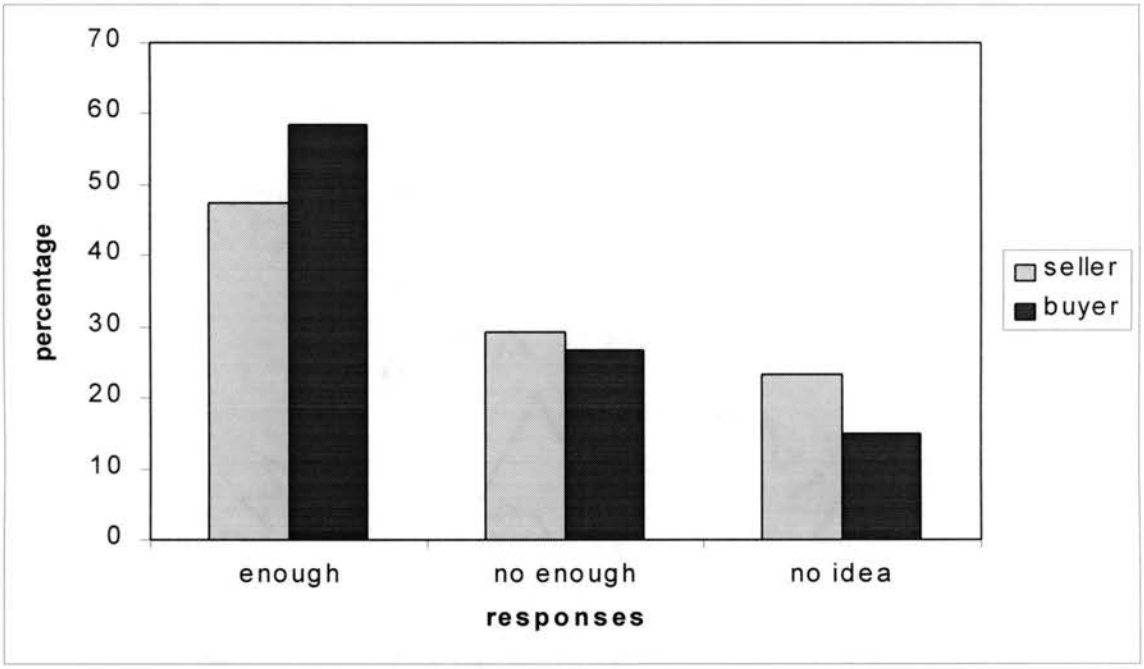


Figure 2. Buyers and sellers responses about the sufficiency of the legal procedures in the exchanges

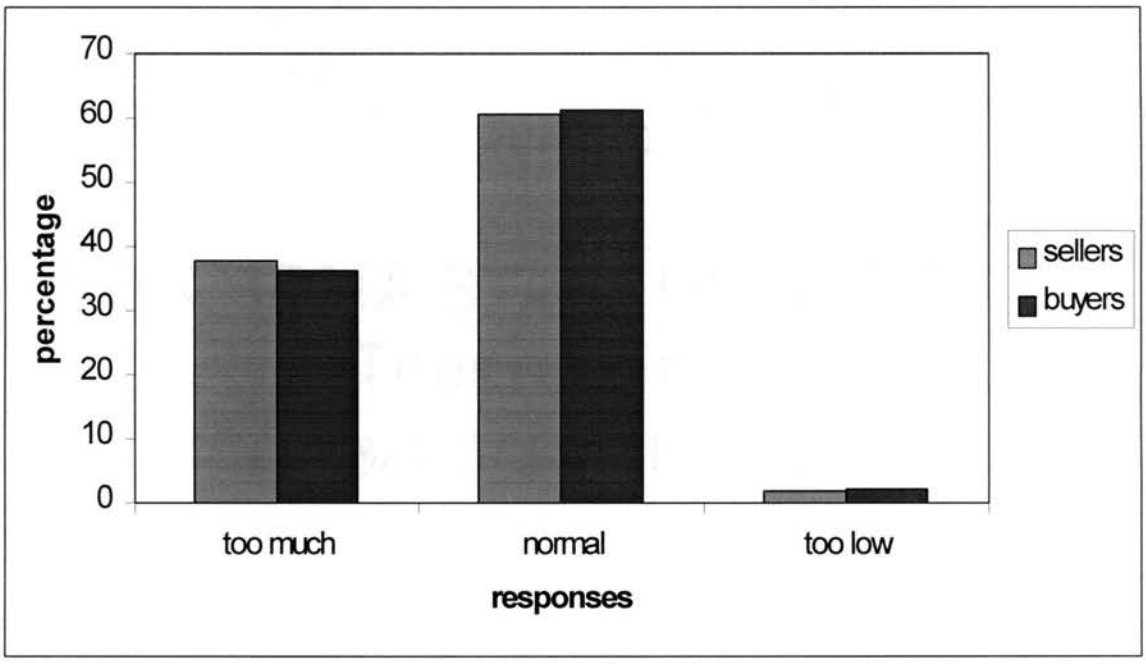


Figure 3. Buyers and sellers' consideration about the amount of tax they pay in the exchanges

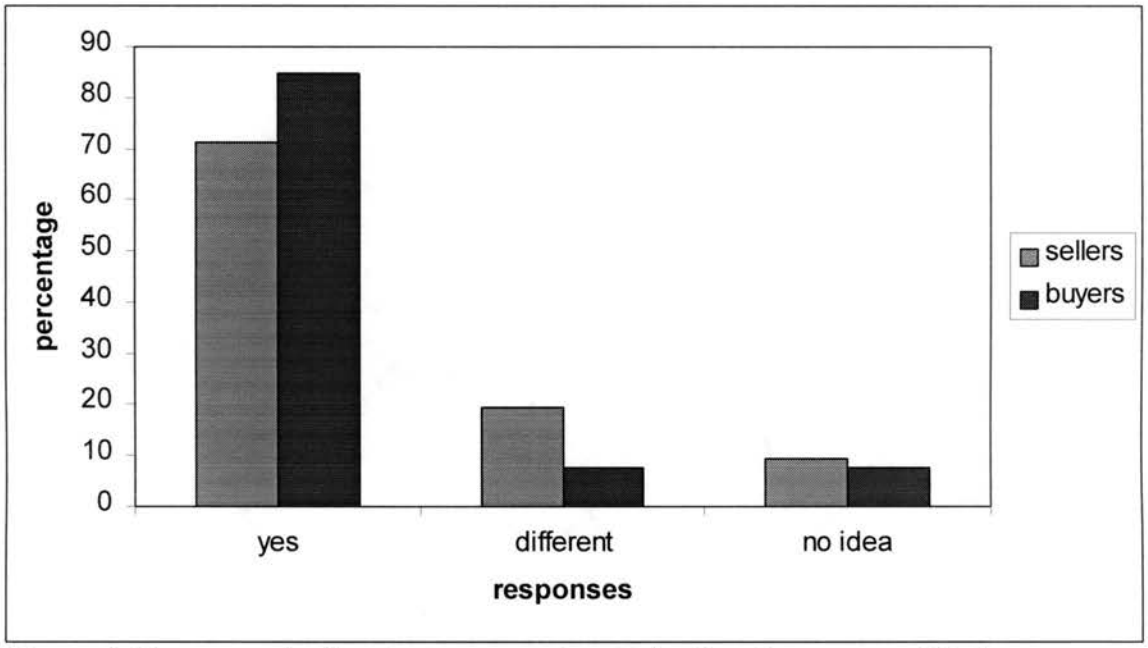


Figure 4. Buyers and sellers' responses about whether they agree with the registration procedures in the exchanges

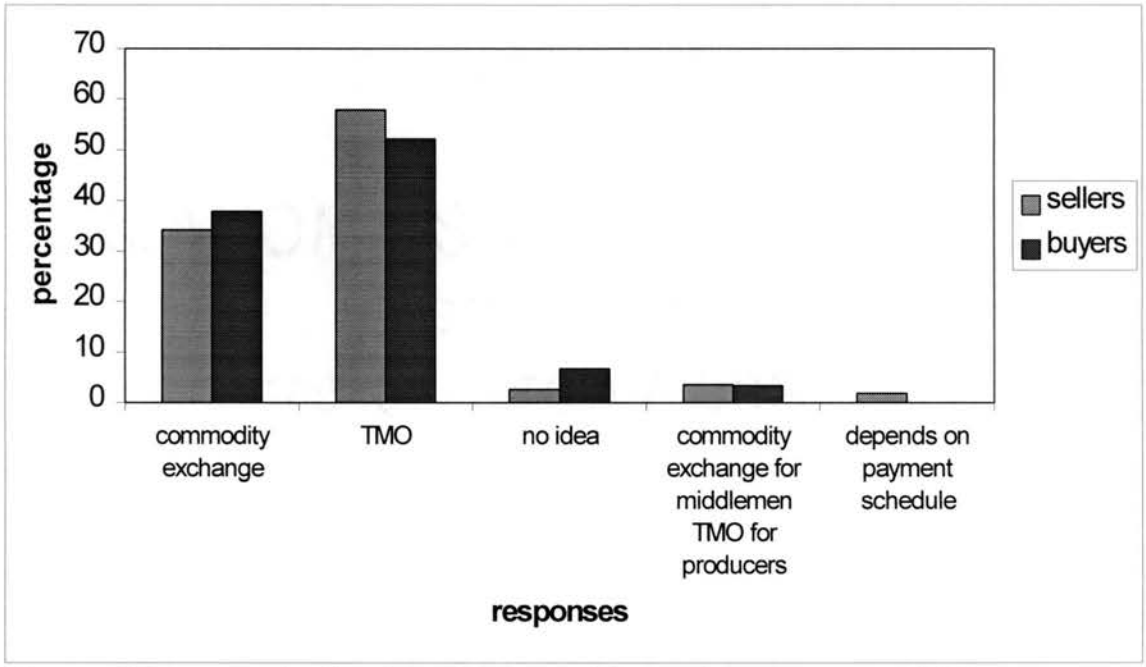


Figure 5. Buyers and sellers' preferences of the exchanges versus TMO

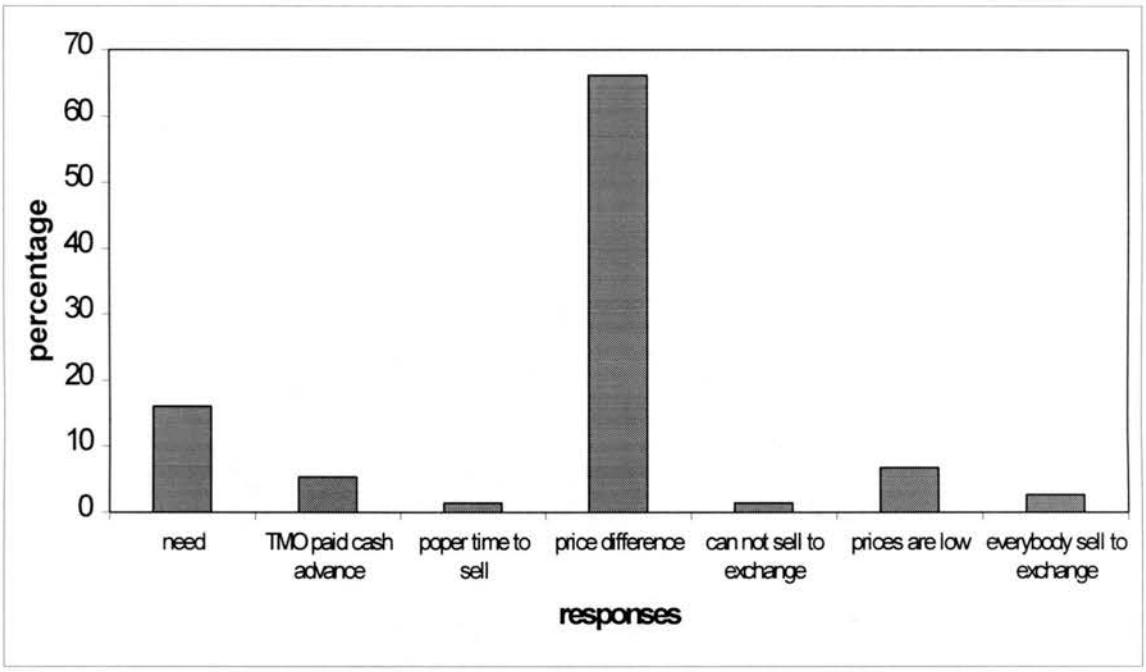


Figure 6. Sellers' responses about why they do not sell wheat in the exchanges

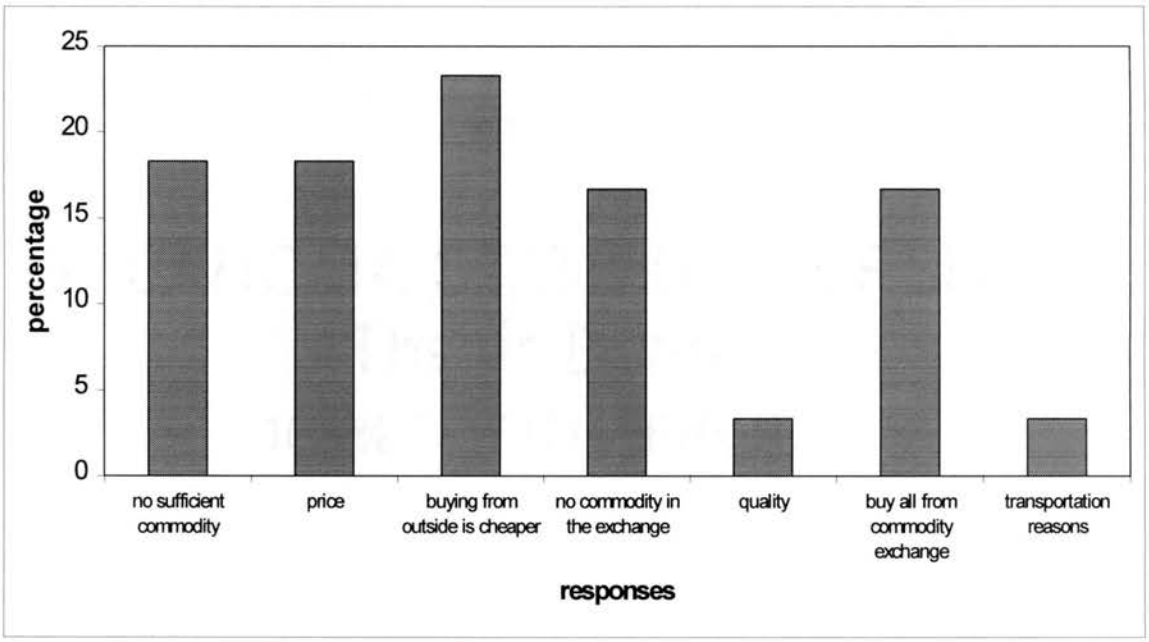


Figure 7. Buyers' responses about why they do not buy from the exchanges

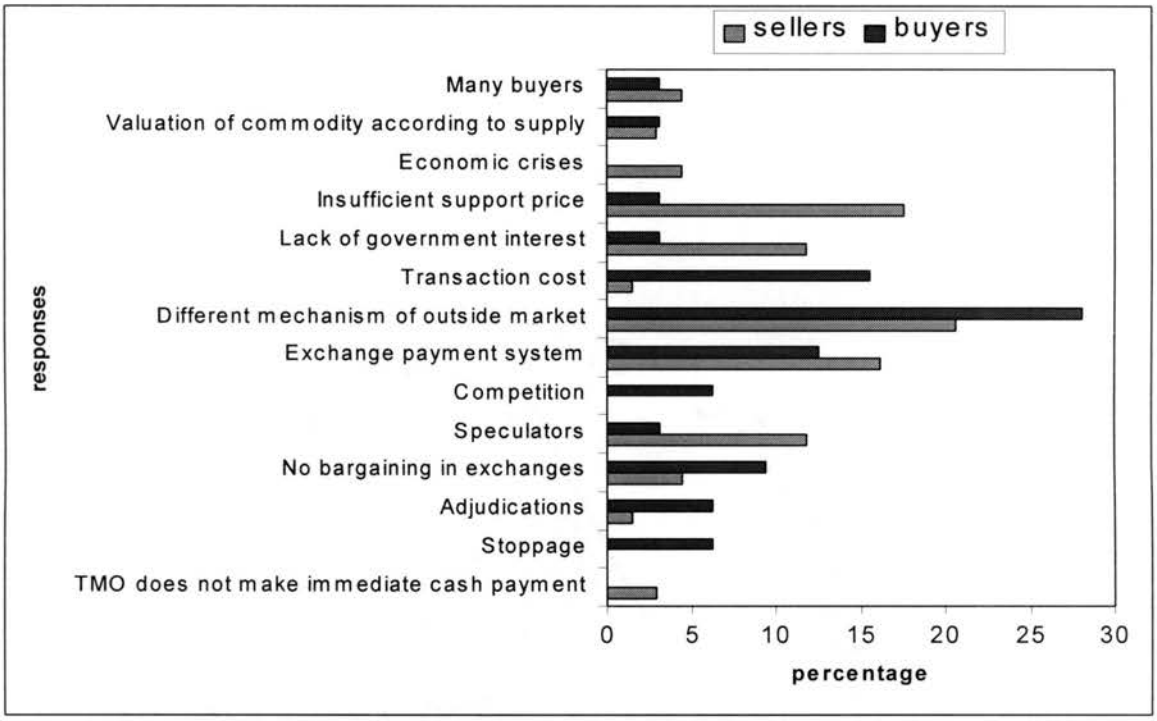


Figure 8. Buyers and sellers' considerations about the reasons for different prices

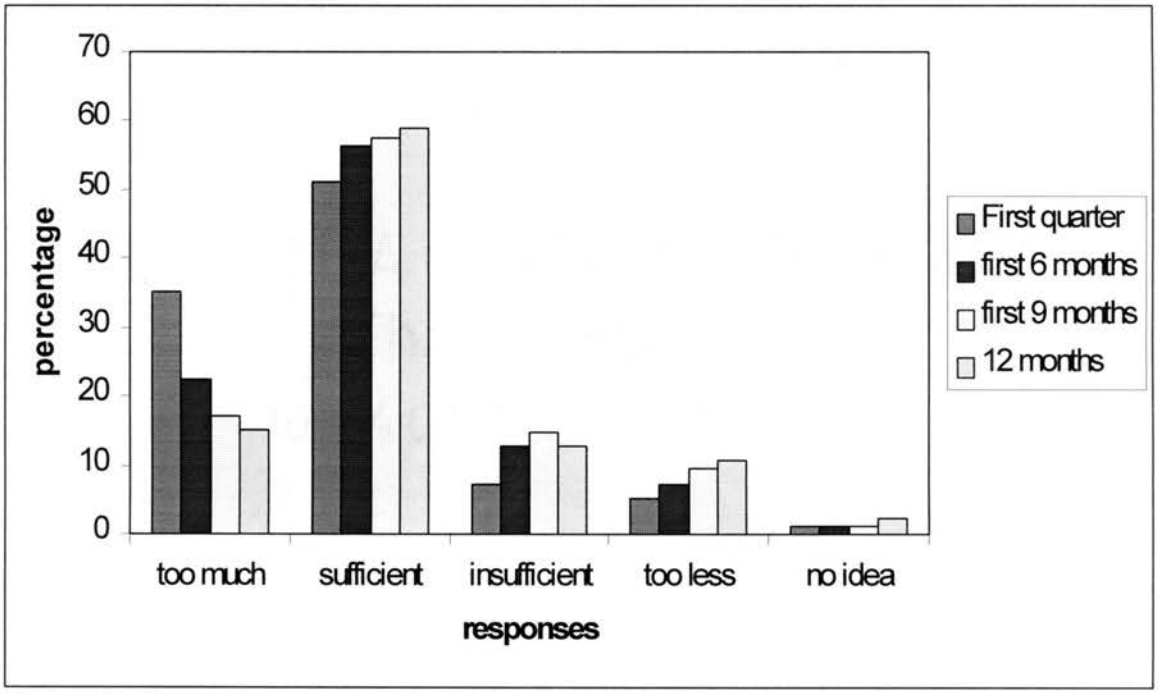


Figure 9. Buyers' responses about the sufficiency of sellers in the exchanges

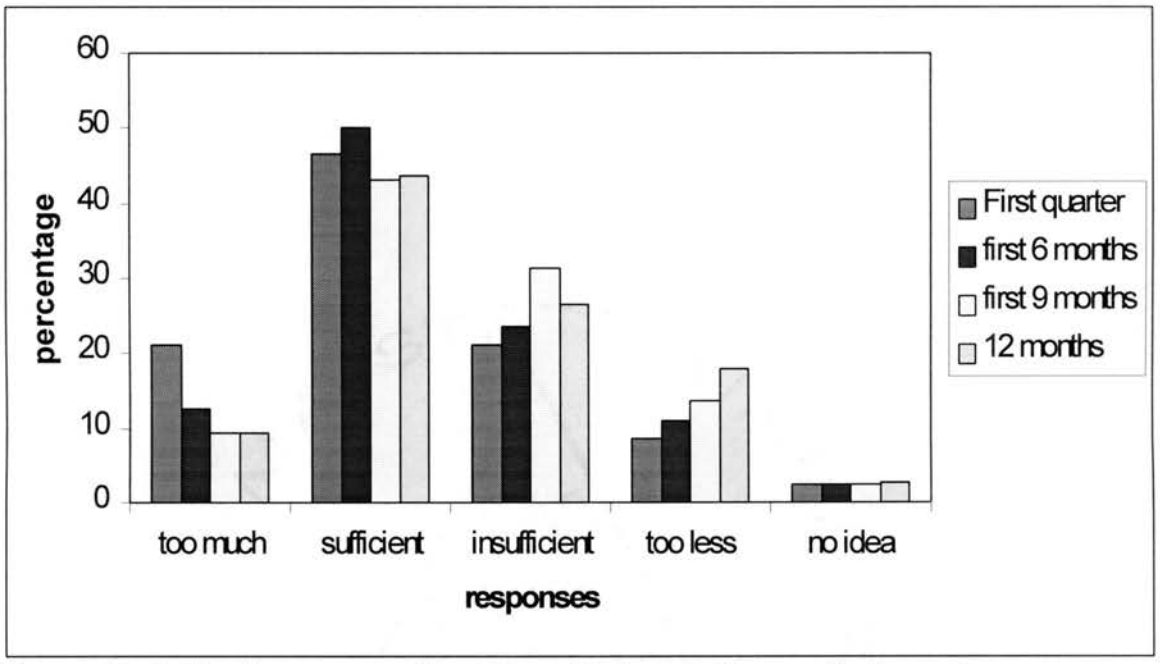


Figure 10. Sellers' responses about the sufficiency of buyers in the exchanges

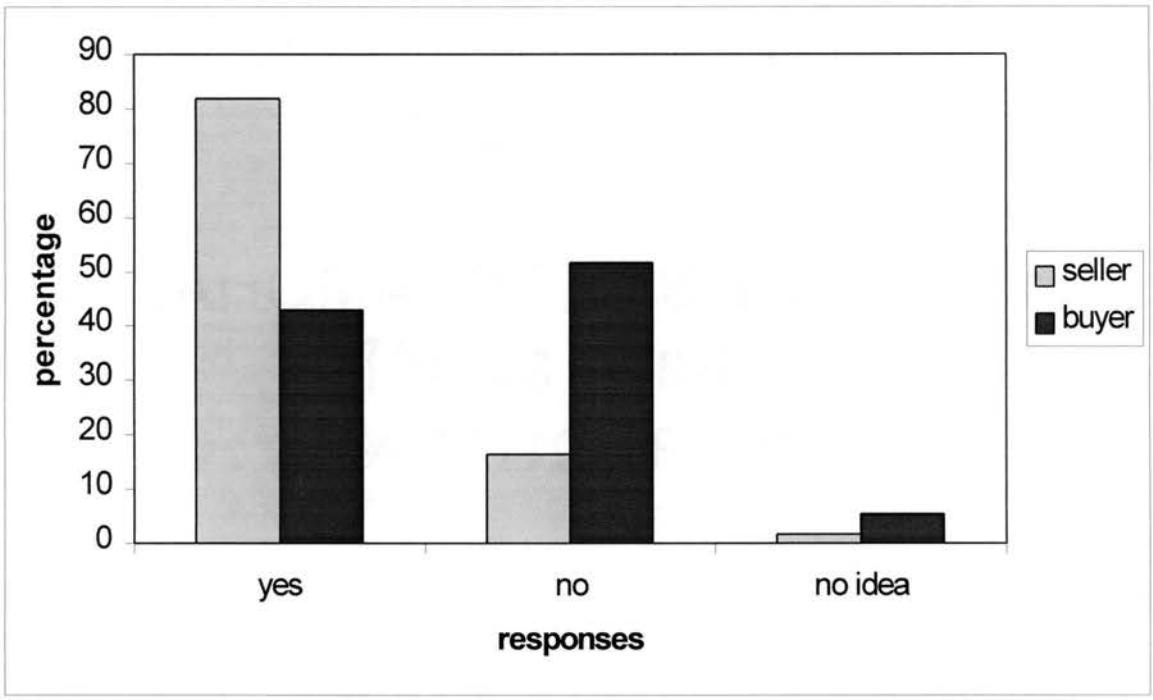


Figure 11. Buyers and sellers' responses about the government control in the exchanges

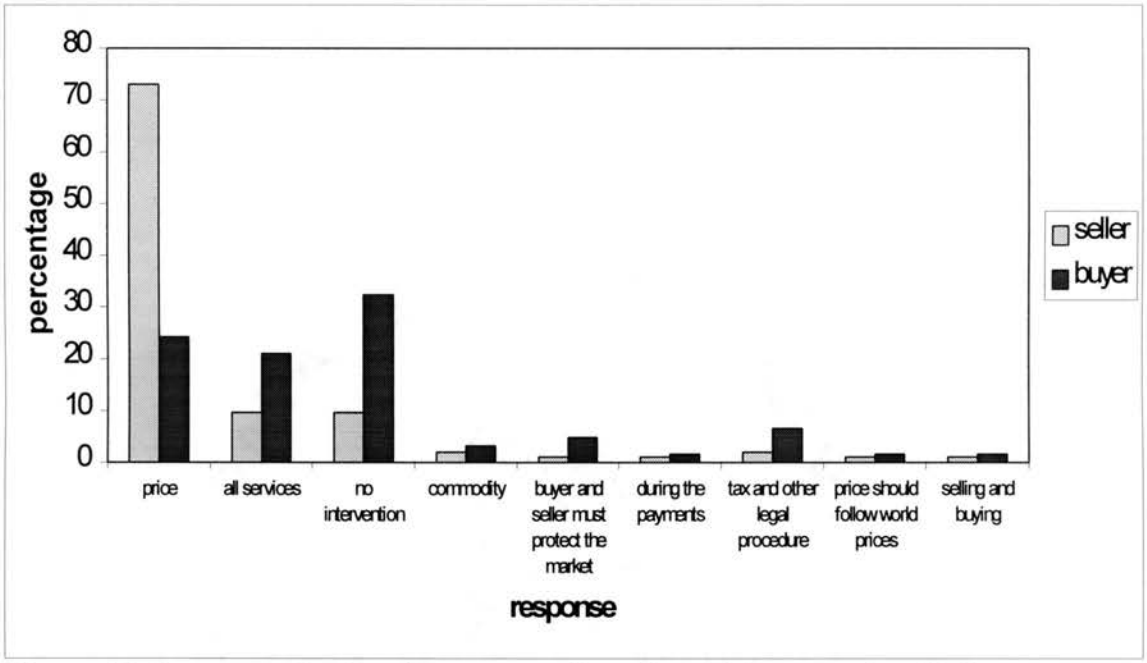


Figure 12. Buyers and sellers' responses about in which areas should the government have control in the exchanges

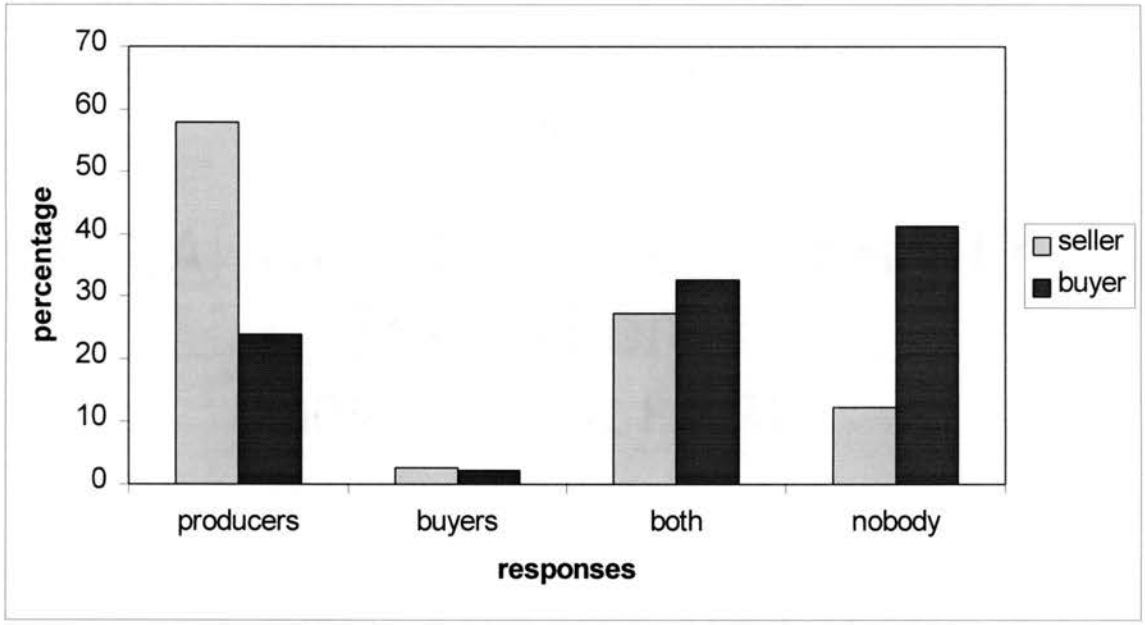


Figure 13. Buyers and sellers' responses about who benefit the most from government intervention in the exchanges

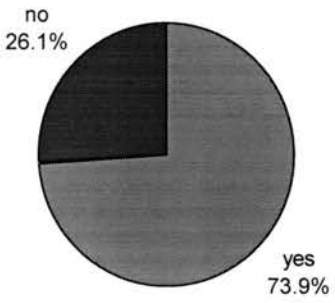


Figure 14. Sellers consideration about whether the state intervention affects their exchange use

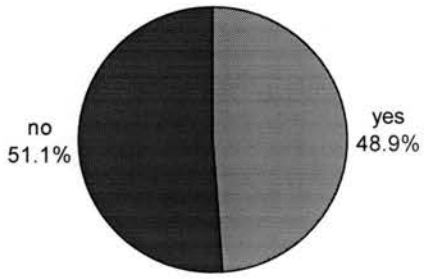


Figure 15. Buyers consideration about whether the state intervention affects their exchange use

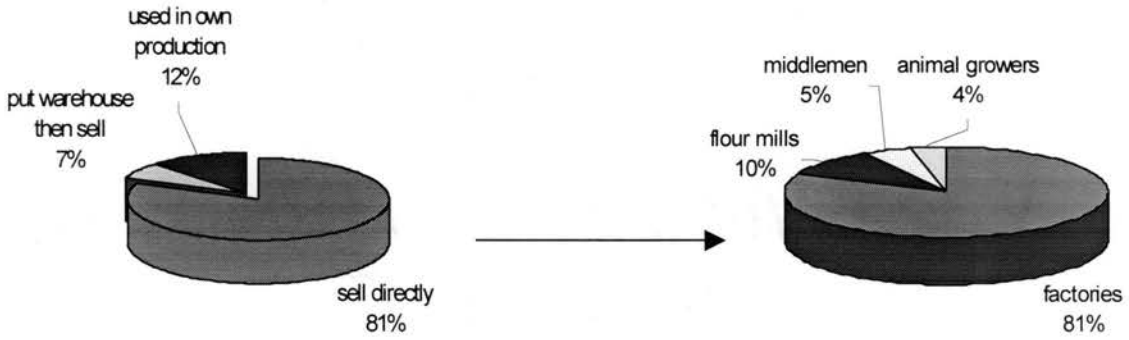


Figure 16. Buyers' responses about what they do with the product they Purchased form exchanges

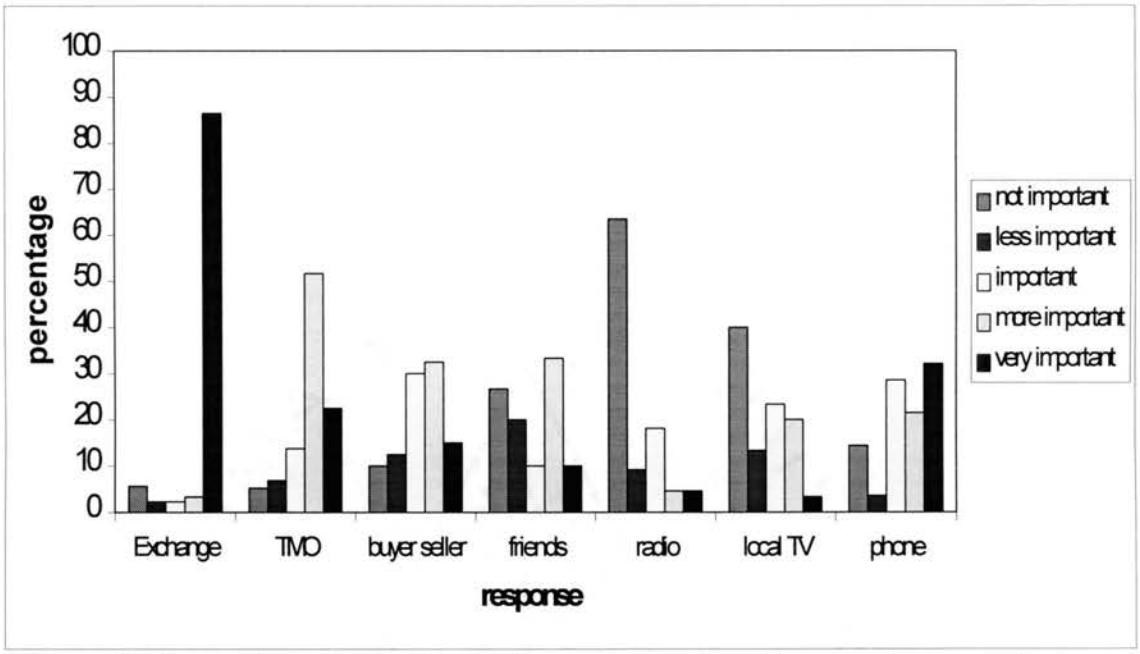


Figure 17. Buyers' responses for the importance of getting price information

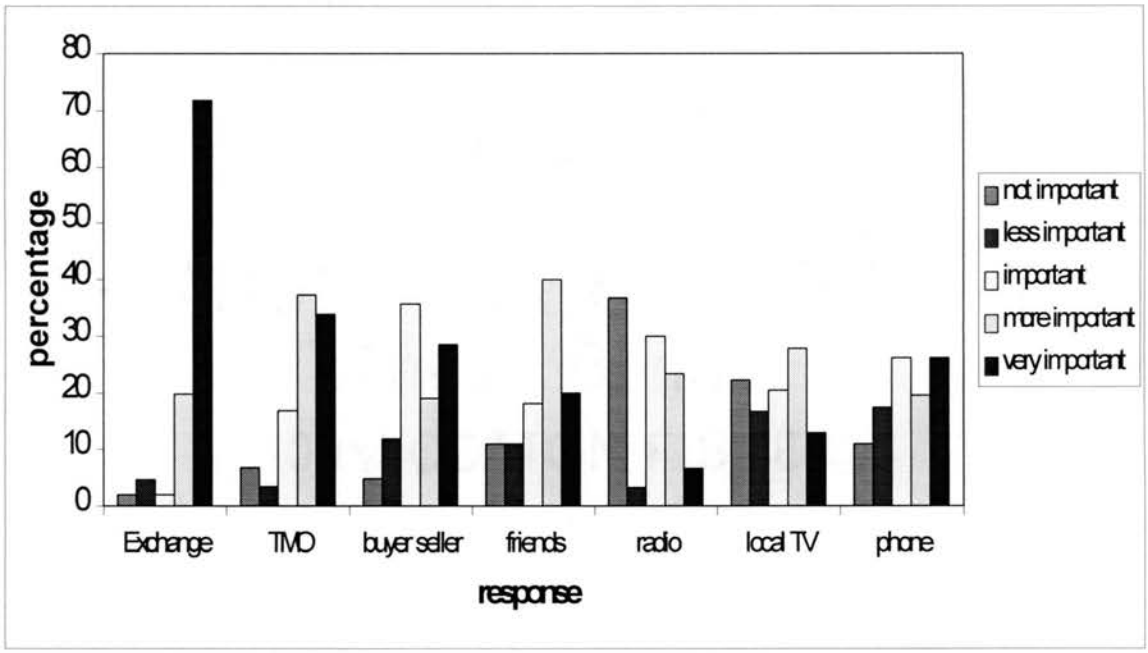


Figure 18. Sellers' responses for the importance of getting price information

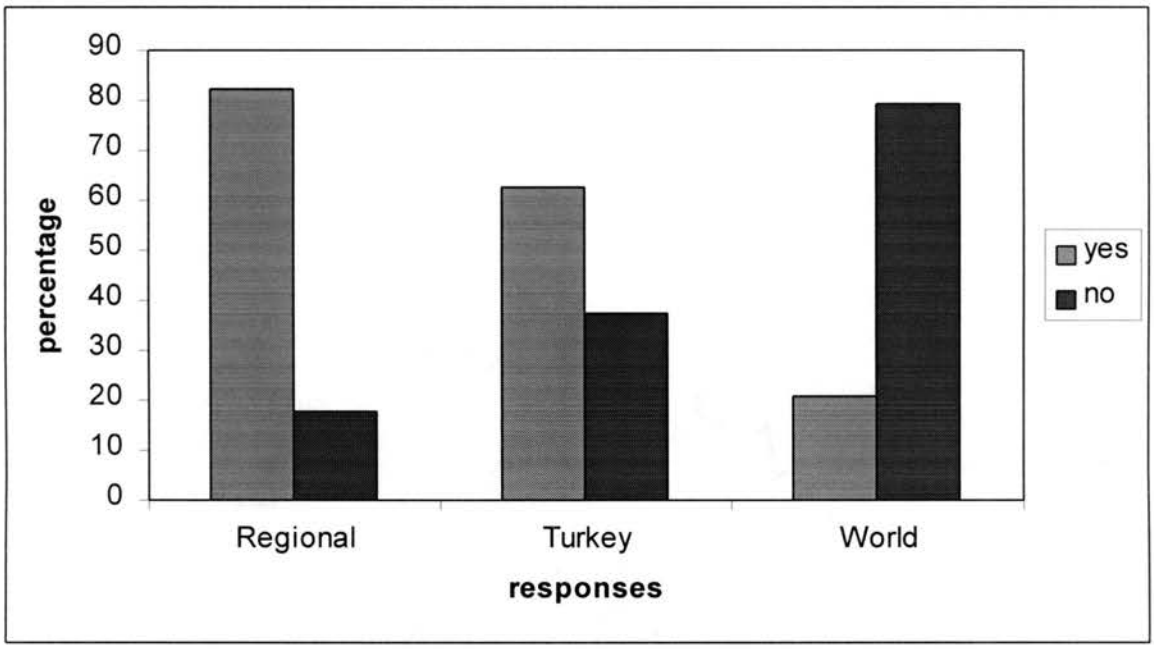


Figure 19. Sellers' responses about whether the exchanges provide price information

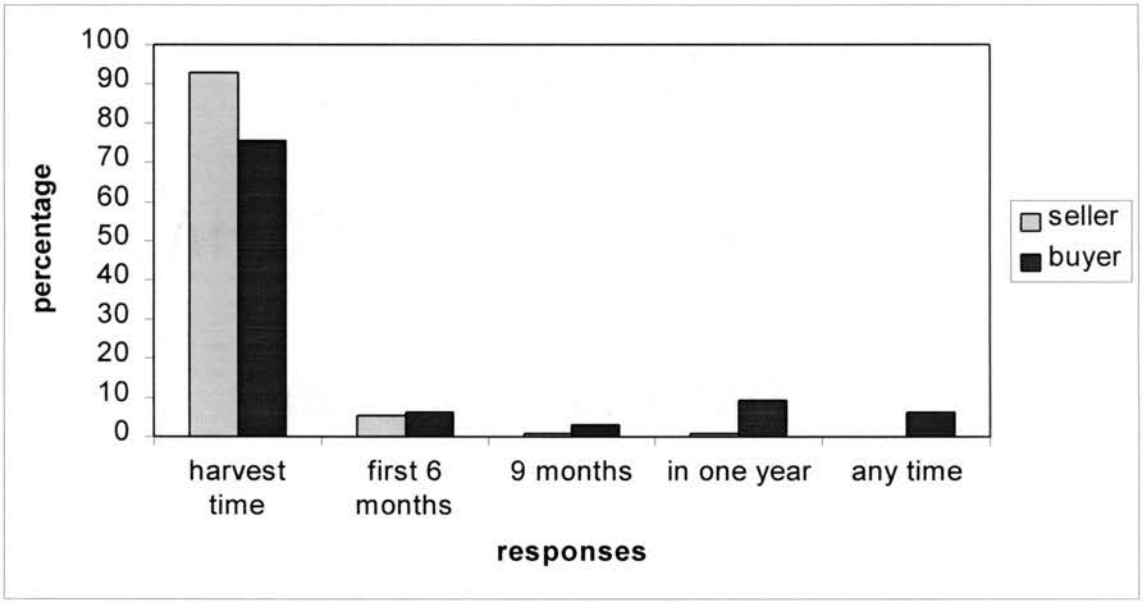


Figure 20. Buyers and sellers' purchasing time of wheat

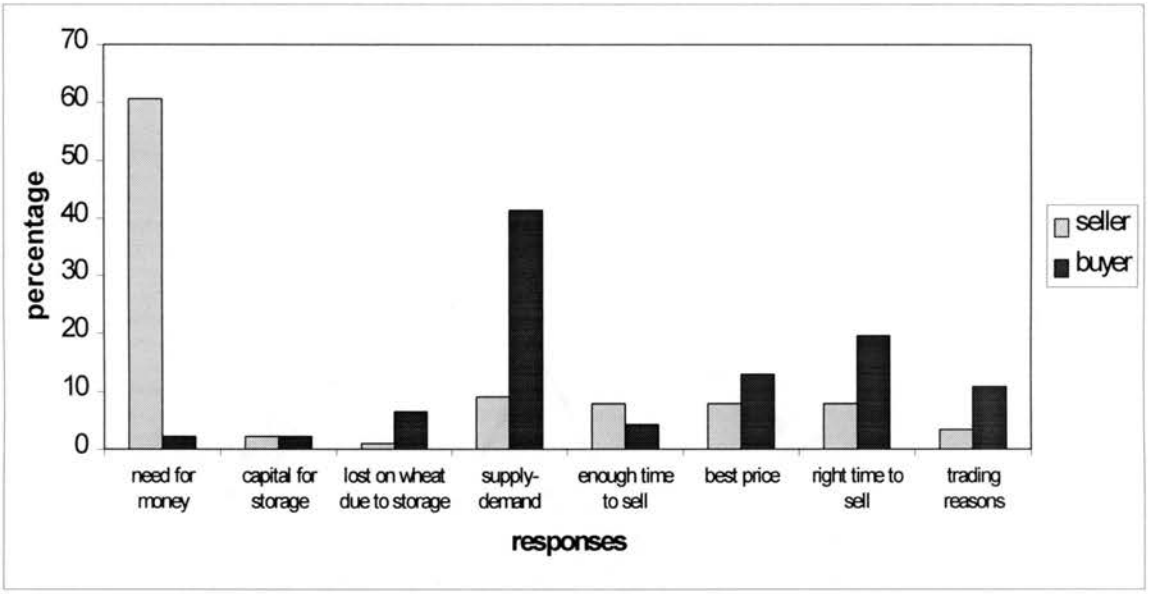


Figure 21. Buyers and sellers' reasons for choosing the purchasing time of wheat

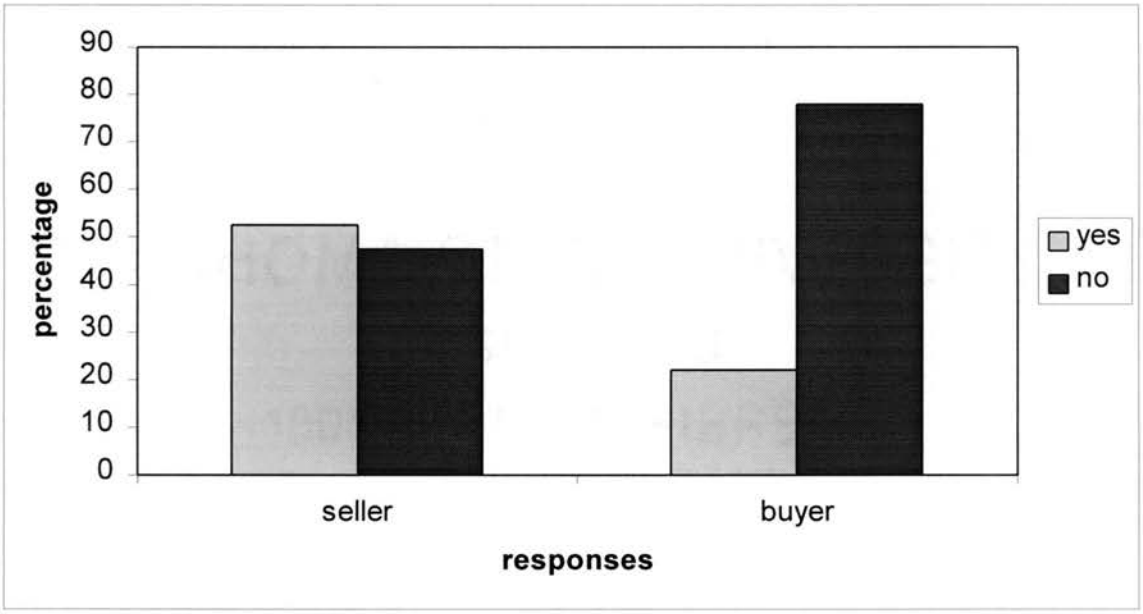


Figure 22. The percentage of buyers and sellers who use credit

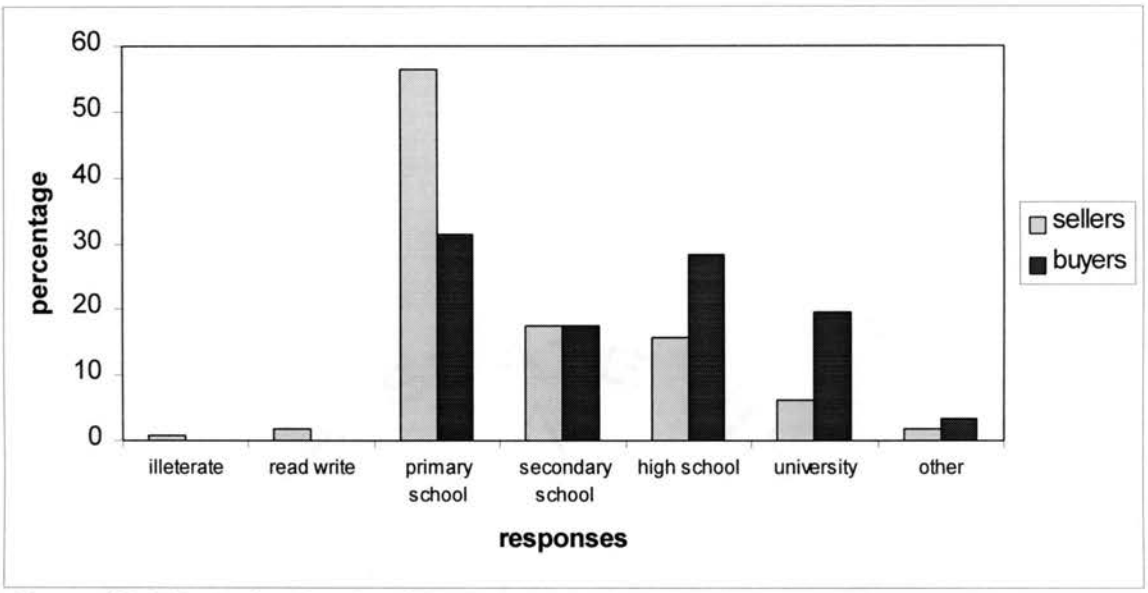


Figure 23. Education levels of the buyers and sellers in the exchanges

BUYER / SELLER
IN THE AGRICULTURAL COMMODITY MARKET
QUESTIONNARE

Sample No._____

Survey Area of Respondents:

Province :_____

Municipality : _____

City : _____

Month Day Year
Date :_____/_____/ 1999

Name of Enumerator: _____

Name of Supervisor :_____

Please circle the appropriate choice pr write down the appropriate code in the tales.

SECTION I: Position of Respondents in the Exchange

Q-1 What is your position within the exchange? If buyer & Seller complete 1) & 2)

1) Buyer

a) Trader b) Industrialist / Processors c) Exporter

2) Seller

a) Farmers b) Trader c) Commission agent d)Exchange's Broker

Q-2 Do you come to exchange regularly?

1) Yes 2) No

If yes

1. How many years .....
2. Each year do you come .....

a – Nearly every day .....

b – Two to three times per week .....

c – Not very often .....

d – Other (Specify) .....

Q-3 Which year did you register?

Year: .....

Opinions about Exchange

Q-4 Using a number from 1 to 5, please tell me whether you are agree, disagree or uncertain about your beliefs about the following:

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
1	2	3	4	5

a) I use the price reported at the exchange to negotiate prices in off-exchange transactions .....

b) Exchange prices are lower than those I receive .....

c) My wheat is generally higher quality than wheat traded at the ..... exchange .....

d) The exchange is too far away from my farm/processing plant to be useful .....

e) Transportation to the exchange limits my ability to use it .....

f) Wheat price information form at the exchange is available when I need it .....

g) If I sell at the exchange I am concerned that I will not be paid for my product .....

h) If I buy at the exchange I am concerned that I will not receive my product .....

i) The large buyer at the exchange set the price paid (producers) .....

j) Wheat price information from the exchange is accurately reported .....

k) Buyers and sellers at the exchange are treated fairly .....

l) Wheat price information is difficult to interpret because grading is not done .....

m) Prices at exchange are determined competitively .....

n) Prices at exchange would be easier to evaluate if product were graded .....

o) Large seller at the exchange can set the price they receive .....

p) Storage cost at exchange are fair .....

q) Disputes that arise at the .... exchange are settled fairly .....

r) Prices at the exchange accurately reflect the true value of the products bought and sold .....

s) Storage space is generally easily obtained at the exchange .....

t) Products are accurately weighted at the exchange .....

u) Off-exchange transaction price information is available when I need it .....

v) Fees charged at the exchange are too high given the service received .....

w) Parking facilities are not sufficient at the .... exchange .....

x) I receive a higher price by selling wheat away from the exchange (farmers) .....

y) I pay a lower price by buying directly from farmers (traders/processors) .....

z) A warehouse receipt system, legally enforceable would encourage me to use the exchange .....

aa) I am treated fairly at the ... exchange .....

bb) The receiving area at the ... exchange is not capable of receiving my product when I want to deliver .....

cc) An accurate and fair wheat grading system would encourage me to use the exchange .....

dd) The warehouses at the ... exchange are clean and free of insects and rodents .....

ee) Too many pesticides are used at the .... Exchange so that the wheat I receive may not be suitable for milling .....

Q-5 On the days that you buy/sell product at ... market, is the price you pay/receive word product

a) ..... percent higher than the average

b) about equal to the average

c) .....percent lower than the average

To what factor do you attribute the price difference? .....

Q-6 What percentage of your purchases / sales are completed at:

a - ..... exchanges

b - ..... TMO/Coop

c - ..... off-exchange private transactions

d - other, please specify .....

Q-7 Do you agree with official registration within your exchange

1) Agree

2) Disagree

3) No idea

Q-8 Are there enough buyer within the exchange?

	Excellent 1	Good 2	Fair 3	Poor 4	No idea 5
First Quarter					
Second Quarter					
Third Quarter					
Fourth Quarter					

Q-9 Are there enough seller within the exchange?

	Excellent 1	Good 2	Fair 3	Poor 4	No idea 5
First Quarter					
Second Quarter					
Third Quarter					
Fourth Quarter					

Q-10 Where do commodities come from?

Province(s): ..... Average ..... Km Max ..... Km

Sub-province(s): ..... Average ..... Km Max ..... Km

Q-11 Where does buyer come from?

Province(s): ..... Average ..... Km Max ..... Km

Sub-province(s): ..... Average ..... Km Max ..... Km

Q-12 Who comes to the exchange as a buyer?

Specify: .....

Q-13 What does the exchange function?

.....

Q-14 Does the exchange provide you for information about prices regularly (day to day)?

1) Regional : a) Yes b) No

2) National (Turkey) : a) Yes b) No

3) World : a) Yes b) No

Q-15 How often do you get price information?

Hourly .....; Daily ..... ; Weekly .....; Monthly .....; Yearly .....

Q-16 Where do you get price information? (Use the scale to rank the importance of following sources of price information)

Not important				Very Important
1	2	3	4	5

a) Exchange .....

b) TMO/Coop .....

c) Buyer/Sellers .....

d) Friends .....

e) Radio market reports ....

f) No information .....

g) Other exchanges, which: .....

Q-17 Do you believe that warehouse receipt system marketing is useful?

1) Yes 2) No

If yes? Specify: .....

If no? Specify: .....

Q-18 What do you think about legal arrangements on the exchange?

1) Adequate 2) Inadequate 3) No idea

Q-19 What do you think about transparency of market except the exchange?

1) Transparent 2) Non-transparent 3) No idea

If your answer is 'transparent', How is it? .....

If your answer is 'non-transparent', Why is it? .....

Using Credit

Q-20 Do you benefit from credit?

1) Yes 0) No

Q-21 What kind of credit do you benefit?

1) Agricultural credit
2) Village cooperative credit
3) Private bank
4) Trader
5) Borrow from blood relatives
6) Borrow from friends and neighbor
7) Do not borrow

Q-22 When do you more sell your products?

a) Harvest time
b) Second quarter
c) Third quarter
d) Fourth quarter

(If producers ask)

Q-23 Both last and this year how much did you produce, sell wheat and whom did you sell them (as percentage), and why did you sell this person/institutions?

Wheat	1-Production amount (ton or kg)	2-Selling amount (kg)	3-To whom ..... (%)	4-Reason
1999	..... ton	..... kg	....	....
1998	..... ton	..... kg	....	....

Kod 3: a) to the exchange

b) to trader

c) to Governmental Organization (TMO vs.)

d) to cooperative

e) to broker

f) Other (specify):.....

Kod 4: a) Better price

b) Everybody sell their commodity to that place

c) I get my money easily

d) I do not know other places

e) Other (specify):.....

Q-24 Do you store your commodity?

1) Yes 2) No

If yes, where ?.....

Its capacity?.....

How long?.....

If no, why?.....

(If he is buyer ask)

Q-25 Last and this year how much did you buy wheat, from whom (as percentage) and

Why did you buy from this person/institution?

Wheat	1-Buying amount (ton or kg)	2-From whom and its percentage (%)	4-Reason
1999	..... ton	..... kg	....
1998	..... ton	..... kg	....

Kod 2: a) From exchange

b) From Governmental organization (TMO vs.)

c) From cooperatives

d) From broker

e) Other (specify):.....

Kod 3: a) Better price

b) Everybody buy his or her commodity from that place

c) I get my money easily

d) I do not know other places

e) Other (specify):.....

Q-26 Over the last five years, how many kg of wheat have you bought/sold? .....kg per year

Q-27 When do you more buy?

a) Harvest and first quarter

b) Second quarter

c) Third quarter

d) Fourth quarter

Q-28 Do you store purchase

1) Yes 2) No

If yes, in where? .....

How long? .....

Its capacity? .....

Costs ..... TL/Monthly

If no, Why? .....

Q-29 What do you do with purchase?

Assume that a grading system was available that allowed all wheat to be identified by quality. Call the grades "grade 1" "grade 2" "grade 3" and "grade 4" where grade 1 produced the best and most flour per ton of wheat, grade 2 the next best and so on.

Q-30 If wheat bought and sold by grade alone (no visual inspection), would the price you (received/paid) be higher _____ ; the same as now _____ ; or lower _____ than you would receive/pay using the current system?

Q-31 If wheat were bought and sold by grade alone and prices were reported at the end of each day for each exchange would it be easier _____; the same as now ____; or more difficult _____; than using the what information you currently obtain.

Q-32 Who would benefit the most if all wheat were bought and sold using the same grading system?

a) Seller

b) Buyer

c) Both the seller and buyer

d) Do not know

Q-33 How often traders profit by buying at one exchange, pay word transportation and sell at another exchange?

Never				Almost always
1	2	3	4	5

Q-34 How often can traders profit by buying at harvest paying storage costs, and selling later in the marketing seasons?

Never				Almost always
1	2	3	4	5

Price Difference

Q-35 Reason for different price

1 Many buyers
2 Valuation of commodity according to supply
3 Economic crises
4 Insufficient support price
5 Lack of government interest
6 Transaction cost
7 Different mechanism of outside exchange
8 Exchange payment system
9 Competition
10 Speculators
11 No bargaining in exchanges
12 Adjudication
13 Stoppage
14 TMO does not make immediate cash payment

Q-36 Reason for not to sell to commodity exchanges

1 Need
2 When TMO paid in cash advance
3 Proper time to sell
4 Price difference
5 Can not sell to commodity exchanges
6 Prices are low
7 Everybody sell to commodity exchange
8 Since I have my own place
9 Lack of exchange
10 Exchange does not work here

Q-37 Reason for not to buy from exchanges

1 No sufficient commodity
2 Price
3 Buying from outside of commodity is cheap
4 No commodity in the exchanges
5 Quality
6 Buy all from exchanges
7 Transportation reasons

Government Intervention

Q-38 Should state control commodity exchanges time to time

1 Yes
2 No
3 No idea

Q-39 To what topic state Intervene?

1 Price
2 All services
3 No intervention

4 Commodity

5 Buyers and sellers must protect the market

6 During the payments

7 Tax and other legal procedure

8 Price should follow world prices

9 Selling and buying

General information about interviewee

Q-40 Age: .....

Q-41 Where do you live? a) Province: ..... b) Sub-province ..... c) Village.....

Q-42 What is you educational level?

1) Illiterate

2) Literate without going school

3) Primary school

4) Secondary school

5) High school

6) University

7) Other (specify): .....

Q-43 What is your profession?

.....

Q-44 What is your current job?

.....

Q-45 How long have you done this job?

.....year

Chapter II

WORLD COTTON MARKET INTEGRATION: THE TURKISH COTTON MARKET

Abstract

This study uses New York, Izmir, and Liverpool Cotton Exchanges' daily cotton prices to determine whether there is a long run price relationship or price leadership among these three markets. The cointegration test results indicate that there is no long-run price relationship among the exchanges. While cointegration test results indicate no long run price relationships between exchanges, causality tests showed that there is a unidirectional short run causality between Liverpool and New York Cotton Exchanges with being the leading market. Since Izmir prices are not cointegrated with prices in other markets, the proposed cotton futures market in Izmir is more likely to be successful.

Keywords: cointegration, causality, market integration, government intervention, cotton exchanges

Introduction

The concept of spatial market integration is based on the Takayama and Judge (1971) model of spatial competitive equilibrium of an economy. The model indicates that if there is trade between two markets, then competitive commodity arbitrage leads to an equilibrium where prices differ only by the transportation and transaction costs. If this holds, these markets can be considered to be spatially integrated and it is said that the Law of One Price (LOP) holds for a group of commodities.

International commodity price relationships have received remarkable attention in recent years. Market structure and price dynamics (e.g., Brorsen et al., 1991; Goodwin and Schroeder, 1991; Taylor et al., 1995; Kohzadi and Boyd, 1995), price leadership, the efficiency of market intervention (e.g. Zwart and Blandford, 1989, and Ismet et al., 1998), market integration (e.g. Ravallion, 1986, and Asche et al., 1999) and some other issues have been studied within the context of price behavior in the international commodity market. Measurement of market integration can be considered as basic to understanding how specific markets work such as dynamics of market adjustments, and whether there exists market imperfections because of government intervention. As indicated by Yang and Leatham (1999), if the market is internationally integrated, government intervention to support prices in one country will be ineffective or very costly.

Turkey has had considerable government intervention in the domestic markets for agricultural commodities. Agricultural policies are often a complex mix of objectives

(Zwart and Blandford, 1989). In the Turkish agricultural sector, the intervention was to support and stabilize farm incomes by raising producer prices and lowering price volatility, and lowering input prices for the textile industry. As stated by Zwart and Blandford (1989), these interventions in agricultural markets have distorted trade flows and international prices.

The Turkish governments' policies of agricultural sector trade controls (import duties and export taxes), government procurement, heavy government involvement in marketing, and input subsidies have likely had negative effects on the agricultural industry and the Turkish economy. Most of these policies have discouraged producers from producing commodities in which Turkey has a comparative advantage, kept out private sector marketers, and encouraged inefficient production technologies. The Turkish cotton industry has been dramatically affected by these policies. Domestic cotton production became insufficient for the textile industry's demand and Turkey has been importing cotton since 1985 as seen in Table 1. Turkey's domestic agricultural policies also affect its closer integration with the European Community (EC).

Turkey has applied for full membership to the EC. According to an agreement between Turkey and the European Community (EC), a customs union became effective on January 1, 1996. As a result of this agreement and adjustment of the Turkish government's domestic policies to the EC's general rules, the degree of economic and financial integration between the parties is expected to increase.

A cotton futures exchange in Izmir is being planned. An agreement signed with the Chicago Board of Trade and EUREX will provide training as well as counseling for the futures exchange market. If cotton prices in Liverpool or New York and Izmir cotton

exchanges tend to be cointegrated and converge quickly then a futures exchange in Izmir may be unnecessary. Turkish traders might find lower transaction costs in the established futures exchanges outweigh any decreased risk from a futures exchange that reflects Turkish prices.

One objective of this study is to determine long-run price relationships among Izmir Cotton Exchange (ICE), New York Cotton Exchange (NYCE) and Liverpool Cotton Exchange (ICE)' spot cotton prices. A second objective is to use these price relationships to provide information on the existence of price leadership and speed of price adjustment between cotton exchanges.

To meet these objectives, both cointegration and causality tests are used. The long run price movements are tested with cointegration tests. Johansen maximum Likelihood, Dickey-Fuller and Phillips-Perron tests are performed to determine price integration among the exchanges. To test whether price leadership exists between exchanges, Granger causality and Holmes-Hutton causality tests are applied to price series.

The issue of price relationships at both international and national levels has been studied either in terms of law of one price or market integration using cointegration, error correction models (ECM), causality tests and VAR models (Ardeni 1989; Goodwin 1992; Goodwin and Schroeder 1991; Mohanty et al., 1996). In empirical studies on international prices, there is no common agreement that the Law of One Price (LOP) holds.

The difference in findings could be due to model selection or excluding some explanatory variables, highly correlated with other variables used in the regression. As

stated by Mohanty et al. (1996) the standard Granger causality tests provide misleading results and a structural VAR approach is likely to be misspecified. In addition to these weaknesses, these tests focus on short-run dynamics rather than long-run equilibrium relationships (Mohanty et al., 1996).

Yang and Leatham (1999) used cointegration analysis to analyze cotton price relationships. In their research, they used six cotton price series including Turkish cotton prices and they found evidence for market integration among some developing countries (excluding Turkey) and the U.S. Baffes and Ajwad (1998) used regression analysis to test the degree of cotton price linkages of world cotton market and identify the source (e.g. short run price transmission versus long run comovements). They found that the main source of the improvements in price linkages seems to be a result of short run price transmission and to a very limited extent a result of long run comovement. Their result shows that there is relatively high long-run convergence between Central Asia and West Africa and very limited long-run convergence between the U.S. and the other origins.

Turkish Cotton Industry

The major players in the world cotton market are the United States, China, the Former Soviet Union and Pakistan/India. Turkey is the one of the major cotton producing countries. As seen in Table 1, the production level in 1998/99 fiscal year was 882,000 metric tons. There are four main cotton-growing regions in Turkey: Cukurova, Aegean, Antalya, and Southeast Anatolia (Figure 1). From 1987/88 through 1997/98, the amount of cotton lint produced in Turkey was 656,000 metric tones (MT) per year (Schmitz, 1999). Turkey imports a significant amount of cotton lint and exports a significant quantity of cotton as well depending on the cotton types. Turkey become a net

cotton importer and in 1998 Turkey's cotton imports reached up to 263 metric tons as seen in Table 1.

Turkish cotton can be separated into two distinct markets; Aegean markets and non-Aegean markets (Figure 1). The cotton produced in the Aegean region is considered to be one of the highest quality products in the world and it is demanded by the rest of the world. In recent years, the main destinations of the Turkish cotton export are Germany, Italy, France and Belgium. The non-Aegean type cotton is usually low quality cotton. Since quantity produced of non-Aegean cotton is lower than the amount of non-Aegean cotton demanded by domestic processors, Turkey imports non-Aegean cotton from the rest of the world. Between 300,000 to 400,000 tons of non-Agean lint cotton are currently imported annually (Gencer et al., 1999). Aegean and non-Aegean cotton are not considered to be substitutes by Turkish processors because Aegean cotton is roller-ginned while most non-Aegean cotton is saw-ginned. (Schmitz). Non-Aegean cotton which does not hold color well, is used in such fabric as denim.

After cotton is ginned, the Taris cooperative may use the lint in the cooperative's textile mills or sell the lint to domestic buyers and exports. Cooperatives in Turkey are 'quasi-governmental" organizations since they buy the largest portion of the cotton sold by growers and they have a great deal of control over grower prices. Starting in 1998/99, the government implemented a procurement price set at the prevailing world market price. All growers are entitled to a premium payment calculated on the basis of seed cotton deliveries to either cooperatives or private gins. For 1998/99, government support was $220 million (International Cotton Advisory Committee).

Cash exchanges in Turkey are fully operating, open out-cry spot markets. The Izmir Mercantile Exchange, operating since the 1800's, is the largest exchange in the Aegean Region and is the most active cash exchange in Turkey (Figure 2). All individuals who buy or sell cotton in Turkey have to be a member of a commodity exchange and register sales transactions with that exchange, but they can trade anywhere. The price leader at the Izmir exchange for cotton, Taris, is a private cooperative that is still subject to some government control. The exchange at Izmir begins with buyers and seller seated closely together in a small arena. Buyers and sellers state bids and offers until some sales are made. Once a price is established, sellers go to their tables throughout the room where they exhibit cotton they have for sale. If a subsequent sale is negotiated, the terms of the sale are immediately posted for all to see. Taris controls only 22 percent of the market.

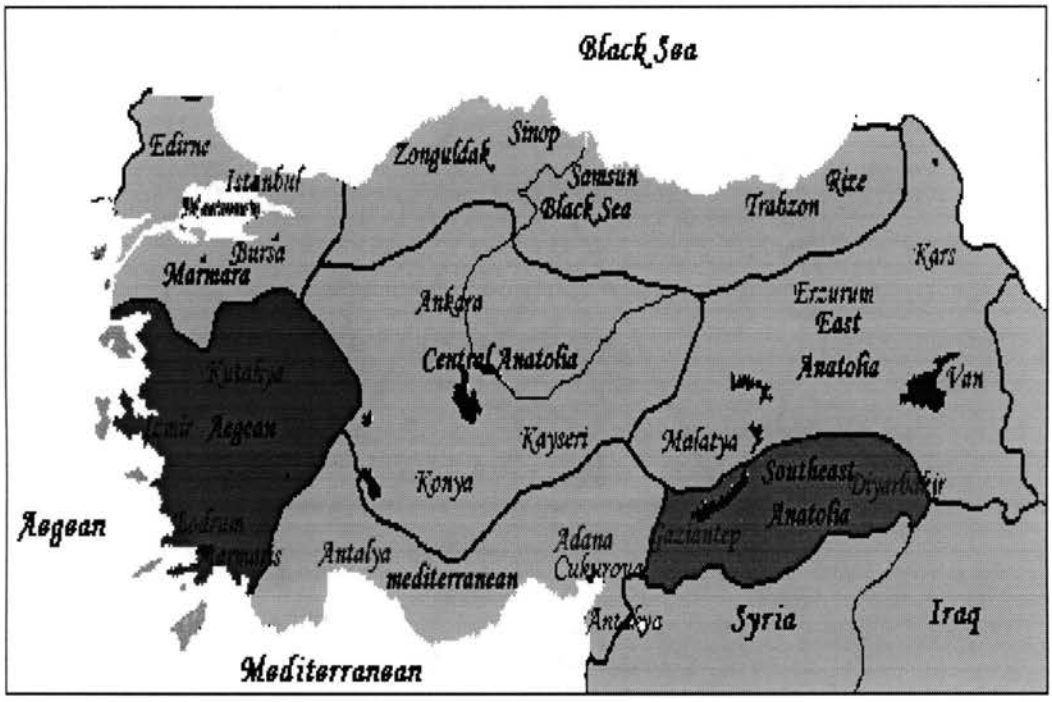


Figure 1 Generalized Cotton Regions of Turkey (Shaded)
(Source: USDA, Foreign Agricultural Service)

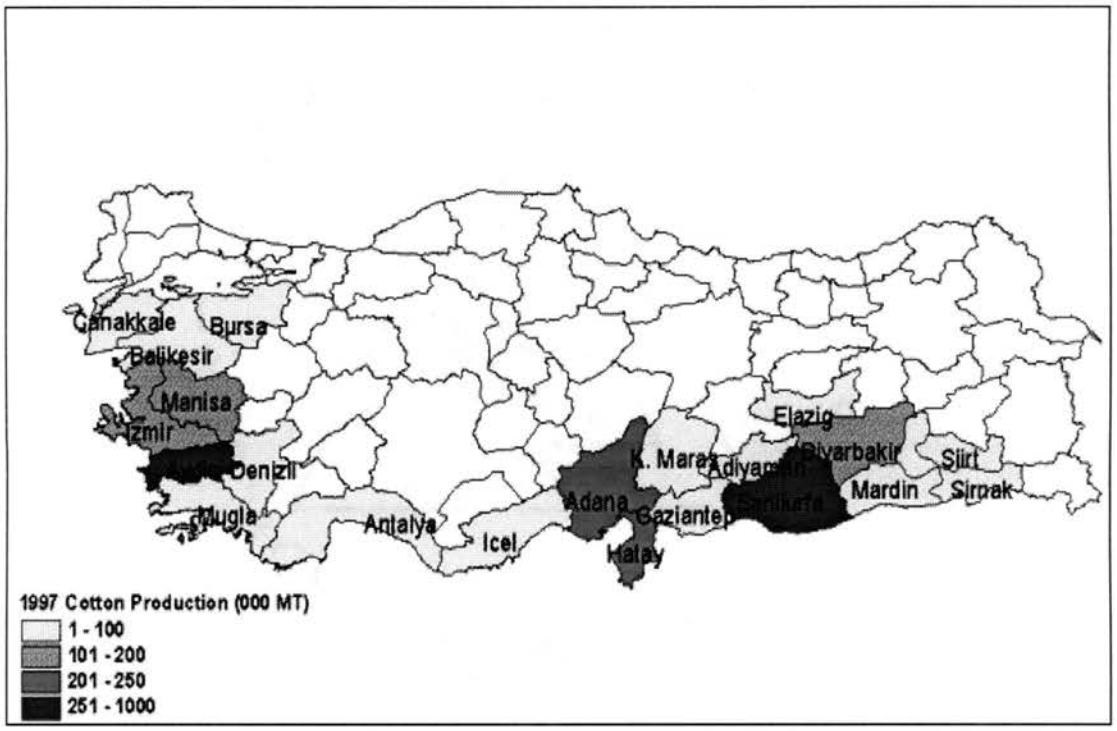


Figure 2: Cotton Areas with the Production Level in 1997
(Source: DIE(Devlet Istatistik Enstitusu) State Institute of Statistics, Republic of Turkey)

Theoretical Background

Unit Root tests for Price Series

Prior to cointegration estimation, we have to ensure that the price series used in the analysis are nonstationary. There are different approaches to testing for unit roots in the autoregressive processes. All tests have to deal with the fact that tabulated distributions of test statistics are based on a model with a white-noise error process (Galbraith and Zinde-Walsh, 1999). Dickey and Fuller (1979) base a test on direct modeling an ARMA error process without additional lag augmentation. An important potential problem and source of error when applying the Dickey-Fuller tests is that they are sensitive to the presence of drift and time trends in the regression (Diakosavvas, 1995). Because of these reasons another alternative approach, Phillips-Perron (PP) procedure (Phillips and Perron, 1988) is used in this study. The PP test is similar to the ADF test. They used a non-parametric correction to the statistical results from a simple regression model, to adjust for the effects of autocorrelation in the residuals of that model.

Co-integration and Causality Analysis

When determining relationships between prices to test market integration, cointegration analysis has recently become the primary method used because most price series tend to be nonstationary. Before cointegration analysis became popular and analysts became concerned with the statistical problems raised by the nonstationarity of prices, earlier studies examining the relationships between prices either looked at correlation coefficients (Lele, 1967; Stingler and Sherwin, 1985) or used the regression type analysis (Gardner and Brooks, 1994).

The traditional way to study market integration relies on correlations between the prices in pairs. The correlation coefficients provide evidence of a high degree of linear comovement between the prices. The correlation coefficients for the daily price series examined in this study are 0.61 for New York and Izmir cotton prices, 0.81 for New York and Liverpool cotton prices, and 0.70 for Izmir and Liverpool cotton prices. The results indicated that the prices are closely related in the short-run. A high correlation coefficient between two series can explain that the two prices will respond to new market information in a similar manner. On the other hand, as indicated by Diakosavvas (1995) and Fortenbery, Cropp, and Zapata (1997) there are some limitations in using simple price correlations to infer anything about the extent of market integration. The main problem is that two functionally isolated markets can appear to be synchronized if prices in each are influenced by a third market or a common factor (Heytens, 1986). The second limitation is that simple correlations do not imply causality. Third, dynamic properties of the series are overlooked by the simple correlation analysis. Problems with this statistical test has led researchers to advocate the use of statistical procedures that includes lagged responses.

Cointegration corresponds to the theoretical notion of a long run or equilibrium relationship. Tests for cointegration constitute test of whether such relationships exist, and hence can be used to test the propositions of economic theory such as the Law of One Price. As indicated by Granger (1986) there is a belief in economic theory that certain pairs of economic variables should not diverge from each other at least in the long run. He indicated that these variables can diverge from each other in the short run or according to seasonal factors, but if they continue to be too far apart in the long run, then

economic forces, such as arbitrage will force them to move together again. As stated by Granger (1986) however, the belief about long-term relatedness is an empirical question. The notion underlying cointegration allows specification of models that capture part of such beliefs.

McNew and Fackler (1997) pointed out that the law of one price implying a cointegration relationship will only hold if transportation costs are stationary. Goodwin (1992) also stated that the lack of cointegration for international wheat prices may be due to nonstationarity in ocean freight rates. Barrett (2000) argues that shipment data can be used when the directions of shipment varies. We recognize the limitation of the technique. Since transportation costs in Turkey are not available, it was not taken into account for this estimation. Also, Turkey was a large net importer of cotton during the entire period.

Cointegration test says nothing about the direction of the casual relationship between the variables, but if two markets, X and Y are co-integrated, then there must be some sort of 'causality' running from one market to the other. The concept of causality is interpreted in the limited meaning of contribution to predictability. The issue is whether lagged values of prices in one market can be used to forecast value in the other market. If this is the case, then market Y prices are said to Granger cause market X prices. If market Y causes market X, and market X causes market Y, then there is a feedback relation between the two markets.

Data and Estimation

The empirical analysis in this study is structured around two questions. First, whether there exists a certain price linkage among the NYCE, LCE and ICE cotton prices. Second, whether there is a price leader among these three cotton exchanges.

The daily cotton price series from January, 1, 1996 to July, 30, 1999 for Izmir Cotton Exchange (ICE), New York Cotton Exchange (NYCE) and Liverpool Cotton Exchange Index A (LCE) were obtained from the Izmir Cotton Exchange. The prices were used with the U.S. dollar base. The price trends for these three markets can be seen in Figure 3.

Testing for the Order of Integration

Each price series is examined to ensure nonstationarity, a necessary condition for the cointegration testing procedure. Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979) and Phillips-Perron (1988) test procedures are performed. The ADF unit root (nonstationary) test relies on rejecting the null hypothesis of a unit root in favor of the alternative hypotheses of stationarity. The following regression is formed and estimated for each series.

$$\Delta X_t = \alpha_0 + \beta X_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta X_{t-1} + \varepsilon_t \qquad (1)$$

where Δ represents first differences. The null hypothesis is $\beta = 0$ with significance levels provided by Dickey and Fuller (1979). A standard D-F test is the special case of $k = 0$. With the ADF test, the length of k is defined to be large enough to achieve a white-noise structure in ε_t. The test statistic is the ratio of $\hat{\beta}$ to its calculated standard

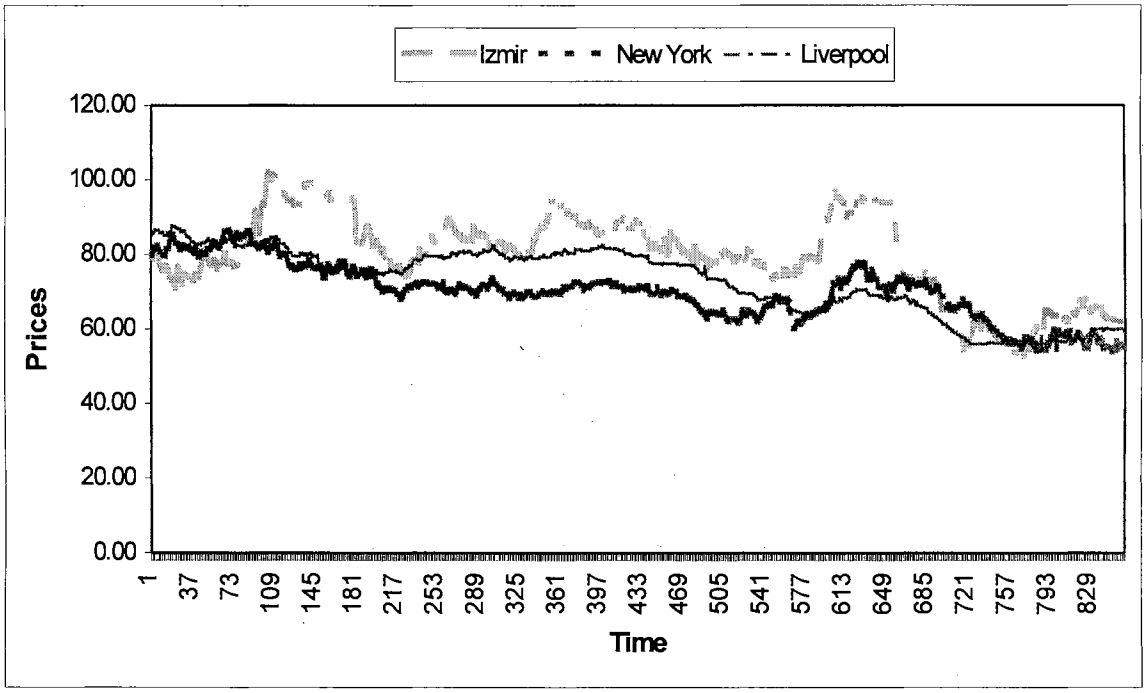


Figure 3. Daily cotton prices for Izmir Cotton Exchange, New York Cotton Exchange and Liverpool Cotton Exchange (1996-1999).

error obtained from an ordinary least squares (OLS) regression. The null hypothesis is $H_0 : x_t \sim I(1)$. This is rejected if $\hat{\beta}$ is negative and significantly different from zero. However, the test-statistic does not have a *t*-distribution but tables of significance levels have been provided by Dickey and Fuller (1979). As indicated before, the PP test is similar to the ADF test. The difference is that they used a non-parametric correction to the statistic results from a simple regression model, to adjust for the effects of autocorrelation in the residuals of that model. The number of lags to include in the equation is determined using the Akaike information criterion.

Cointegration and Causality Tests

To test whether two or more series are cointegrated, series must first be individually integrated. Then a linear combination of the series must be stationary. This test is accomplished by using Johansen Maximum Likelihood, augmented Dickey Fuller (ADF), and Phillips-Perron (PP) cointegration tests. The procedure is to test whether there is a unit root (nonstationary) in the residual of the cointegration regression. If the series are not cointegrated, there is a unit root in these residuals. The cointegration testing processes is given in Figure 4.

Engle and Granger's Augmented Dickey Fuller test

Granger (1986) and Engle and Granger (1987) provide a test of cointegration. If x_t and y_t are both $I(1)$ then it is typically true that any linear combination $x_t + by_t$ will also be $I(1)$. However, for some pairs of $I(1)$ series there exist a linear combination $z_t = x_t - Ay_t$ that is $I(0)$. When this occurs, x_t and y_t are said to be cointegrated.

One of the most commonly used cointegration tests is Engle and Granger's augmented Dickey Fuller (ADF) test. It is assumed that the variables y_t and x_{it}, $i=1,...,m$, are individually $I(1)$. The null hypothesis is that all linear combinations of these variables are $I(1)$. The alternative hypothesis is that at least one linear combination is stationary or $I(0)$. The variables are then cointegrated under the alternative hypothesis. Engle and Granger (1987) proposed a two-step procedure for inferring the existence of such a linear combination. The first stage is a ordinary least squares (OLS) regression of one variable against the other.

In order to test for cointegration between price series ICE, $NYCE$ and LCE, which are expected to be $I(1)$, a cointegration regression shown in equation (2) was formed using OLS estimation and then test the residual, υ_t, to see if it obeys the $I(0)$ properties:

$$ICE_t = \alpha_0 + \alpha_1 NYCE_t + \alpha_2 LCE_t + \upsilon_t . \qquad (2)$$

The residuals υ_t are subjected to a test proposed by Dickey and Fuller (1979). The regression they proposed along with a test of the null hypothesis $H_0 : \upsilon_t \sim I(1)$ is:

$$\Delta\upsilon_t = \alpha_0 + \beta\upsilon_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta\upsilon_{t-1} + \varepsilon_t . \qquad (3)$$

We reject the null hypothesis if $\hat{\beta}$ from (3) is negative and significantly different from zero. The t-ratio from this test does not have the Dickey-Fuller distribution. The distribution of this test was first tabulated by Engle and Granger and called Engle-Granger distribution. Critical values are from MacKinnon (1990).

Johansen's Maximum Likelihood Tests

Compared to the Engel-Granger test (EG), Johansen (1988) provides a better and more efficient approach to test for cointegration based on the well-accepted likelihood ratio principle. Even though this test has more advantage in multivariate model, Enders (1995) favored the Johansen approach over the EG test in bivariate models. Based on maximum likelihood principle, Johansen (1988) and Johansen and Juselius (1990) proposed an alternative approach for testing cointegration.

Johansen and Juselius (1990) have developed the maximum likelihood estimator and likelihood ratio tests for hypothesis testing in a cointegrated system. Consider a p-dimensional Gaussian vector autoregression of order $k+1$ with constant term μ:

$$X_t = \sum_{i=1}^{k+1} \pi_i X_{t-i} + \mu + e_t \qquad (4)$$

with non-singular, not necessary diagonal, covariance matrix. Let X_t denote a vector that includes k price series ($k = 3$ in this case). The k price series in X_t can be expressed as a reduced form error correction model:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + ... + \Gamma_{k-1} \Delta_{t-k+1} + \Pi X_{t-1} + \mu + \varepsilon_t \qquad (5)$$

where $\Pi = \alpha\beta'$ and the rank of Π determines the number of cointegrating vectors and $X_t = [ICE_t, NYCE_t, LCE_t]'$, ICE_t is Izmir cotton exchange daily prices, $NYCE_t$ is New York cotton exchange daily prices and LCE_t is Liverpool cotton exchange Index A prices all of them are $I(1)$, $\Delta x_t = x_t - x_{t-1}$, μ is a $(zx1)$ vector and $\Gamma_1,...,\Gamma_{k+1}$ are (3x3) matrices of parameters, Π is a (3x3) matrix of parameters and ε_t is a (3x1) vector of white noise errors. Where Π is of reduced rank, that is $r = 1$, it can be decomposed into

$\Pi = \alpha\beta'$, where $\alpha = [\alpha_1, \alpha_2, \alpha_3]'$ is the adjustment matrix and $\beta = [\beta_1, \beta_2, \beta_3]'$ is the cointegrating matrix. Thus, equation (5) can be rewritten in full as:

$$\begin{bmatrix} \Delta \mathrm{ICE}_t \\ \Delta NYCE_t \\ \Delta LCE_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \end{bmatrix} + \sum_{i=1}^{k-1} \begin{bmatrix} \Gamma_{i,11} & \Gamma_{i,12} & \Gamma_{i,13} \\ \Gamma_{i,21} & \Gamma_{i,22} & \Gamma_{i,23} \\ \Gamma_{i,31} & \Gamma_{i,32} & \Gamma_{i,33} \end{bmatrix} \begin{bmatrix} \Delta \mathrm{ICE}_{t-i} \\ \Delta \mathrm{NYCE}_{t-i} \\ \Delta \mathrm{LCE}_{t-i} \end{bmatrix} + \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix} \begin{bmatrix} \beta_1 & \beta_2 & \beta_3 \end{bmatrix} \begin{bmatrix} ICE_{t-k} \\ NYCE_{t-k} \\ LCE_{t-k} \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \end{bmatrix}$$

Determination of the rank of Π involves its ordered eigenvalues, $(\lambda_1 > \ldots \lambda_p)$, which can be derived as solution to the equation

$$\left| \lambda S_{kk} - S_{k0} S^{-1}{}_{00} S_{0k} \right| = 0 \qquad (6)$$

In equation (6), the product moment matrices of residuals are defined as

$$S_{ij} = T^{-1} \sum_{t=1}^{T} R_{it} R'_{jt} \qquad i, j = 0, k \qquad (7)$$

The residuals R_{0t} and R_{kt} are determined by regressing ΔX_t and X_{t-k} on $\Delta X_{t-1}, \ldots, \Delta X_{t-k+1}$. To determine the number of cointegrating vectors in the vector of time series X_t, Johansen and Juselius use two likelihood ratio test statistics by using the residual vectors. Using SAS CANCORR procedure (SAS Institute Inc., 1990), canonical correlation techniques were performed.

To test the order of at most r cointegrating vectors for a kx1 vector, the trace test and maximal eigenvalue (λ_{max}) statistics are calculated as follows:

$$\lambda_{\max} = -T \ln(1 - \hat{\lambda}_{r+1})$$

and

$$Trace = -T \sum_{i=r+1}^{k} \ln(1 - \lambda_i)$$

where T is the number of observations, λ_i's are the n-r smallest squared canonical correlations of X_{t-1} with respect to ΔX_t corrected for lagged differences (also called eigenvalues). The Johansen trace test statistics of the null hypothesis is that there are at most $r(0 \leq r \leq k)$ cointegrating vectors and thus $(n-r)$ common stochastic trends. The first question can be answered by testing $r \neq 0$, it implies there is some degree of market integration among some of or all of these three exchanges.

According to Kunst and Neusser (1990) the treatment of seasonality and the choice of the lag order k are important problems that arise in applying Johansen's procedure. The choice of the order of the vector autoregression $k+1$ was guided by the autocorrelation function of the residuals and the Ljung-Box Q-statistics of each equation in the restricted system.

If the values of the test statistics, derived from these cointegration tests are insufficient to reject the null hypothesis of non-cointegration, one will continue to estimate the Vector Autoregressive model (VAR) for causality test. If the null hypothesis is rejected meaning the series are cointegrated, then the Error Correction Model (ECM) will be used.

Granger Causality Test

To examine the direction of causality between any two variables, the Granger test has gained a lot of popularity in different research areas due to its simplicity.

The Granger causality test for the bivariate case as defined by Feige and Pearce (1979) is as follows:

Let $[Y_t X_t]$ be the bivariate process of inference assumed to be jointly covariance stationary, and let

1) $\overline{Y}_t$ and $\overline{X}_t$ represent all past value of variables Y and X.

2) $\widetilde{Y}_t$ and $\widetilde{X}_t$ represent all past and present values of the variables Y and X.

3) $\sigma^2(X_t \mid Z)$ represent the minimum predictive error variance of X_t given Z where Z may be any of the sets mentioned in (1).

Following Granger, Feige and Pearce define four causal situations:

1) Y causes X if $\sigma^2(X_t \mid \widetilde{Y}_t, \overline{X}_t) < \sigma^2(X_t \mid \widetilde{X})$. This says that the inclusion of past Y in the set of values upon which the prediction of X_t is conditioned lowers the minimum predictive error variance.

2) Y causes X instantaneously if $\sigma^2(X_t \mid \overline{X}_t, \widetilde{Y}_t) < \sigma^2(X_t \mid \overline{X}_t, \overline{Y}_t)$. The prediction of X_t is made better by considering the current value of Y in addition to all past X and Y.

3) Feedback is said to occur if Y causes X and X causes Y; i.e.,

$$\sigma^2(X_t \mid \overline{X}_t, \widetilde{Y}_t) < \sigma^2(X_t \mid \widetilde{Y}_t)$$

and

$$\sigma^2(Y_t \mid \overline{Y}_t, \widetilde{X}_t) < \sigma^2(Y_t \mid \widetilde{Y}_t)$$

4) X and Y are independent if neither causes the other

$$\sigma^2(X_t \mid \overline{X}_t, \widetilde{Y}_t) = \sigma^2(X_t \mid \overline{X}_t, \overline{Y}_t) = \sigma^2(X_t \mid \overline{X}_t)$$

and

$$\sigma^2(Y_t \mid \overline{Y}_t, \widetilde{X}_t) = \sigma^2(Y_t \mid \overline{Y}_t, \overline{X}_t) = \sigma^2(Y_t \mid \overline{Y}_t).$$

As indicated by Feige and Pearce (1979), above definitions are conditional on the assumption that all variables except X and Y may be excluded from consideration without giving rise to spurious causality.

The test for causality used by Bailey and Brorsen (1985) in their research is performed in this study. First of all, an autoregressive model of order p ($AR(p)$) is estimated. The $AR(p)$ is

$$Y_t = \sum_{j=1}^{p} \begin{bmatrix} a^{(j)}_{11} & \cdots & a^{(j)}_{1n} \\ \vdots & & \vdots \\ a^{(j)}_{n1} & \cdots & a^{(j)}_{nn} \end{bmatrix} Y_{t-j} + E_t \qquad (8)$$

where Y_t is $nx1$ vector of observations (n is 2 for bivariate time series), p is the order of the autoregressive model, $a_{ik}^{(j)}$ i, $k = 1,...,n$; $j = 1,...,p$ are parameters (where p stands for the number of restrictions which is the order of the autoregressive model) and E_t is a vector of multivariate white noise error terms. The causality tests are performed using equation (8). If $a_{12}^{(j)} = 0$ for all j, then it is said that variable 2 does not cause variable 1 This test is performed by examining the significance of the group as a whole. If an intercept term is included then the test statistics may be calculated using F-tests (or t-test on the individual coefficients if an AR(1) is selected) as follows:

$$F = \frac{(SSE_r - SSE_u)/p}{SSE_u/T - (np+1)} \qquad (9)$$

where SSE_u is the unrestricted sum of squared residuals, SSE_r is the sum of squared residuals with the restrictions and T is the number of observations. For sufficiently large values of (F), the null hypothesis that (X) does not cause (Y) is rejected. The process for causality test is given in Figure 4.

Holmes and Hutton Causality Test

The Granger causality model is premised on the maintained hypotheses of correct functional form (i.e. linear), homoskedasticity and the normality of the error terms. Holmes and Hutton argue that violations of these conditions can affect causality conclusions and suggest an alternative procedure for causality testing based on the rank ordering of each variable. That is, they suggest ranking each variable and using the rank value for each observation in causality testing. The Holmes and Hutton (1990)-causality test is a modified version of the standard Granger testing procedure. The causality conclusions achieved using the Granger testing procedure applied to the rank ordering of the variables is robust over alternative distributions of the error structure and invariant to monotonic transformations of the variables. If the maintained hypotheses for Granger estimation are satisfied, the Holmes-Hutton results are similar to the Granger results. For violations of these conditions, however, the Holmes-Hutton procedure is more powerful than the conventional Granger test.

The same data used with the conventional Granger test was used with the Holmes-Hutton test. This model is specified using the rank values, $R(.)$, of the three price variables, LCE, NYCE, and ICE cotton prices. The pairwise and trivariate causality test as follows:

In the bivariate model, for instance, evidence of causality from NYCE to ICE (written as $NYCE \rightarrow ICE$) requires rejecting a null hypothesis $H_0 : \sum_{i=1}^{k_2} b_i = 0$ in the regression

$$R(ICE_t) = \sum_{i=1}^{k_1} a_i \, R(ICE_{t-1}) + \sum_{i=1}^{k_2} b_i \, R(NYCE_{t-1}) + \varepsilon_{1t} \qquad (10)$$

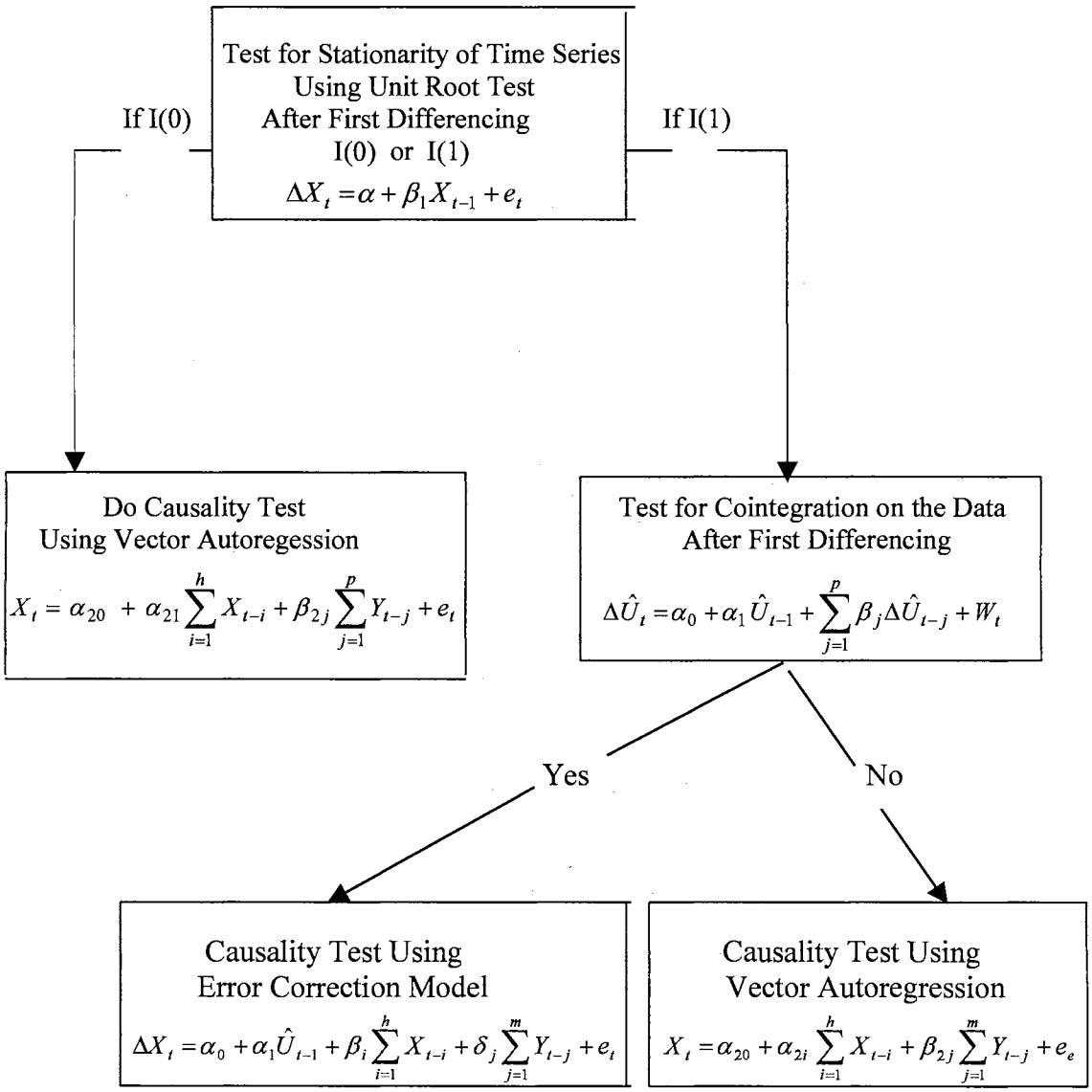
using OLS and regular t-test or F-test depending on the number of lags and interchanging variables in Equation (10) allows a test of $ICE \rightarrow NYCE$. The optimal lag orders, k_1 and k_2 are selected using Akaike Information Criterion.

In the trivariate model, for instance, evidence of causality from both NYCE and LCE to ICE (written as, $NYCE + LCE \rightarrow ICE$) requires rejecting the null hypothesis

$$H_0 : \sum_{i=1}^{k_2} b_i = 0 \text{ and } H_0 : \sum_{i=1}^{k_3} c_i = 0, \text{ in the regression}$$

$$R(ICE_t) = \sum_{i=1}^{k_1} a_i \, R(ICE_{t-1}) + \sum_{i=1}^{k_2} b_i \, R(NYCE_{t-1}) + \sum_{i=1}^{k_3} c_i \, R(LCE_{t-1}) + \varepsilon_{4t} \qquad (11)$$

Figure 4. Processes of Cointegration and Causality Testing



Empirical results

Test result for Order of Integration

Before testing whether the price series are cointegrated, we need to determine that each variable is nonstationary, $I(1)$. Two unit root tests, augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) were applied to series with levels and first differences. Both tests were also applied with trend and without trend cases. The null hypothesis of nonstationarity ($\beta = 0$) was tested using a t-test. The null hypothesis is rejected if the estimated β is significantly negative. Table 3 and Table 4 report the unit root test results. Based on the critical values reported by MacKinnon (1991), the null hypothesis that the series have a unit root (nonstationary), was not rejected for all three series at 1 percent significance level in both tests. The null hypothesis of two unit roots was rejected for all three series at a 5 percent significance level when the first differenced data were used.

Results for Cointegration tests

After confirming that the price series each have a unit root, three types of cointegration tests were performed. These are Johansen's maximum likelihood procedure, bivariate and multivariate Engle and Granger cointegration technique and the Phillips-Perron test.

The results of the cointegration test between ICE, NYCE and LCE cotton prices are reported in Table 5 and Table 6. The Johansen and Juselius (1990) trace test statistic was used to test for a number of cointegrating relations, r, between three international cotton exchange prices and to estimate them consistently. Table 5 presents the results of

cointegration analysis for Johansen's maximum likelihood procedure. Both the trace and the maximum eigenvalue tests did not reject the null hypothesis of no cointegrating vectors with and without trend.

The bivariate and multivariate Engle and Granger cointegration test is based on testing stationarity of the residuals derived from the cointegration equation. Table 6 presents Engle-Granger cointegration test results. Using ADF tests, nonstationarity of residuals was not rejected in each bivariate and multivariate case indicating that the price series are not cointegrated.

Phillips-Perron cointegration test is also based on stationarity of residuals of the cointegration equation. Table 6 reports the test results. At the 10 percent significance level, the null hypothesis of nonstationarity was rejected for the cointegration equation of Izmir Cotton Exchange (ICE) and New York Cotton Exchange (NYCE) prices. The null hypothesis of nonstationarity of residuals was also rejected for Izmir Cotton Exchange (ICE) and Liverpool Cotton Exchange (LCE) cotton prices. These two results in constrast to the previous results indicate that there is a long run equilibrium relation between ICE-NYCE and ICE-LCE cotton price series.

The results found from three cointegration tests are inconsistent. Johansen maximum likelihood and Engle-Granger test results indicate that all price series are not cointegrated. Phillips-Perron test results showed that there are two cointegrated series in the vector. Since, as indicated before, compared to the Engle-Granger test (EG), Johansen (1988) provides a better and more efficient approach to test for cointegration and this test has more advantage in the multivariate model, it can be concluded that ICE, NYCE and LCE cotton prices are not cointegrated. The explanations for these findings

can be given with insufficient market arbitrage due to government intervention in the market. The findings in this study also support Yang and Leatham's (1999) findings that Turkish cotton prices are not cointegrated with other market prices. It is important to note that there are other market factors affecting the price relationships. Davutyan and Pippenger (1990) stated that it is less likely to find cointegrated prices or stationary price spreads when transaction costs are large. Goodwin (1992) indicated that the lack of cointegration for international wheat prices may be due to nonstationarity in ocean freight rates. Regardless of the reason for the lack of cointegration it suggests the potential success of a futures market in Izmir.

Results for Causality Tests

It was concluded that there is no cointegration between cotton exchange prices indicating that there is no long run dynamic relationship. The short run dynamics are characterized by unidirectional causation. As indicated before when a cointegration relation does not exist between series, a vector autoregression (VAR) can be used to determine causality. The causality test in the Granger sense was performed by using the differenced data with the order of the model being selected by Akaike's Information Criteria. The AIC selected a multivariate AR(1) for all price series. The model was estimated using OLS and the causality test calculated. A standard t-test was conducted for testing causality between series because an AR(1) was selected for all three models.

The causality tests showed that lagged New York Cotton Exchange (NYCE) impacts Liverpool Cotton Exchange (LCE). The impact on LCE is positive indicating that the LCE prices follow NYCE cotton prices. There seems to be no significant short run causality between both ICE and NYCE and ICE and NYCE cotton prices in either

directions. Ordinary least square (OLS) estimates of the VAR for cotton prices are reported in Table 7. These results indicate that the New York Cotton Exchange is the most important in terms of price discovery process.

Holmes-Hutton pairwise causality test results (Table 8) find no causality from one variable to another. When Holmes Hutton trivariate causality test was used, the conclusions were the same as with the Granger causality test. Table 9 shows that the only causality runs from New York exchange cotton prices to Liverpool exchange cotton prices.

Summary and Conclusion

Two issues related to market integration for the Izmir Cotton Exchange (ICE), New York Cotton Exchange (NYCE) and Liverpool Cotton Exchange (LCE) were examined. Daily price data from January 1, 1996 to July 30, 1999 (856 observations) from three exchanges were used. No long run relationships between the three exchanges' prices were found. While cointegration test results indicate no long run price relationships between exchanges, Granger and Holmes-Hutton causality tests showed that LCE prices lag the NYCE cotton price.

As indicated by Mohanty, Peterson and Smith (1998), the empirical rejection of the Law of One Price (LOP) is troubling because it is difficult to believe that rational traders are incapable of finding profitable arbitrage opportunities or that markets function so imperfectly that deviations in prices for the same commodity can persist for a long time. For the case of the Izmir Cotton Exchange, Liverpool Cotton Exchange and New York Cotton Exchange being not cointegrated in terms of prices might be because of other important factors such as transportation costs, differences in quality, or changes in

market not taken into account. Since Izmir prices are not cointegrated with prices in other markets, the proposed cotton futures market would not duplicate existing futures markets and so a futures market in Izmir may be successful.

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APPENDIXES

Table 1. Cotton Supply and Use in Turkey

Years	Area 000 Ha	Yield Kgs/Ha	Production	Imports	Consumption	Export
				000 Metric Tons		
1980/81	672	744	500	0	293	222
1985/86	660	785	518	16	430	68
1990/91	641	1021	655	46	557	164
1995/96	741	1148	851	112	900	55
1996/97	743	1055	784	320	1065	35
1997/98	719	1165	838	399	1150	23
1998/99	757	1165	882	263	1000	86

Source: International Cotton Advisory Committee, Washington, D.C. USA

Table 2. Summary Statistics for Cotton Prices in Izmir Cotton Exchange, New York Cotton Exchange and Liverpool Cotton Exchange

	Izmir	New York	Liverpool
Mean	78.86	69.89	72.92
Median	79.81	70.53	76.00
Standard Deviation	10.77	7.65	9.39
Normality	0.110	0.092	0.145
Skewness	-0.44	-0.11	-0.57
Kurtosis	-0.14	-0.37	-0.98
Max	101.85	86.48	87.27
Min	52.66	53.76	54.27

Table 3. Augmented Dickey-Fuller (ADF) Unit Root Test Results for the Izmir Cotton Exchange, New York Cotton Exchange and Liverpool Cotton Exchange

	Izmir	New York	Liverpool	Critical Value (10%)
LEVEL				
Constant no trend	-2.22	-1.09	-0.89	-2.57
Constant and linear trend	-2.97	-3.04	-2.18	-3.13
FIRST DIFFERENCE				
Constant no trend	-7.40*	-8.63*	-7.73*	-2.57
Constant and linear trend	-9.69*	-22.41*	-20.41*	-3.13

Note: Asterisk (*) denotes significant at 5% significance level. Critical values for ADF test for 5% Significance level is –3.42. Null hypothesis is that series have a unit root.

Table 4. Phillips-Perron(PP) Unit Root Test Results for the Izmir Cotton Exchange, New York Cotton Exchange and Liverpool Cotton Exchange

	Izmir	New York	Liverpool	Critical Value (10%)
LEVEL				
Constant no trend	-2.18	-1.41	-0.38	-2.57
Constant and linear trend	-2.96	-3.85	-1.69	-3.13
FIRST DIFFERENCE				
Constant no trend	-7.42*	-8.68*	-7.77*	-2.57
Constant and linear trend	-9.68*	-21.09*	-19.2*	-3.13

Note: Asterisk (*) denotes significant at 5% significance level. Critical values for ADF test for 5% significance level is –3.42. The null hypothesis is that series are unit root.

Table 5. Johansen Maximum Likelihood Cointegration Test Results

			Critical Values	
Null	Alternative	Eigenvalue	95%	90%
$r = 0$	$r = 1$	16.24	21.3	19.0
$r \leq 1$	$r = 2$	1.97	14.6	12.8
$r \leq 2$	$r = 3$	0.08	8.1	6.7
		Trace test		
$r = 0$	$r \geq 1$	18.30	31.3	28.4
$r \leq 1$	$r \geq 2$	2.05	17.8	15.6
$r \leq 2$	$r = 3$	0.08	8.1	6.7

Note: The null hypothesis is that the series are not cointegrated. The results indicate that there is no long-run price relationship among the cotton exchanges.

Table 6. Augmented Dickey-Fuller (ADF) and Phillips-Person (PP) Cointegration Tests Results for the ICE, NYCE and LCE's Cotton Prices

Proper cointegration Equation	ADF	PP
A. Bivariate system		
ICE and NYCE	-2.559	-3.2475
ICE and LCE	-2.619	-3.3845
NYCE and LCE	-1.853	-2.9729
B. Multivariate system		
ICE, NYCE and LCE	-2.622	-3.3953

Notes: Critical value at 10% significance level for ADF and PP for Bivariate system is –3.04
Critical value at 10% significance level for ADF and PP for multivariate system is –3.45.
The null hypothesis is that residuals provided from OLS regression are unit root.

Table 7. Multivariate Autoregressive Models for the ICE, NYCE and LCE's Cotton Prices

Independent Variable	Model		
	ICE	NYCE	LCE
Intercept	0.033	-0.018	0.009
	(0.667)	(-0.388)	(0.537)
ICE	0.065	0.024	0.009
	(1.546)	(0.604)	(0.603)
NYCE	0.014	-0.184*	0.122*
	(0.317)	(-4.162)	(7.397)
LCE	0.092	-0.051	-0.121*
	(0.797)	(-0.466)	(-2.959)
R-square	0.008	0.037	0.112

Notes: t-values are given in parentheses. Asterisk (*) indicates significance at the 0.05 level.

Table 8. Holmes Hutton Pairwise Causality Test Results for the ICE, NYCE and LCE's Cotton Prices

Dependent	Causal	Coefficient	t-value	Causal inference
ICE	NYCE	0.019	0.469	No causality
	LCE	-0.11	-0.169	No causality
NYCE	ICE	0.045	0.837	No causality
	LCE	-0.055	-0.831	No causality
LCE	ICE	0.042	1.324	No causality
	NYCE	0.025	1.362	No causality

Table 9. Holmes Hutton Multivariate Causality Test Results for the ICE, NYCE and LCE's Cotton Prices

Independent Variable	Model		
	ICE	NYCE	LCE
Intercept	-0.012	-0.184	0.77
	(-0.01)	(-0.134)	(1.093)
ICE	0.027	0.046	0.011
	(0.600)	(0.054)	(0.383)
NYCE	0.020	-0.0062	0.309*
	(0.489)	(-0.132)	(12.767)
LCE	-0.015	-0.048	-0.17*
	(-0.233)	(0.66)	(-4.472)
R-square	0.001	0.002	0.270

Notes: t-values are given in parentheses. Asterisk (*) denotes significant at the 0.05 level.

Chapter III

TESTING WEAK-FORM MARKET EFFICIENCY HYPOTHESIS: EVIDENCE FOR THE ISTANBUL STOCK EXCHANGE

Abstract

The Marketing Efficiency Hypothesis (EMH) for the Istanbul Stock Exchange (ISE) was tested using ISE's composite, industrial, and financial index weekly closing prices. The results obtained from four different tests indicate that all three series are weak-form efficient.

Keywords: Istanbul Stock Exchange, weak-form efficiency

Introduction

Osborne (1959) argued that if stock exchanges were efficient then the returns on a stock would be unpredictable from previous price changes. There has been considerable subsequent attention on testing the efficient market hypothesis (EMH), usually by testing whether stock prices follow a random walk process. The conclusion from these studies are inconsistent depending on the data or the method used. As indicated by Lo and MacKinlay (1988), even after three decades of research, economists have not yet reached a consensus about whether markets especially financial markets are efficient.

The findings from the empirical testing of efficient market (random walk hypothesis) have been mixed, either indicating that stock price do follow random walk or not. Early studies by Working (1960), Samuelson (1965) and Fama (1965) examined market efficiency and could not reject the null hypothesis of a random walk. On the other hand, several studies using tests for serial dependence have rejected the random walk model (e.g., Niederhoffer and Osborne, 1966; Fama 1976; Fama and French, 1988; Lo and MacKinlay, 1988)

After Lo and MacKinlay (1988) found that the stock prices do not behave according to the random walk hypothesis by using the U.S. stock prices, many researchers have mostly focused on testing the efficient market hypothesis for different stock markets in the world. The presence or absence of random walk properties has important implications for potential stock trading and asset pricing models. Lo and MacKinlay (1988) provide evidence that stock prices do not follow a random walk using

a variance ratio test. Their results indicate that the random walk model is generally not consistent with stochastic behavior of weekly returns, especially for the smaller capitalization stocks.

Poterba and Summers (1988) argued that there is little theoretical basis for strong attachment to the null hypothesis that stock prices follow a random walk. Poterba and Summers, using a variance ratio test showed that developed capital markets' stock returns, exhibit positive autocorrelations over short horizons and mean reversion over long horizons. Fama and French (1987) also showed that long holding period returns are significantly negatively serially correlated (mean reversion), implying that 25 to 40 percent of the variation of longer horizon returns is predictable from past returns. On the other hand, Shiller (1989) indicated that there are reasons that the random walk behavior of stock prices should hold and there is plenty of evidence suggesting that stock prices do follow a random walk.

Stock market efficiency implies that prices respond quickly and accurately to the relevant information. In contrast, as indicated by Schwartz, weak form efficiency does not require that price changes (returns) be strictly independent over time. Rather, price changes are expected to exhibit upward drift, because risk averse investors demand a positive expected return. When the expected value of a stock's price change is zero, and when successive price changes are statistically independent and identically distributed, the security's price follows a random walk over time.

Harvey (1993) stated that stock returns of emerging countries are highly predictable and have low correlation with stock returns of developed countries. He concludes that emerging markets are less efficient than developed markets and that higher

return and low risk can be obtained by incorporating emerging market stocks in investors' portfolios. Even though some studies (i.e. D'Ambrosio, 1980; Urrutia, 1995; Balaban, 1995a, 1995b; Kawakatsu and Morey 1999; Grieb and Reyes, 1999) support Harvey's statement about nonrandomness of emerging markets' stock prices, some other studies related to these markets (i.e. Dockery and Vargari, 1997; Liu et al., 1997) contradict this statement. The studies carried out for emerging-market stock prices indicate that these market prices have been far away from concluding that these markets are less efficient and prices are highly predictable.

Summers (1986) indicates that certain types of inefficiency in market valuations are not likely to be detected using standard methods. According to Summers, failing to reject the hypothesis of efficiency should not lead someone to conclude that market prices represent rational assessment of fundamental valuations. He also pointed out that most tests have relatively little power against certain types of market inefficiency.

The above discussion points to a conflicting response to the question of whether emerging markets' stock prices do follow a random walk hypothesis. It is also matter that the conflicting results might be because of the methodologies used in these studies. If stock price movements are more complicated than the random walk model suggests, it will take more sophisticated techniques to explain them. However many of the traditional approaches such as the runs test and serial correlation that also do not reject the randomness of ISE's indexes may have assumptions that are too restrictive to capture the pattern of the price behavior. The test results for serial dependence of ISE's stock indexes are presented in Table 8.

This study tests informational efficiency of the Istanbul Stock Exchange (ISE) to fill the gap in the literature for ISE stock indexes by applying more robust statistical techniques to the composite, financial and industrial indexes for the period of 1992-1999. A number of random walk tests are performed for weak-form efficiency. To determine if the conclusions are fragile with respect to the method used, Lo and MacKinlay (LOMAC) variance ratio test developed by Lo and MacKinlay (1988), rank and sign based variance ratio test proposed by Wright (2000), Geweke Porter-Huddak (GPH) test, and augmented Dickey Fuller tests are used to test random walk hypothesis for Istanbul Stock Exchange indexes.

Balaban (1995a, 1995b) tested weak form market efficiency for the ISE composite index over 1988-1994 using both parametric and nonparametric random walk tests. His findings from both tests suggest that the Istanbul Stock Exchange is neither weak-form nor semi-strong form efficient if daily and weekly data are used. His conclusion about weak form efficiency of ISE contradicts the results of Alparslan's (1989) study suggesting that ISE is weak-form efficient.

In their study Kawakatsu and Morey (1999) tested the random walk hypothesis for 31 emerging stock markets including Turkey using a variance ratio test, DF-GLS test and KPSS test. Their data period used in the study for Turkey was from 1987 to 1997. Their findings indicate that Turkish stock price index behaves like a random walk in the small lags (lag 2) and then becomes non-random with an increase in the number of lags (lags 6 and 12). They also tested randomness of stock indices by using DF-GLS unit root tests (Elliott, Rothenberg, and Stock, 1996), and KPSS test proposed by Kwiatkowski,

Phillips, Schmidt, and Shin (1992), and they fail to reject the randomness of Turkish stock price index.

Despite the conclusive studies of researchers investigating the efficient market hypothesis (EMH) in developing countries in weak-form (Fama and Blume, 1996; Zarovin, 1990), many studies conducted in such markets are inconclusive. Panas (19900 tested for weak form efficiency of the Greek stock market and concluded that the EMH cannot be rejected for Greece. Butler and Malaikah (1992) compared Kuwaiti and Saudi stock markets and concluded that, unlike the Kuwaiti market, the Saudi market exhibited considerable serial dependence.

D'Ambrosio (1980) examined the Singapore Stock Exchange indices to test market efficiency. He found that three indices, industrials, hotels, and tins do not behave in a manner consistent with a random walk. He indicated that although the indices may be representative in the sense that they are microcosms of all shares traded both the size and trading activity possibly explained the nonrandom character of some indices. Urrutia (1995) tested the random walk hypothesis in securities' prices using a variance ratio test for stock indexes from Latin American countries. His findings support the mean aversion in index returns for Argentina, Brazil, Chile, and Mexico. Grieb and Reyes (1999) re-examined the presence of a random walk in stock prices in Brazil and Mexico using the variance ratio test. Their results are also consistent with Urrutia's findings that these two markets' equity indexes indicate a mean aversion. Grieb and Reyes, and Urrutia's findings are also consistent with the Lo and MacKinlay (1988) study of U.S securities in which they found mean aversion for U.S. stock indexes. Dockery and Vergari (1997) tested the random walk hypothesis using a variance ratio test for an emerging market, the

Budapest stock exchange. Their findings showed that the Budapest stock exchange is a random walk market. Liu et al. (1997) examine Chinese stock markets, Shanghai and Shenzhen Stock Exchanges whether they are efficient using Augmented Dickey-Fuller unit root test. Their findings suggest that both stock exchanges are individually efficient and they are characterized as random walk processes.

The Istanbul Stock Exchange

After starting a financial liberalization program in Turkey during the beginning of 1980, Istanbul Securities Exchange (ISE) was established in 1986 as a part of this financial liberalization, which induced a structural change from a governmental-regulated system to a more market oriented system (Muradoglu and Unal, 1994). Istanbul Stock Exchange (ISE) is an emerging market according to definition of International Finance Corporation (IFC).

The ISE is the only securities exchange in Turkey established to provide trading in equities, bonds and bills, revenue-sharing certificates, private sector bonds, foreign securities and real estate certificates as well as international securities. According to Salman (1999), the ISE is ranked within the top ten developing markets of the world and ranked eighth in Europe in terms of volume. Salman indicated that the ISE ranked beyond the Oslo, Brussels, Copenhagen, and Madrid and competes with Amsterdam, Milan and Stockholm Stock Exchanges in terms of daily turnover.

As indicated by Kawakatsu and Morey (1999), most emerging market countries have changed their laws to allow foreigners to invest legally in their markets. The ISE also provides a trading environment not only for domestic participants but also for foreign issues and investors. Kawakatsu and Morey (1999) stated that as a result of the

financial liberalization, flow of foreign portfolio investment into emerging markets has increased dramatically. Since Turkey has had one of the more liberalized foreign exchange regimes, and there is no restriction on foreign investors who want to participate, foreign ownership of shares has increased and reached 3 billion U.S. dollars which is almost half of the shares in the ISE (Salman).

Average daily trading volume in 1998 reached up to 474 million U.S. dollars, bond and bill markets up to 1.76 billion U.S. dollars. The number of companies whose stocks traded in exchange reached from 110 in 1990 to 279 in 1999.

The ISE is a full member of the Federation Internationale des Bourses de Valeurs (FIBV), federation of Euro-Asian Stock Exchanges (FEAS), International Securities Services Association (ISSA), International Securities markets Association (ISMA), European Capital Markets Institute (ECMI), World Economic form (WEF) and Swiss Commodities, futures and Option Association (SCFOA).

Efficient Market Hypothesis

According to Fama (1970, 1991), an efficient market is one that accurately incorporates all known information in determining price. This definition is known as the efficient market hypothesis (EMH). Although there is considerable disagreement about whether EMH holds, it is the dominant paradigm for doing research on financial markets. In efficient financial markets, asset prices adjust instantaneously to reflect new information. Instantaneous adjustment eliminates the possibility of predicting future prices using only past prices. Hence, the possibility of earning systematic excess profits is also eliminated. There are three conditions that are necessary for a market to be informationally efficient. First, information must be costless, and it must be available to

all market participants at the same time. Second, there can be no transaction cost, taxes, or other barriers to trading. Third, prices cannot be affected by the trading of a single person or institutions. However, as indicated by Zulauf and Irwin (1997), at least two assumptions are unrealistic. These are existence of transaction costs and costly information. If information is costly, it is impossible for prices to perfectly reflect all available information (Zulauf and Irwin). In their study, Grossman and Stiglitz (1980) argued that the notion of market efficiency is inconsistent with the reality of costly arbitrage and showed that costless information is both necessary and sufficient for to fully reflect all available information. These two assumptions are also not likely true for Turkey.

Without advent of online trading, power and influence are in the hands of institutions that dominate the market in Turkey. These institutions have superior access to resources and the individual is at the mercy of the brokerage houses. Individuals can not receive the new information instantaneously. Transaction costs are also high because of lack of online trading resources. Without better trading resources and low commissions, traders and investors can not capitalize on potential anomalies.

The assumptions of perfect capital markets are sufficient conditions for the market to be efficient, but not necessary conditions. The existence of market imperfection such as transaction costs, costly information, and heterogeneous beliefs among investors are not necessarily source of market inefficiency, they are only potential sources. On the other hand, even if stock prices deviate significantly from the random walk process, market participants may not have profitable trading opportunities by acting

on the deviations because of market frictions. In this case, it is possible to reject the random walk model without rejecting the notion of market efficiency.

There are three different forms of informational efficiency in stock markets. These are weak form, semi-strong form, and strong form efficiency. All three forms of efficiency under efficient market hypothesis (EMH) depend on information sets of investors. Weak-form efficiency basically asserts that one cannot use past price changes to achieve abnormal profits ignoring transaction costs. Since stock prices do follow a random walk, past prices have nothing to do with future prices. As indicated by Muradoglu and Unal (1994), in weak form inefficient markets, it is possible to earn abnormal profits by incorporating with the information contained in past changes. Semi-strong form efficiency enhances information set to include all publicly available information is quickly incorporated to stock prices to prevent investors trading on this piece of information from extra profits in a stock market. According to strong-form efficiency, stock prices reflect all information whether publicly available or not. Strong –form efficiency implies semi-strong efficiency implies weak-form efficiency. However, the reverse is not correct.

The market efficiency hypothesis is associated with the idea of a "random walk", a term used in the finance literature to characterize a price series in which all price changes represent random departures from previous prices. This implies that successive price changes are an independent incremental process, the past price series is of no use in forecasting future changes in the series. Fama (1970) argued that efficient markets are those that do not allow consistent abnormal rates of return which indicates that past prices do not contain valuable information about future prices. In addition, it was usually

assumed that successive returns are identically distributed. These two hypotheses together constitute the random walk model. The major concepts underlying the EMH is simply defined by Zualauf and Irwin as follows:

$$P_{t+1} = \alpha + \beta P_t + \varepsilon_t \qquad (1)$$

where P_{t+1} is the price at time $t+1$, P_t is the current price , α and β are parameters, and ε_t is a random error term that is independently and identically distributed with mean 0 and constant variance σ^2. For the return of the price series, the statement says

$$f(r_{j,t+1} \mid \Phi) = f(r_{j,t+1}), \qquad (2)$$

which indicates that the conditional and marginal probability distribution of an independent random variable are identical. In addition, the density function *f* must be for all t. In equation (2),

$r_{j,t+1}$ is the one-period percentage change return $(p_{j,t+1} - p_{jt})/p_{jt}$,

Φ_t is a general symbol for whatever set of information is assumed to be "fully reflected" in the price *t*,

p_{jt} is the price of security *j* at time t; $p_{j,t+1}$ is its price at *t+1*..

To have more understanding EMH, equation 1 can be rearranged as follows:

$$P_{t+1} - \beta P_t = \alpha + \varepsilon_t \qquad (3)$$

if $\alpha = 0$ and $\beta = 1$, then

$$P_{t+1} - P_t = \varepsilon_t \qquad (4)$$

taking the expectation of equation 4 yields

$$E_t(P_{t+1} - P_t) = 0 \qquad (5)$$

The price process described above is usually referred to as a random walk (Lo and MacKinley). The expected average change in price is zero. In addition, because the ε_t' s are uncorrelated, changes in prices are uncorrelated.

The concluding results from some studies, related to EMH indicate that there are departures from the efficient market hypothesis in terms of positive (mean aversion) and negative serial correlation (mean reverting) between successive price returns. Poterba and Summers (1988) defined mean reversion as follows: "If market and fundamental values diverge, but beyond some range the difference are eliminated by speculative forces, then stock prices will revert to their mean." This definition tells us that stocks with low returns today tend to have high return in the future, and vice versa, and indicates that there will be predictable positive changes in the future price, suggesting that stock prices are not a random walk.

Data and Estimation

To test random walk in stock market prices, 396-week time span from 1992-1999 were used. The trend of price index series are shown in Figure 1. The choice of a weekly observation interval was determined by following two considerations. First, D'Ambrosio (1980) stated that even though the indices may be representative, lack of trading activity in markets those have relatively inactive trading compared with U.S. stock exchanges, may produce nonrandom characteristics. Second, Lo and MacKinlay (1988) quoted that while daily sampling yields many observations, the biases associated with nontrading, the bid-ask spread, asynchronous prices, etc., are troublesome. They stated that weekly sampling is the ideal compromise, yielding large number observations while minimizing the biases inherent in daily price data.

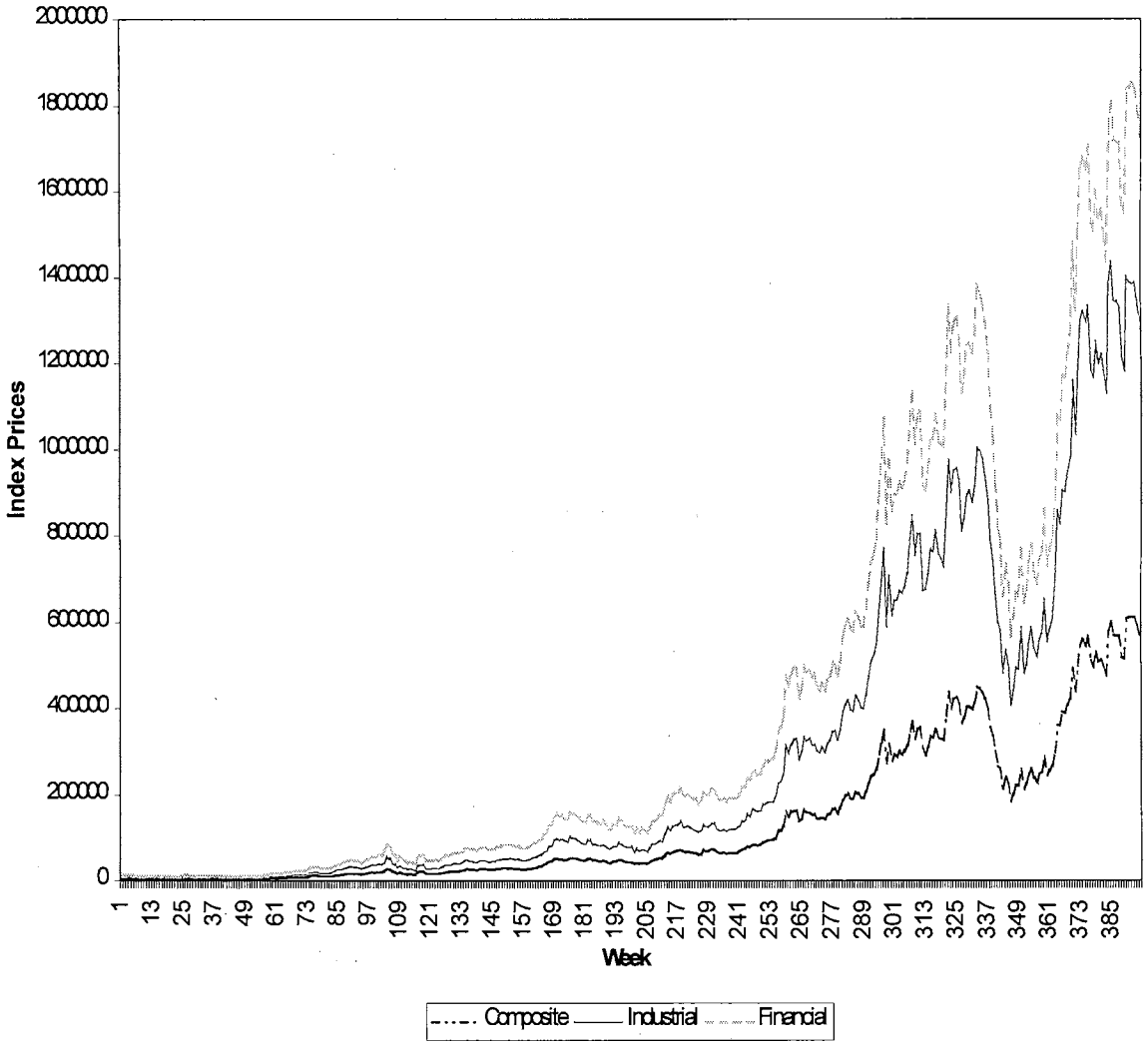

Figure 1. Weekly prices of composite, industrial and financial indexes (1992-1999) (1,000 Turkish Liras)

The weekly prices for the composite index which is an equally weighted index calculated by the ISE, financial and industrial indexes were derived from the Central Bank of Republic of Turkey' data bank. The weekly indexes of each index are computed as the price index from Wednesday's closing price to the following Wednesday's close. If the following Wednesday price is missing, then Thursday's price (or Tuesday's if Thursday's is missing) is used. If both Tuesday's and Thursday's prices are missing, the return for that week is reported as missing.

Testing for Random Walk Hypothesis

Many researchers have used unit root tests of Dickey-Fuller (1981) and the 'white noise' tests of Box-Pierce and Ljung-Box in testing the randomness of stock prices. Recent studies, however, use tests more sensitive to random walk, and cast doubt on the accuracy of past methods. In this study, Augmented Dickey Fuller, the GPH tests, LOMAC variance ratio tests, and Rank and Sign based variance ratio tests were used to test the efficient market hypothesis (EMH) for Istanbul Stock Exchange.

Augmented Dickey Fuller Test

The augmented Dickey-Fuller (ADF) unit root testing procedure (Dickey and Fuller, 1979) is used to test the null hypothesis of a unit root. The presence of a unit root is a necessary condition for a random walk. The following regression is formed and estimated for each series:

$$\Delta X_t = \alpha_0 + \beta X_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta X_{t-1} + \varepsilon_t \qquad (6)$$

where Δ represents first differences. While in standard D-F test $k = 0$, in ADF test, the length of k is defined to be large enough to achieve a white-noise structure in ε_t. The

Akaike Information Criterion (AIC) was used to find the lag length. The test statistic is the ratio of $\hat{\beta}$ to its calculated standard error obtained from an ordinary least squares (OLS) regression. The null hypothesis is $H_0 : x_t \sim I(1)$ which means nonstationary or random walk. This null hypothesis corresponds to $\hat{\beta}$ equal to zero. The null hypothesis is rejected if the t statistic is larger than the critical value τ_1. However, the test-statistic does not have a *t*-distribution but tables of significance levels have been provided by MacKinnon (1990).

Geweke and Porter-Huddak Fractional Integration Test

Diebold and Rudebusch (1991) observed that standard unit-root tests such as the Dickey-Fuller test may have low power against fractional alternatives. Using a simulation approach, Cheung and Lai measured the power of the GPH test against a conventional unit root test and they showed that the GPH test performs at least as well as the Augmented Dickey Fuller test against the other unit root tests. To allay any possible concerns about the other tests used in the study, a semi-nonparametric test was employed to corroborate the Dickey-Fuller, LOMAC, Rank and Sign-based variance ratio tests results. Geweke and Porter-Huddak (GPH) (1983) proposed a semi-nonparametric procedure that can be used to test for a random walk.

A fractionally integrated series y_t can be identified from its spectral density $f_y(w)$, which behaves like w^{-2d}, as $w \to 0$. For $d > 0$, $f_y(w)$ is unbounded at frequency $w = 0$, rather than bounded as a stationary ARIMA series (Cheung and Lai). Geweke and Porter-Huddak used this relationship to develop a procedure to estimate fractional integration behavior.

In general form the fractional integration equation can be written as:

$$(1-B)^{d} Y_t = e_t \tag{7}$$

where Y_t is a first-differenced stationary stock return series; B is the backshift operator, and d is a fractional integration parameter also called the memory parameter; $(1-B)^{d}$ is the fractional integration operator; and e_t is a stationary process with the usual spectral density function $f_e(w)$. The parameter d is usually restricted to integer values in the classical time series models, such as the autoregressive integrated moving average (ARIMA) models. GPH relaxes that restriction and allows for fractional values of d.

The GPH estimation procedure relies on OLS regression:

$$\ln\left[I(w_j)\right] = c - d\ln\left[4\sin^2(w_j/2)\right] + \zeta_j, \quad \forall_j = 1,\ldots,n \tag{8}$$

where c and ζ_j are equal to $\mathrm{Log}(\sigma^2 f_u(0)/2\pi)$ and $\log[I(w_j)/f(w_j)]$, respectively. For $w = 2\pi j/T \quad (\forall_j = 1,\ldots,T-1)$, $n = g(T) < T$, where $I(w_j)$ is the periodogram of X at frequency w_j defined by

$$I(w) = \frac{1}{2\pi T}\left|\sum_{t=1}^{T} e^{itw}(X_t - \bar{X})\right|^2 \tag{9}$$

There is evidence of fractional integration if $\hat{d}$, the least squares estimate of d, is significantly different from zero. With a proper choice of n, the asymptotic distribution of $\hat{d}$ depends on neither the order of the ARMA part or the distribution of the error term. Geweke Porter-Huddak suggests to set $n = T^{0.5}$ and use the known variance of ζ_j, $\pi^2/6$, to compute the sample variance of $\hat{d}$. A choice must be made of the number of harmonic ordinates to be included in the spectral regression. If too few ordinates are included, the slope is calculated from small sample. If too many are included, medium and high-

frequency components of the spectrum will contaminate the estimate. A choice of root (T), or power 0.5 is often employed. To evaluate the robustness of the GPH estimates, a range of power values (from 0.5 – 0.65) is commonly calculated as well.

Lo and MacKinlay Single Variance-Ratio Test

Lo and MacKinlay (LOMAC) (1988) developed variance ratio tests for random walk. Their test was used to test the stochastic behavior of macroeconomic aggregates such as GNP, stock prices, equity returns and exchange rate series.

Let Y_t denote a stochastic process satisfying the following recursive relation:

$$Y_t = \mu + Y_{t-1} + \varepsilon_t, \qquad E[\varepsilon_t] = 0, \text{ for all } t, \tag{10a}$$

or

$$\Delta Y_t = \mu + \varepsilon_t, \qquad \Delta Y_t = Y_t - Y_{t-1}, \tag{10b}$$

where the drift μ is an arbitrary parameter. The essence of the random walk hypothesis is that the disturbances ε_t are serially uncorrelated. Lo and MacKinlay developed their test under two null hypotheses which capture this aspect of the random walk which is independently and identically distributed Gaussian increments.

Liu and He (1991) stated that the variance ratio test-statistic, a z-statistic developed by Lo and MacKinlay is unique for the following two reasons. First, after deriving an asymptotic distribution of the variance-ratio, the z-statistic is developed by comparing the sample variance-ratio with the asymptotic variance of this variance ratio, which hence provides an asymptotic standard normal test statistic for the variance ratio. Second, the refined z* statistic, which is heteroskedasticity-consistent and able to use overlapping data, allows a more efficient and powerful test. Lo and MacKinlay (1989)

indicated that under heteroskedasticity random walk null, this variance ratio test is more powerful than both the Dickey-Fuller t and the Box-Pierce Q-test (Portmanteau) tests.

The idea behind the LOMAC variance ratio test is that if the natural logarithm of a time series Y_t is a pure random walk, the variance of its $q-$differences grows proportionally with the difference q. In other words, if a series follows a random walk process, the variance of its $q-$differences would be q times the variance of its first differences. Therefore, if we obtain $nq+1$ index observations $Y_0, Y_1, Y_2, \ldots, Y_{nq}$ at equally spaced intervals (where q is any integer greater then one), the ratio of $1/q$ of the variance $Y_t - Y_{t-q}$ to the variance of $Y_t - Y_{t-1}$ would be equal to one. The variance-ratio, $VR(q)$, is defined as:

$$VR(q) = \frac{\sigma^2(q)}{\sigma^2(1)} \tag{11}$$

where $\sigma^2(q)$ is $1/q$ the variance of the $q-$differences and $\sigma^2(1)$ is the variance of the first differences. The null hypothesis that the ratio of variance:

$$VR(q) = \sigma_q{}^2 / q\sigma_1{}^2(q) = 1.0$$

The following formulas for calculating $\sigma^2(q)$ and $\sigma^2(1)$ are taken from Lo and MacKinlay (1988):

$$\sigma^2(q) = \frac{1}{m}\sum_{t=q}^{nq}\left(Y_t - Y_{t-q} - q\,\hat{\mu}\right)^2 \tag{12}$$

where

$$m = q(nq - q + 1)\left(1 - \frac{q}{nq}\right)$$

and

$$\sigma^2(1)=\frac{1}{(nq-1)}\sum_{t=1}^{nq}(Y_t-Y_{t-1}-\hat{\mu})^2 \tag{13}$$

where

$$\hat{\mu}=\frac{1}{nq}(Y_{nq}-Y_0)$$

Y_0 and Y_{nq} are the first and last observations of the time series.

Lo and MacKinlay (1988) also derive asymptotic standard normal test statistic for their variance-ratio. The modified test statistics presented below is from Liu and He (1991). The first test statistic, $z(q)$, is developed under the maintained hypothesis of homoskedasticity:

$$z(q)=\frac{VR(q)-1}{[\phi(q)]^{1/2}} \sim N(0,1) \tag{14}$$

where

$$\phi(q)=\frac{2(2q-1)(q-1)}{3q(nq)} \tag{15}$$

The second test statistic, $z^*(q)$, is robust to heteroskedasticity:

$$z^*(q)=\frac{VR(q)-1}{[\phi(q)]^{1/2}} \sim N(0,1) \tag{16}$$

where

$$\phi^*(q)=\sum_{j=1}^{q-1}\left[\frac{2(q-j)}{q}\right]^2\hat{\delta}(j) \tag{17}$$

and

$$\hat{\delta}=\frac{\sum_{t=j+1}^{nq}(Y_t-Y_{t-1}-\hat{\mu})^2(Y_{t-j}-Y_{t-j-1}-\hat{\mu})^2}{\sum_{t=1}^{nq}[(Y_t-Y_{t-1}-\hat{\mu})^2]^2} \tag{18}$$

Rank and Sign-Based Variance-Ratio Tests

Wright (2000) proposed an alternative test for standard variance ratio tests using ranks and signs. Wright indicates that tests based on ranks have two potential advantages. First, it is often possible to compute their exact distributions since there is no need to make any asymptotic approximation, and there is no size distortion effect when the rank test is used. Second, the test may be more powerful than alternative tests if the data are highly nonnormal.

Wright considers the model in which y_t is a time series of asset returns such that $y_t = \mu + z_t$ and $z_t = \sigma_t \varepsilon_t$. He introduced the following assumptions in the model by letting $I_t = \{y_t, y_{t-1}, y_{t-2}, \ldots\}$. First, z_t is iid. Second, σ_t and ε_t are independent, conditional on I_{t-1}. Third, $E(\varepsilon_t \setminus I_{t-1}) = 0$ and 1 $(\varepsilon_t > 0)$ is iid binomial variable that is 1 with probability ½ and 0 otherwise. The model is as follows:

Let $r(y_t)$ be the rank of y_t among $y_1, y_2, \ldots, y_T$.

Define

$$r_{1t} = \left(r(y_t) - \frac{T+1}{2} \right) \Big/ \sqrt{\frac{(T-1(T+1)}{12}} \tag{19}$$

$$r_{2t} = \Phi^{-1}(r(y_t)/(T+1)) \tag{20}$$

where Φ is the standard normal cumulative distribution function. According to Wright, even though there are many transformations of the ranks of a series that are used to construct nonparametric rank test, r_{1t} and r_{2t} are the most common. The series r_{1t} is a simple linear transformation of the ranks, standardized to have sample mean 0 and sample variance 1. The series r_{2t}, known as the inverse normal or van der Wearden scores has sample mean 0 and sample variance approximately equal to 1.

The rank-based variance-ratio tests was performed by substituting r_{1t} and r_{2t} in place of y_t in the LOMAC variance ratio test statistic. The proposed tests by Wright:

$$R_1 = \left(\frac{\frac{1}{Tk}\sum_{t=k+1}^{T}(r_{1t} + r_{1t-1} + \cdots + r_{1t-k})^2}{\frac{1}{T}\sum_{t=1}^{T} r_{1t}^{\,2}} - 1 \right) \mathrm{X} \left(\frac{2(2k-1)(k-1)}{3kT} \right)^{-1/2} \qquad (21)$$

and

$$R_2 = \left(\frac{\frac{1}{Tk}\sum_{t=k+1}^{T}(r_{2t} + r_{2t-1} + \cdots + r_{2t-k})^2}{\frac{1}{T}\sum_{t=1}^{T} r_{2t}^{\,2}} - 1 \right) \mathrm{X} \left(\frac{2(2k-1)(k-1)}{3kT} \right)^{-1/2} \qquad (22)$$

under the hypothesis that y_t is iid, $r(y_t)$ is just a random permutation of the numbers $1, 2, \ldots, T$, each with equal probability, giving the distribution of the test statistics. Wright (2000) provided the 2.5 and 97.5 percentiles of the null distribution of R_1 and R_2 for different levels of T and k.

Wright also proposed modified variance ratio tests by using the signs of returns, rather than their ranks. For any series y_t, let $u(y_t, q) = 1(y_t > q) - 0.5$. So $u(y_t, 0)$ is $\frac{1}{2}$ if y_t is positive and $-\frac{1}{2}$ otherwise. Let $s_t = 2u(y_t, 0) = 2u(\varepsilon_t, 0)$. s_t is an iid series with mean 0 and variance 1. Each s_t is equal to 1 with probability $\frac{1}{2}$ and is equal to -1 otherwise. Wright defined the variance ratio statistic using s_t as

$$S = \left(\frac{\frac{1}{Tk}\sum_{t=k+1}^{T}(s_t + s_{t-1} + \cdots + s_{t-k})^2}{\frac{1}{T}\sum_{t=1}^{T} s_t^{\,2}} - 1 \right) \mathrm{X} \left(\frac{2(2k-1)(k-1)}{3kT} \right)^{-1/2} \qquad (23)$$

Empirical Results

In this study, Istanbul Stock Exchange (ISE) composite, financial and industrial indexes weekly prices were used to test the random walk hypothesis. The data sample obtained from the central bank of the Republic of Turkey covers January 1992 to December 1999.

The Augmented Dickey-Fuller test was used with both levels and first difference natural logarithms of the stock-price indices to test whether the Istanbul Stock Exchange composite, industrial and financial indexes are nonstationary which is a necessary condition for a random walk. ADF tests were performed by including constant, and including both constant and a linear trend in the model. The presence of a time trend was tested using the *t* statistics. Table 3 reports the statistics derived from the ADF test. The ADF statistics indicate that all three price indexes have one unit root but not two and thus the necessary condition for a random walk is met.

Table 4 reports the results of the GPH test on the first-differenced price return series for the three indexes. The estimation of the fractional integration parameter, *d*, is given in the main row while the asymptotic t-ratios for the null of a random walk against the alternative of long memory are in parentheses. The GPH test statistics confirm the results obtained from the ADF test and indicate that for all three series examined the hypothesis of a unit root cannot be rejected. Some evidence of long memory is obtained for the industrial and financial index series but it is robust to sample size of the spectral regression considered.

The result of the LOMAC variance ratio test for ISE with homoskedasticity-consistent variance – ratios are presented in Table 5. The random walk hypothesis was

not rejected for all financial, industrial, and composite indexes. In effect, almost all of the variance-ratios are statistically higher than or equal to one in all lags indicating that there is no evidence of mean reversion in the series. Variance-ratios equal to 1 indicate that the variances grow proportionally with time.

Further investigation of the time behavior of stock prices for ISE, a heteroskedasticity-consistent variance ratio test with the statistic $z^*(q)$ was used. The results for variance ratios allowing heteroskedasticity are presented in Table 6. The null of a random walk again was not rejected with all indexes in the ISE. In general, the results are robust to heteroskedasticity. The results obtained from both homoskedastic and heteroskedasticty-consistent variance – ratios are consistent with the results of both ADF and GPH tests indicating that the series are a random walk.

The test statistics for rank and sign based variance ratio tests are given in Table 7. For these series, most of the test statistics are not significant even at the 10 percent significance level, but in all series, there are some values of k for which $R1$, $R2$ and S tests rejected the null of a random walk. The results obtained using the rank-based variance ratio test are mixed. For composite index, $R1$ gives a much stronger rejection than $R2$ and S tests in which the random walk null hypothesis was rejected for all level of k, except $k=2$ in R2 test. For the industrial index, R1 and S variance ratio tests did not reject the null hypothesis of a random walk for all levels of k except $k=4$ in the R1 test. R2 test results are significant at 1% and 5% level of significance.

For the financial index all $R1$, $R2$ and S tests rejected null hypothesis of random walk for $k=2$, but levels for $k>2$ $R2$ and S test did not reject the null hypothesis of

random walk and results become more ambiguous. These inconclusive results, rejecting for some but not all values of k, were also obtained by Wright (2000).

Summary and Conclusions

In this paper, the random walk hypothesis for Istanbul Stock Exchange's composite, industrial and financial index prices is tested using four different tests to provide comparisons. These are Augmented Dickey Fuller unit root test (ADF), GPH fractional integration test developed by Geweke and Porter-Huddak (1983), LOMAC variance ratio test developed in Lo and MacKinley (1988) and modified variance ratio test using ranks and signs of the series, proposed in Wright (2000) over the period from 1992-1999.

The results obtained from the four different tests indicate that all three series are efficient (obey the random walk hypothesis) in terms of weak-form efficiency that means the movement of a variable whose future changes cannot be predicted. Using the ADF unit root test, LOMAC variance ratio tests and GPH test, the random walk hypotheses are not rejected decisively for composite, industrial and financial index prices.

With the rank and sign based variance ratio tests, it was concluded that it is not possible to reject the null hypothesis of random walk decisively because it yields ambiguous results for all three series.

The results obtained from this study support the study of Kawakatsu and Morey (1999) in which they failed to reject the randomness of the Istanbul Stock Exchange. It also supports Alparslan's (1989) study in which he also concluded that Istanbul stock exchange is weak form efficient. On the other hand, this study contradicts the results of Balaban's (1995a and 1995b) study in which he concluded that the Istanbul stock

exchange is neither weak form nor strong form efficient. The difference between this study and Balaban's study may be attributed to the different time span and statistical methods used in both studies.

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APPENDIXES

Table 1. Summary Statistics of the Istanbul Stock Exchange Composite, Financial and Industrial Daily and Weekly Price Indexes in 1,000 Turkish Liras (1996-1999)

Statistic	Daily Data			Weekly Data		
	Composite	Industrial	Financial	Composite	Industrial	Financial
Mean	133240.77	159234.28	111259.35	159065	111243	134563
Median	48202.80	40027.40	54142.20	40286	54216	49466
Shapiro-Wilk Test for Normality	0.772 (0.0001)	0.773 (0.0001)	0.821 (0.0001)	0.774 (0.0001)	0.735 (0.0001)	0.823 (0.0001)
Standard deviation	164191	217566	120034	216594	119637	165458
Skewness	1.333	1.405	1.0759	1.474	1.074	1.328
Kurtosis	0.657	1.089	-0.039	1.116	-0.029	0.641
Max	625206	837789	470809	836016	463488	610829
Min	2746	2091	3056	2156	3870	3141
NOBS	1934	1934	1934	396	396	396

Note: The p-values for Shapiro-Wilk statistic for normality test are given in parenthesis. The null hypotheses of normality are rejected for all series with daily and weekly data.

Table 2. Summary Statistics of the Istanbul Stock Exchange Composite, Financial and Industrial Daily and Weekly Index Returns in 1,000 Turkish Liras (1996-1999)

Statistic	Daily Data			Weekly Data		
	Composite	Industrial	Financial	Composite	Industrial	Financial
Mean	0.002	0.003	0.002	0.027	0.022	0.024
Median	0.002	0.002	0.002	0.026	0.018	0.023
Shapiro-Wilk Test for Normality	0.879 (0.0001)	0.845 (0.0001)	0.776 (0.0001)	0.976 (0.0001)	0.982 (0.0001)	0.971 (0.0001)
Standard deviation	0.033	0.039	0.036	0.116	0.100	0.107
Skewness	0.532	0.129	0.409	0.178	0.107	-0.087
Kurtosis	27.320	32.550	51.580	1.296	1.224	0.804
Max	0.464	0.483	0.484	0.423	0.418	0.337
Min	-0.361	-0.482	-0.474	-0.376	-0.281	-0.310
NOBS	1933	1933	1933	395	395	395

Note: The p-values for Shapiro-Wilk statistic for normality test is given in parenthesis. The null hypotheses of normality are rejected for all series with daily and weekly data.

Table 3. Augmented Dickey-Fuller (ADF) Unit Root Test Results for the Istanbul Stock Exchange Composite, Industrial and Financial Index Returns

	Composite	Industrial	Financial
LEVEL			
Constant	-0.394	-0.913	-0.767
Constant and linear trend	-2.700	-2.195	-3.481*
FIRST DIFFERENCE			
Constant	-5.603*	-4.690*	-4.390*
Constant and linear trend	-5.601*	-4.710*	-4.370*

Note: Critical values for ADF test for 5% significance level is –3.13 and for 10% is –2.57. Asterisk (*) denotes that the null hypothesis of one unit root was rejected.

Table 4. Geweke and Porter-Huddak Fractional Integration Test of Random Walk Hypothesis of the Istanbul Stock Exchange's Composite, Industrial and Financial Indexes

Index Series	$\tilde{d}(0.45)$	$\tilde{d}(0.50)$	$\tilde{d}(0.55)$	$\tilde{d}(0.60)$	$\tilde{d}(0.65)$	$\tilde{d}(0.70)$
Composite	0.624	0.245	0.200	0.065	0.141	0.104
	(1.018)	(0.174)	(0.156)	(0.020)	(0.119)	(0.079)
Industrial	0.866	0.105	0.110	0.010	0.116	0.089
	(1.732)*	(0.035)	(0.047)	(0.0005)	(0.080)	(0.058)
Financial	0.842	-0.016	-0.014	0.068	-0.001	-0.095
	(1.634)*	(-0.0008)	(-0.0007)	(0.023)	(-0.00005)	(-0.066)

Notes: $\tilde{d}(0.45)$, $\tilde{d}(0.50)$, $\tilde{d}(0.55)$, $\tilde{d}(0.60)$, $\tilde{d}(0.65)$, and $\tilde{d}(0.70)$ give the $\tilde{d}$ estimates corresponding to the GPH spectral regression of sample size, $n=T^{0.45}$, $n=T^{0.50}$, $n=T^{0.55}$, $n=T^{0.60}$, $n=T^{0.65}$, and $n=T^{0.70}$, respectively. The t-statistics are given in parentheses and are constructed using the known theoretical error variance of $\pi^2/6$. The superscripts ***, **, * indicate statistical significance for the null hypothesis $\tilde{d}=0$ against the alternative $\tilde{d}\neq 0$ at the 1, 5, and 10 percent levels, respectively. Rejection of null hypothesis suggests that the series is driven by long memory dynamic instead of the random walk process.

Table 5. Lo and MacKinlay (LOMAC) Variance Ratio Test Results for the Istanbul Stock Exchange Composite, Industrial and Financial Index Prices under Homoskedasticity Assumption

Indexes		Sampling interval (q) in weeks			
		2	4	8	16
Composite	VR(q)	1.013	1.047	1.091	1.125
	ϕ(q)	0.002	0.009	0.022	0.049
	Z(q)	0.267	0.505	0.612	0.565
Industrial	VR(q)	1.026	1.079	1.181	1.345
	ϕ(q)	0.002	0.009	0.022	0.049
	Z(q)	0.532	0.848	1.222	1.561
Financial	VR(q)	1.035	1.092	1.142	1.161
	ϕ(q)	0.002	0.009	0.022	0.049
	Z(q)	0.697	0.982	0.956	0.729

Notes: The variance ratio *VR(q)* is as defined in equation (11), $\phi(q)$ is asymptotic variance of the *VR* and *Z(q)* is the test statistic under homoskedasticity. The null hypothesis is that *VR(q)* = 1, meaning that the stock index follows a random walk process. The null hypothesis was not rejected for all three indexes.

Table 6. Lo and MacKinlay (LOMAC) Variance Ratio Test Results for the Istanbul Stock Exchange Composite, Industrial and Financial Index Prices under Heteroskedasticity Assumption

Indexes		Sampling interval (q) in weeks			
		2	4	8	16
Composite	VR(q)	1.013	1.047	1.091	1.125
	$\phi^*(q)$	0.007	0.025	0.058	0.118
	$Z^*(q)$	0.151	0.295	0.376	0.366
Industrial	VR(q)	1.026	1.079	1.181	1.345
	$\phi^*(q)$	0.012	0.037	0.078	0.155
	$Z^*(q)$	0.230	0.192	0.280	0.875
Financial	VR(q)	1.035	1.092	1.142	1.161
	$\phi^*(q)$	0.006	0.022	0.051	0.101
	$Z^*(q)$	0.457	0.625	0.629	0.504

Notes: $\phi^*(q)$ is asymptotic variance of the VR and $Z^*(q)$ is the test statistic under heteroskedasticity. The null hypothesis is that $VR(q) = 1$, meaning that the stock index follows a random walk process. The null hypothesis was not rejected for three indexes.

Table 7. Results of Ranks and Signs Based LOMAC Variance Ratio Test for the Istanbul Stock Exchange's Composite, Industrial and Financial Index Prices

Indexes	Statistic	Sampling Interval (q) in weeks			
		2	4	8	16
Composite	R1	4.975***	7.196***	2.038**	1.523
	R2	-2.887***	-0.017	-1.195	-1.195
	S	0.000	-0.115	0.512	0.295
Industrial	R1	-0.360	1.945*	-0.380	0.128
	R2	-7.259***	-0.522	-2.131**	-3.460***
	S	0.000	-0.124	1.095	0.578
Financial	R1	8.735***	6.012***	2.440**	1.241
	R2	2.867***	-0.581	-0.667	0.167
	S	2.842***	0.325	0.549	0.369

Notes: This table gives the values of the test statistics R1, R2, S for each index return series. The null hypothesis is that series are random walk. The test Statistics have three asterisk if significant at the 1% level, two stars if significant at 5% level, and one stars if significant at 10% level.

Table 8. Autocorrelation Coefficient and Box-Pierce Q Statistics for the Istanbul Stock Exchange Composite, Industrial and Financial Stock Index Returns

Lag	Composite	Industrial	Financial
1	0.005	0.019	0.025
2	0.036	0.034	0.054
3	-0.005	0.021	-0.009
4	0.004	0.004	0.015
5	0.035	0.055	0.016
6	0.024	0.037	0.010
7	-0.021	0.005	0.013
8	-0.070	-0.043	-0.051
9	0.089	0.133	0.034
10	-0.123	-0.107	-0.152
11	0.063	0.047	0.091
12	0.022	-0.007	0.019
13	-0.016	0.013	0.002
14	0.123	0.118	0.097
15	0.024	0.031	0.010
Ljung-Box Q (15)	20.99	14.90	20.10

Note: Critical value for chi-square test with 15 df and is 22.3 at 10% significance level. Since all test statistics are less than critical value, we cannot reject that the series are white noise.

VITA[v]

Cumhur BUGUK

Candidate for the Degree of
Doctor of Philosophy

Thesis: ESSAYS ON TURKEY'S WHEAT EXCHANGES, THE TURKISH COTTON MARKET INTEGRATION, AND EFFICIENCY OF THE ISTANBUL STOCK EXCHANGE

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Kibriscik, Bolu, the Republic of Turkey, July 20, 1969, the son of Irfan and Fatma.

Education: Graduated from Bolu Technical High School, Bolu, Turkey, July, 1987; received the Bachelor of Science degree in Agricultural Economics from Ankara University, Ankara, Turkey, in September 1991; received the Master of Science degree in Agricultural Economics from Texas Tech University, Lubbock, Texas, in August 1996; completed requirements for the Doctor of Philosophy degree in Agricultural Economics at Oklahoma State University, Stillwater, Oklahoma, in December 2000.

Professional Experience: Research Assistant, Department of Agricultural Economics, Gaziosmanpasa University, July 1993 to December 1993.