12-2007

The Firm Size, Farm Size, and Transaction Costs: The Case of Hazelnut Farms in Turkey

Ibrahim Demir
Clemson University, idemir@clemson.edu

THE FIRM SIZE, FARM SIZE, AND TRANSACTION COSTS: THE CASE OF HAZELNUT FARMS IN TURKEY

A Dissertation
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy
Applied Economics

---

by
Ibrahim Demir
December 2007

Accepted by:
Dr. Michael T. Maloney, Committee Chair
Dr. Robert D. Tollison
Dr. John T. Warner
Dr. Cotton M. Lindsey

ABSTRACT

This study analyzes the determinants of the size of the hazelnut farms in Turkey within the framework of the theory of firm and transaction costs. This study argues that, for a farm production function, land is a complex input with many transaction cost-increasing interactions with nature. Natural effects, such as land slope and variation in the weather conditions, can increase transaction costs. Transaction costs are the costs of using the inputs necessary for production. This study utilizes two separate data sets in order to test if the predicted relationship between transaction costs and farm size holds. The first data set explores the individual characteristics of hazelnut farmers. The second data set explores the regional farm characteristics across hazelnut production regions. Based on the OLS and IV estimation results, it is found that holding other factors constant higher land slope and higher variation in rainfall cause a decrease in the size of the hazelnut farms.

DEDICATION

To my wife Derya, our new son EmirHan Tolga, my parents Halit and Yildiz, my sister Ummuhan, and my brother Ali, who all supported me during my study, and the hazelnut growing people of the Black Sea coasts of Turkey.

ACKNOWLEDGEMENTS

This study started with Michael T. Maloney's curiosity about the incentive-guided behavior wherever it occurs. Dr. Maloney made this into a dissertation project from a commentary on the issues regarding storage costs within the petroleum choke industry. I owe special thanks to him for his endless support and advising during my study. Robert D. Tollison was generous and always there whenever I needed help. Special thanks go to him. I benefited a great deal from John T. Warner's comments on econometric estimations and the text itself. I also would like to thank Ismail Aktar, Ali Kabasakal, Fatih Savasan, and Raymond Lee for reviewing the text and helpful comments.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

Farms are firms. Their objective is to maximize profits and their input choices must be in accordance with this objective. For agricultural firms, land is a complex input with many interactions with nature that have crucial transaction costs and size implications. In this context, this study argues that holding input prices constant across the production sections, variation in transaction costs that come from natural effects determines the farm size.

Although nature has been taken as given or “unobservable” for ordinary production functions, and many farm production activities can be performed in conditioned environments with modern techniques that can isolate the effects of nature, the effects of nature on the farm production function and farm size should be explored. In this regard, this study finds that higher land slopes and greater weather variation lead to higher transaction costs and smaller size of hazelnut farms in Turkey.

Hazelnut farmers find smaller lands more efficient and this is not only due to the productivity of the lands but also due to transaction costs, monitoring, and contractual issues. Therefore, even though this has been the common approach to the issue, farm size is not only about factor productivity (FP) of land but also total factor productivity (TFP) and profitability. That is, the costs of a productive resource should include relevant transaction costs in decision making. When the transaction costs are taken into account, farmers prefer to own lands in size that they can handle by themselves with little or no outside hiring due to high monitoring and contractual costs of non-family labor in the hazelnut farming. Besides, rain and land slope, particularly, increase the costs of using non-land inputs and reduce the returns to managerial inputs employed by the farmer.

Land holdings per farmer may be influenced by land reform, land rushes, wars, civil wars, and inheritance. Besides these exogenous shocks, there must be some internal dynamics that are guided by economic incentives that affect the size of the land holdings per farmer. Natural constraints, for instance, can limit farm size by affecting the transaction costs, incentives, and thus choices made by farmers. This argument differs from the explanations of risk that agricultural production is risky due to uncertainty of weather conditions. Hazelnut farmers, similar to a portfolio choice, own properties at different locations in order to minimize the risks imposed by the natural forces because the probabilities are not distributed uniformly across the landscape. The scattering of strips in 18th century English open field farming has the same risk-minimizing behavioral aspects that farmers scattered and exchanged the strips to hedge against the risks of crop loss and price changes (McCloskey, 1972). Besides the risks that they impose on farm production, this study argues that natural effects can increase the associated transaction costs. Fog, rain, wind, temperature variation, elevation, and land slope are measurable natural effects that can increase the costs of using land and labor by increasing the costs of monitoring, transportation, and coordination. Given its cost-increasing effects, suitable weather and land conditions for farm production can be a matter of choice that is reflected by the size of the land holdings. For instance, good (suitable) weather is an input for farm production and farm-firms can choose the amount of good weather (less variation and hence less risk and low transaction costs) through their size and location choices. Therefore, this study views the choice of land as the choice of nature since a farmer can choose more or less of the properties of nature through the land choice.

Stable natural conditions improve contractual outcomes and better contractual outcomes should lead to an increase in the farm size. When a farmer plans to buy a piece of land in order to increase the size of his farm, he would prefer it to be in a region where the weather is stable and land is relatively flatter. Another response of the farmers to the natural (input) constraints is to apply adaptive cultivation. In high elevations, for instance, hazelnut farmers plant low-yield but more cold-resistant hazelnut trees. By doing so, farmers react against the constraints from the natural effects of their location and arrange (delay) the timing of pollination and harvesting through the choice of cultivar.

This study differs from mainstream farm size studies in two ways. First, so far, farm size studies (Sen, 1966; Kimhi, 2006; Bardhan, 1973; Feder, 1985; Lipton, 1985) have intensively analyzed the (inverse) relationship (IR) between productivity and farm size. However, this study takes a detailed view into size, transaction costs, and profitability. Second, most of the size studies (Kimhi, 2006, for instance) deal with perishable annual or seasonal crops, such as maize and rice, while this study deals with nut trees as "vulnerable assets" that require long term investment and thus special contractual arrangements. Land size and agricultural contract studies (Tunali, 1993, for instance) mainly focus on the land itself, yet ignore the crop properties. They usually draw and analyze land data from surveys about multi-crop and multi-region, sometimes nationwide, farm activities. However, cash crops and nuts, for instance, are different in nature and they may affect the structure of agricultural contracts and transaction costs.

Based on the practice of hiring hazelnut laborers on a lump-sum daily wage, the study also shows that lump-sum or fixed pay schedules are not necessarily inferior to piece-rate or tournament (Lazear and Rosen, 1981) settings. Moreover, based on the repeated dealings between dealers and processors in the hazelnut industry, this study argues that contracts are based on expected post-contractual performance rather than strict and term-by-term monitoring and policing.

The study has policy implications for land reform, tax and subsidy policies, and institutional arrangements that target to regulate the lease, transfer, and inheritance of agricultural lands. This study argues that small farms may be welfare increasing based on crop characteristics, natural effects, and labor market conditions.

The study is laid out as follows. Chapter two provides a detailed background about the economic and organizational properties of the hazelnut farms and farming in Turkey. Chapter three reviews the theoretical and empirical literature on firm size, with applications to hazelnut farms of Turkey. Chapter four is allocated for specification of the formal model. Chapter five is for data analysis and methodology. Finally, Chapter six is allotted for the empirical analysis.

CHAPTER TWO

INDUSTRIAL PROPERTIES OF THE TURKISH HAZELNUT MARKET

A. Size of the Industry

The history of hazelnuts in Turkey's Black Sea region goes back to 300 B.C. The spread of hazelnuts from Turkey to the world started some 600 years ago. Up to elevations of 750-1,000 meters, hazelnut plantations lie as a 20-30 mile lane off the shores of the Black Sea from the province of Duzce on the West through Turkey's border with Georgia on the East. There are two hazelnut production areas based on productivity: The First Standard Production Area (Ordu, Giresun, Rize, Trabzon, and Artvin) and the Second Standard Production Area (Samsun, Sinop, Kastamonu, Bolu, Düzce, Sakarya, Zonguldak, and Kocaeli). Turkey is believed to have a comparative advantage due to weather and soil conditions such that the Black Sea coastal lane of Turkey is considered as the best location for hazelnuts (Fiskobirlik; Hazelnut Promotion Group).

Eighty five percent of the hazelnuts are used in the chocolate industry, 15% in pastry, and 5% are used in other use places (Fiskobirlik). Besides their unique flavor, longer shelving time in chocolates gives a comparative advantage to hazelnuts relative to alternatives such as peanuts and almonds.

Hazelnut farms in Turkey are small family farms. Three hundred ninety five thousand family-farms deal with hazelnut farming and a population of 2-4 million have interests in it (TUGEM, 2005; Hazelnut Promotion Group). The total hazelnut production area in Turkey is 584,000 hectares (1.4 million acres) for the year of 2005 (Fiskobirlik). These totals yield about 3.6 acres of hazelnut land per farmer. Table-1 shows the surface area and farm size figures that were collected from various sources for producing countries. As shown in the middle column of Table-1, hazelnut farms in Turkey can be categorized as “small” based on World Bank (2003)’s criteria of 2 hectare (1 acre =.4047 hectare) per farmer. They are also smaller than the hazelnut farms in Italy, U.S.A., Spain, and France. According to results of the survey of this study, that questioned 99 randomly selected farmers from 21 hazelnut producing sub-provinces of Turkey, family-farmers own about 3.64 hectares (9 acres) of land on the average. It should be noted here that it is normal to have varying figures as shown in Table-1’s middle and left columns since the data collection dates vary. Also, the definition of the farmer is an ambiguous one because the structure of the farmer-family is complex in the production areas, government data bases might not be updated, and, more importantly, farmers do not report the actual land holdings for the reasons that will be mentioned later in the chapter of data analysis.

Table 1. World Hazelnut Acreage (acres)

Country	Surface Area*	Farm Size**	Farms Size***
Turkey	1,413,392	0.98-2.47	< 4.94 (58% of the farmers)
			4.94-9.88 (25% of the farmers)
Italy	169,261	12.35-24.7	2.23 (FAO)
USA	22,238	37.05-74.1	64 (Hazelnut Growers Union)
Spain	55,102	4.94-9.88	N/A
France	6,177	17.29-24.7	N/A

(*) Fiskobirlik, 2005.
(**) Formed from Marti, Joan Tous. 2001. World Hazelnut Production. Acotanc Papers. http://www.aoi.com.au/acotanc/Papers/Tous-1/Author-n-Text.htm
(***) Compiled from various sources.

As shown in Table-2 and Table-3, Turkey is the world’s leading hazelnut producer with almost 80% (2001-2005 average) of world production, and the leading exporter with the share of about 86% (2001-2004 average). The annual production of

540,000 tons (2001-2005 average, Fiskobirlik) constitutes $2-3 billion of gross income based on the price. The sharp drop in Turkey's 2004 production share was due to a one-night frost that caused a significant crop loss. Italy follows Turkey in both production and exports to the world markets.

Table 2. World Hazelnut Production Shares (in-shell, %)

Country	2001	2002	2003	2004	2005
Turkey	80.22	81.88	81.88	69.79	80.77
Italy	12.64	13.42	9.54	19.49	11.71
United States	4.40	2.01	5.41	5.85	4.18
Spain	2.75	2.68	3.18	4.87	3.34

Source: Fiskobirlik.

Table 3. World Hazelnut Export Shares (shelled, %)

Country	2001	2002	2003	2004
Turkey	92.38	78.34	86.38	87.96
Italy	5.01	7.10	10.43	8.20
United States	0.82	1.09	1.63	2.02
Spain	1.79	1.55	1.56	1.82

Source: Fiskobirlik.

B. Hazelnut Farming

Hazelnuts grow on the groups of bush-like branches that are about 6 to 15 feet high. Forming rows in a lot, hazelnut groups contain 5 to 10 branches and they are about 6 to 10ft away from each other. It takes 5 to 10 years for a newly planted bush to come to a full yield. A well-maintained hazelnut tree can live more than 20 years. There are about ten different cultivars of hazelnuts and farmers adopt them based on the characteristics of their land and region. The bush-like nature of the Turkish hazelnut trees distinguishes them from the tree-like cultivars and relevant farming characteristics that take place in Italy, Spain, and United States.

Hazelnut flowers begin to pollinate in late November through early December. Appropriate wind and temperature that affect pollination in this period is very essential for the next year's crop. The trees start to blossom in late February and early March. Crop estimates, which are very crucial for the expected price, come in late March and early April. The longer and harsher the winter, the higher the risks of a one-night frost that kills almost all the hazelnut blossoms. Other main negative shocks to hazelnut crop are hot tropical winds and drought during the late stages of the crop development. Besides the random shocks, hazelnut crop is subject to periodicity.

Main farming tasks are planting, pruning, fertilizing, pesticiding, weeding, picking, husking, and sun-drying of hazelnuts. Farmers plant hazelnut bushes during the winter to develop new areas or to rehabilitate the diseased groups. While some farmers prefer to form groups far from each other with fewer bushes, some prefer close groups with crowded bushes. Bushes and sprouts in each group need pruning at least once a year since pruning increases per bush nourishment from the soil and reduces the timing costs of collecting hazelnuts from ground. Pruning requires special care in a sense that sprouts should be cut short off the ground with special knives so that the next pruning would not damage the hands of the farmers. Moreover, if the sprouts are not cut off short enough, then they do not die completely and continue getting nourishment from the soil and hence less nourishment goes to the productive bushes. Which spring or bush in a group should be discarded is another area of choice where each farmer applies his own agricultural knowledge. Therefore, pruning workers should be closely monitored and given directions often. Hand-fertilizing is also subject to different timing and application methods of different farmers. While some prefer to apply fertilizers three times a year, some prefer only once. Pesticiding and weeding are almost standardized tasks throughout the regions in terms of timing and methods used. They have been almost totally mechanized in recent years with the introduction of weed eater tools.

One of the most important and most labor consuming tasks of the hazelnut farming is harvesting. Harvesting starts in mid-August depending on the elevation and lasts till the end of September and even October in high-elevation regions. There are two methods of harvesting: First, hand-picking of the nuts from the trees one by one especially during the early stages of the harvesting. Second, hand-picking of the nuts from the ground when they ripen and fall off the bushes with light shakes. There is no effective mechanization used in this stage of farming due to terrain (high slope) and rainy climate. While the survey results show that the highest slope of the hazelnut fields can go up to 70 degrees in angle, weather data shows that maximum rain can reach up to 3,812 mm/m^2 (mostly average of 1975-2004) in the hazelnut production regions (see Appendix B). Therefore, almost all of the hazelnuts are hand-picked, and hence this requires intensive use of labor and harvesting brings a huge seasonal temporary labor movement to the region.

Harvested hazelnuts are piled up for a few days and husked by specific machinery. Farmers contract out husking to a machinery owner based on an hourly rental rate. After being husked, the in-shell hazelnuts are sun-dried for about 5-10 days depending on the sunlight and non-rainy days on the yards of their farm houses. Then, sun-dried in-shell hazelnuts are made ready for shipment as bags of 70-80kg. While some farmers prefer immediate shipping of the output, some prefer to store them especially if they have no immediate need of cash and do not know a trustworthy dealer to deposit it.

In addition to these mentioned main tasks, there are several carrying, loading, and unloading activities that require use of labor or draft animals throughout the whole stages of the farming. There are cases in which all of the carrying, loading, and unloading tasks are performed by laborers since the slope can be too high to use even draft animals. Therefore, it can be concluded that hazelnut farming in Turkey is a labor intensive one that requires engaging in costly labor market related activities of searching, hiring and firing, monitoring, instructing, and motivating the hired labor[1].

C. Major Actors of the Industry

There are five major actors in the hazelnut industry of Turkey: farmers, laborers, dealers, processors, and commissioner/exporters.

Farmers grow hazelnuts and sell them to Fiskobirlik, semi-public cooperative, or private sector dealers after the tasks of husking and sun-drying. Hazelnut plantations are usually family-owned farms rather than corporate-type of agricultural organizations. Farmers also do not deal with retail sale of hazelnuts. Moreover, they do not carry a brand name but reputation. They are large in number and very loosely organized if not at all. According to the survey results of this study, farmer families consist of 3 working age members that can and are willing to go to hazelnut fields on the average. They own 1 or 2 animals, usually a cow for dairy needs and a draft animal, if any. Of them, about 58% has secondary employment; this makes the definition of the "farmer" an ambiguous one.

[1] Light ATV (All Terrain Vehicle) type of tractors is likely to bring a technological change and substitute labor in many tasks. They have been in use for about 5 years and their use is increasing rapidly.

Twenty eight percent grows vegetables or fruits for income, 12% owns a draft animal, 49% has transportation, and 24% owns light tractors. Forty one percent employs hired labor and 58% of the harvesting is done by family members. Only 26% received technical support from the local agricultural office recently. Mean family income is about $16,250, of which $7,300 is from the non-hazelnut sources.

There is no regular, specialized or institutionalized labor supply for the hazelnut industry but temporary and unspecialized ones due to farmer-specific and time varying farming applications. Hazelnut laborers come from the city population if the need for the outside-hiring cannot be met by hiring neighbor-farmers, which is a highly preferable source of labor. Neighboring fellow farmers require minimum instruction, monitoring, and motivation. Mostly, they are not paid a wage but the labor is exchanged day for a day. This practice is called *imece*. As it will be explained in detail below, the rest of the farm labor is mostly hired temporarily using a daily-base-wage contracts rather than piece-rate pay schedules. Harvesting brings a specific labor movement in addition to the remote living family members that take their vacation and travel to their villages to also take part in the harvesting that lasts about a month. Therefore, family oriented work force shows a surge during the harvesting season. However, farmers, especially larger ones, still rely on temporary seasonal hiring for harvesting. The survey results indicate that farmers need to hire temporary harvesting workers to meet about 42% of their harvesting labor needs. Besides migrating family members to the region, there is a huge labor migration to the region from the southern provinces of Turkey to get a share from the demand for harvesting labor.

Dealers buy hazelnuts from the farmers and sell them in bulk to processors. They turn retail transactions into the wholesale ones. They add nothing to physical product, however, since they serve as "local agents" on behalf of the processors and complement the formal credit market. As such, the industry keeps them as contractual safeguards. Local agenst meet farmers' financial needs during the off-season, and bad years, under the promises of *exclusive buying agreements*. Combined with the failure of formal financial markets, financial needs of the farmers put the whole industry within a chain of debt and invite opportunistic behavior. Since most of the profits of the dealers depend on the kernel (shelled to in-shell ratio), measurement costs and uncertainty also play a big role.

Processors own small plants to shell the hazelnuts. They sell shelled hazelnuts to domestic markets or commissioner/exporters in quantities of 10 tons minimum. They also financially support the dealers in their financing of farmers. Some processors own integrated facilities to whiten and roast hazelnuts. Processors are small in numbers.

Commissioners match processors and exporters. Comissioning is usually a single-person business that operates with high daily transactions and cash flow. Daily markets open around 11:30 a.m. every business day and local price is formed through the dealings between processors and commissioners. Then, processors base their price offerings to the dealers on those transactions that they finalize with the commissioners.

D. Potential Contractual Issues across the Industry

Contrary to its common worldwide application with many agricultural products, land contracts or share tenancy is not common in the hazelnut industry of Turkey.

Therefore, contractual issues with sharecropping or cash contracts are not applicable here. Labor intensiveness and limited use of machinery due to weather and terrain make labor contracts more important regarding the contractual issues within the industry.

Contracts are costly due to bounded rationality, measurement costs, and opportunistic behavior. Depending on these factors, the hazelnut industry operates with less contractual problems as moved toward commissioning since the number of parties gets smaller, transactions occur in large quantities, and contracts become written (mostly due-to strict export inspections of government agencies). However, contractual performance (Klein and Leffler, 1981) is lower when the transactions between the farmers and dealers are the matter, since the number of parties gets larger; transactions are in smaller quantities; and contracts are informal and based on proxies rather than actual measurements of the crop quality and the trustworthiness of the farmers. A detailed view can be taken into potential contractual issues among the agents of the industry as follows:

i) Between Farmers and Dealers: As mentioned earlier, there are mutual debt relations between the farmers and dealers. First, farmers may deposit their produce with a known dealer with the promise of cashing it anytime. Second, dealers provide informal financing to farmers when they need it in return for the promise of exclusive buying. Then, the most common contractual issue between the dealer and farmers is the default of each party. Farmers may fail to repay their financial obligations to the dealer due to either a bad crop year or a deliberate cheating. Smaller farmers are more likely to cheat relative to big ones since their cost of default, mainly the sunk cost of developing and protecting a reputation, is lower. They may invest fewer resources to develop a reputation due to low returns to reputation while big farmers gain more from developing reputation than small capacity farmers due to fixed costs. Given poor or mostly unavailable credit history, smaller farmers can easily visit and cheat a different dealer each year and play a single shot game. Considering the smallness of farm sizes across the industry, costs of information, costs of congestion, and defaults are some of the major contractual issues.

Dealers also may fail to repay their obligations on the deposited crop of the farmers due to either bankruptcy or cheating. Some farmers, usually bigger ones, may not cash their produce and deposit them to the dealers. This is because farmers may (a) not have an immediate need of cash, (b) want to wait and speculate against price fluctuations, and (c) want to get rid of storing costs and risks, such as fire, flood, theft, and so on. Most of the farmers usually prefer to deposit their produce if they know a trustworthy dealer. Besides risks and pecuniary costs, hazelnut kernels will also shrink and lose weight during their storage time. Hence, neither farmers nor dealers and processors keep hazelnuts stored long term in their possession. Thus, the market economizes on the storing costs and storing time is kept very short across the different stages of the market. However, this depositing and economizing on storing costs leaves the hazelnut market to operate on a chain of debt relations among the actors of the market and cause defaults.

Since there is no effective governmental price stabilization program that includes a stock management program, *a livrer* buying agreements of the importers outside the country and exporters inside the country (from processors) are common yet rather speculative practices against the price fluctuations due to periodicity or supply shocks.

Buyers simply get a crop estimate and take this as a base for the expected price, then purchase enormously large quantity of “to be delivered” hazelnuts at the expected price. This type of buying agreement also takes place between farmers and dealers and brings high profits as well as chained bankruptcies and defaults depending on the actual price. According to *Food News* (Nov. 21, 2003; 19 Feb. 2004), for instance, buyers of the Turkish hazelnuts lost millions of dollars due to the defaults that resulted from the differences between estimated-actual crop and estimated-actual price.

Implicit contracting that depends on promises, trust, and “indefinite guarantees” rather than written agreements (Akerlof, 1970), is one of the most important reasons for the defaults. While implicit contracting reduces the costs of contracting, it may also reduce contractual performance. In the absence of explicit contracting, non-repeating business, the lack of knowledge, and the last period problem are the main causes for the defaults. For instance, dealers who plan to expand their market share and try to enter new villages suffer from the lack of knowledge. Therefore, the entry comes with uncertainties and requires a transition path, establishing trust, and gathering information about farmers of the new region. They may be faced with several default cases during this transition and expansion period.

Asymmetric information (Akerlof, 1970) and information-measurement problems (Barzel, 1982) are the other sources of contractual issues between the dealers and farmers. Since farmers have more knowledge than the dealers about the quality of their crop, they may behave opportunistically by shipping humid (heavier) or rotten hazelnuts. Moreover, the probability of getting a loan and its amount mainly depends on the expected crop of the farmers. The higher the expected crop the higher the possible amount of loan at outgoing rates. However, actual properties of the crops are uncertain until the actual shipment is made. Farmers have more knowledge about their expected production quantity and quality and they can use this knowledge opportunistically to get good loans. When they fail to repay and it is real cheating, they may usually use "the bad year" argument. Since the effects of nature on the farms (and farmers) are non-uniformly distributed, the bad year argument helps the cheating farmer with justifying the "natural" cause of the default in order to get rid of the consequences of default. Hence, dealers try to get an estimate of crop quality and quantity for each client-farmer and region no later than February or March each year to be able to lend securely. Reputation, especially references and guarantors[2], and price premium are safeguards for parties against cheating at this stage of the market.

ii) Between Dealers and Processors: Processors can by-pass dealers by offering higher wholesale prices directly to the farmers and leave no room for them to operate. However, they prefer not to deal with farmers directly due to higher relative costs of retail transactions and their need of dealers as local agents to collect and process information about the farmers at a lower cost. Farmers need financial aid, pesticides, and other working capital, and storage services as explained earlier. Therefore, dealing with farmers requires year around transactions with them regarding their needs of financial aid, working capital, and storage services. Processors refrain from dealing with large numbers of farmers that come from remote villages and leave these services to the dealers

[2] New client-farmers are usually required to bring along a reference or guarantor who is known to the dealer.

as local agents so that their costs of gathering information about farmers and building a trust is lower. However, they sometimes free-ride on the services provided by the dealers by offering wholesale prices to farmers which disturb their exclusive buying agreements with the farmers. Since cities are compact, there are no substantial time and transportation costs, which may prevent direct dealings between farmers and processors. However, reputation, the lack of information about the financial structure, and the trustworthiness of the processor limit the processors' opportunistic behavior against dealers. Moreover, while farmers would not prefer to deal with processors until a certain price difference occurs on the one hand, processors would not deal with farmers until their product amount reaches a certain level on the other.

Dealers usually offer higher (than the season averages) at the very beginning of the season[3] to secure themselves against the default of the farmers that might be caused by the free-riderness of the processors on the services provided by the dealer. This is to secure pay backs and induce farmers to pay their loans as soon as possible. It is because of this practice that opening prices, that last about 3-4 weeks, are always higher and the prices start to fall slowly by then. This practice of the dealers can well be considered as a price premium (Klein and Leffler, 1981) paid by dealers to the farmers for not defaulting.

Measurement is another major contractual issue between processors and dealers since it has a big effect on the profits of both parties. As noted above, kernel and overall quality of the hazelnuts vary by region due to changes in micro-climate and soil quality. Hence, both dealer and processor use the region as a proxy (Barzel, 1982) for the quality.

[3] Farmers are to pay their loans back in the first month of market's opening.

Simply, the region of the farmer sends signals about the properties of his produce. If a farmer, for instance, is from a high-elevation location where the hazelnut trees are different and of a more cold resistant type, the industry knows that his crop is of a lower quality.

Since the price premium paid for extra kernel quality is a big profit opportunity for both dealer and processor, kernel measurement is an area of conflict between the processor and dealer. Measurement of kernel is performed by the processor under in-person monitoring of the dealer in a tiny room furnished with mirrors all around to monitor any movements of the parties. A main sample of about 20kg (45 pounds appr.) is taken from each of the 80kg bags of the whole shipment that usually consists of 5 to 10 tons of unshelled hazelnuts. Then, another sub-sample of 500 gr. (about 1.1 pound) is taken from the main sample. Sampling, hand-made shelling, weighting, and treating the cynic and rotten hazelnuts, are subject to processors' discretion and it provides the potential for opportunistic behavior that aims to undervalue the kernel quality of the dealers' shipment[4]. Dealers also can behave opportunistically by mixing the bulk with humid and low-quality hazelnuts bought from outside of their regular regions at lower prices. This is to fool the processor who takes the region of the dealer as a proxy for quality. This is also why Welch's grape juice is made of grapes that are grown on farms owned by Welch's (as a cooperative) in order to minimize the opportunistic behavior and measurement costs.

[4] Dealers ship hazelnuts in 70-80kg (150lbs app.) jute bags. When they collect samples from each bag, processors prefer to grab hazelnuts from the top of each bag rather than the bottom since the hazelnuts at the top will weight lighter than the ones on the bottom. Thus, they aim to pay less kernel premium to the dealers.

Dealers can threaten processors by holding-up the stock and not shipping it when the processors need it. As noted above processors need to maintain a load factor and hence need a certain flow of shipment from the dealers. Otherwise, they would have to keep a huge inventory and this is an integration question related to storage costs. This is another reason for the existence of dealers in the market that processors prefer to deal with.

In a repeating game setting, both the processor and the dealer set their expectations on average product quality and average measurement quality. That is, expectations rather than written terms of contracts may align incentives better in many contractual issues among parties. Both reputation and repeating business protect the dealer and processor against shirking and cheating. No party prefers to take the advantage of measurement difficulties since the expected returns of repeating business attains a higher value than one-time cheating. Hence, both processors and dealers gain from fair trade. Akerlof (1970: 499) notes that, in general, sellers rather than buyers may bear more of the risks and costs of one-time cheating.

iii) Between Farmers and Workers: The labor intensiveness of hazelnut farming was mentioned above. While small farmers do farm tasks with their family-members, relatively larger farmers and farmers who have secondary employment will need to hire maintaining and harvesting workers. The two main contractual troubles that farmers face regarding hired labor are shirking and hold-up.

The aforementioned daily-wage payment schedule offered to hazelnut workers seems to invite shirking and requires momentary direct monitoring of the farmers at first sight. For harvesting, for instance, even though metering and performance measurement (Alchian-Demsetz, 1972; Barzel, 1982), such as weighting and counting of heavy bags collected by each worker and assessing each row that a particular worker operates in, are costly, a piece-rate rather than a lump-sum payment would indeed induce and force the workers to work harder in terms of the amount of hazelnuts collected per day. However, this incentive and forcing could lead workers to damage the hazelnut trees and leave some uncollected hazelnuts behind. In order to collect more and thus earn more, they would not turn each leaf and look for hazelnuts underneath, pick the visible and reachable hazelnuts only and would not spend enough time for making sure that no hazelnuts are left behind on the bushes. The time consuming procedures of a "clean" collection would of course reduce the amount collected by a worker. However, not only the amount of hazelnuts collected but also leaving no uncollected hazelnuts behind and taking care of the trees are important for the farmer. While leaving hazelnuts uncollected reduces the crop amount and requires extra collection work, damaging the trees may substantially reduce the next year's crop. Thus, a lump-sum or fixed payment schedule with close monitoring has been a preferred way of hiring harvesting workers in the majority of production areas. Sustaining this application shows that farmers calculate all the pecuniary and non-pecuniary costs and benefits in their decision-making. More importantly, it shows that lump-sum pay schedules are not necessarily inferior to piece rate or tournament settings under all circumstances.

Harvesting laborers are organized as teams of 5 to 10 members with a team supervisor. Monitoring is done by the supervisors who perform nothing but monitor the team members. They are paid twice of a regular worker for their monitoring task. Owner-farmers monitor the monitor as residual claimants. Monitoring and other labor-related transaction costs, such as coordination, motivation, and instruction costs, would be extremely lower if the neighbor farmers could be hired. Hired labor, however, requires often warnings over shirking, coordination, and giving instructions constantly.

Large farmers need the harvesting done in about a month since the rains start in mid-September. This time constraint invites the hold-up problem of the temporarily-hired harvesting workers. They usually break their promises of labor supply and switch to a better offer in the middle of the time-constrained harvesting season. Written contracts, reputation, repeat deals, and bonuses paid in advance to the team heads are the measures that farmers take against this hold-up problem.

The above mentioned labor intensiveness of the hazelnut farming due to terrain, climate, and labor related transaction costs lead farmers to prefer owning lands in a size that they can handle worked by family members.

CHAPTER THREE

LITERATURE REVIEW

A. The Concept of Firm Size

Decades after Coase (1937), the firm, firm size, and the number of firms in an industry still remain puzzles for economists. Since Coase (1937), firm size has been explained by the marginal organizational costs and benefits of the expansion. Diminishing returns to management, which is determined by organizational costs, information about the value of the inputs, and input supply price determine the size of the firms. In this view, the firm is a sorting and directing unit alternative to the market mechanism.

Specialization, division of labor, size of market (Smith, 1776; Stigler, 1966; Roumasset, 1995; Roumasset and Uy, 1987), risk (Knight, 1921), transaction costs (Coase, 1937), market power (Kumar, et al. 2001), institutional effects (Kumar et al. 2001; Davis and Henrekson, 1999), and business cycles (Hodges, 1934) have been the mainstream explanations for firm size.

Williamston (1967) put forward the hierarchical view and "loss of control" theory of firm size that indicates expansion brings loss of control. Alchian and Demsetz (1972) discussed metering costs, team production, residual claimant, and principal-agent problems regarding economic organizations. Klein, Crawford, and Alchian (1978) stressed appropriable rents through the specialized assets, vertical integration, and hold-up problems. Becker and Murphy (1992) focused on the coordination and motivation costs on the matter. Barzel (1982) argues that measurement costs affect the contractual performance and organization of markets that the firm should be an efficient sorting agent.

Lucas (1978) separates production technology and managerial technology, which consists of variable skill or talent and diminishing returns to scale, or to span of control. The allocation of resources involves, first, a division of labor between managers and employees and, second, the allocation of factors across managers. Capital and labor are not combined costlessly. What matters is the allocation of resources per manager instead of per firm. Then, the firm is one manager, together with the capital and labor under his or her control (p. 510). Changes in the wage rate will affect the decision to work for someone else or managing. Higher wage rates, for instance, will increase the opportunity cost of managing and marginal managers will become employees. This, in turn, will increase the average size of firms (p. 518).

Davis and Haltiwanger (1990) discuss labor market dynamics as an explanation for firm size. Den Butter, et al. (2001) argue that differences in firm size can usually be explained by the heterogeneity of workers and enterprise. In particular, they point out that the performance and size of the firm are influenced by aspects of human capital and personnel management such as hiring costs, firing costs, search costs, wage policy, training, job matching, and setting requirements for worker qualifications. Thus, even if transaction costs are the same for different firms, their size may differ due to qualities and qualifications of the incumbent workers (p. 21).

Davis and Henrekson (1999) took institutional views that institutional constraints determine the firm size. Akerlof (1970) asserts that implicit contracting that depends on promises, trust, and "indefinite guarantees" rather than written agreements, reduces post-contractual performance. Kumar, et al (2001) proves that firms facing larger markets are larger. They all argue that high capital-intensive industries, high wage industries, and industries that allocate large resources into R&D tend to have larger firms. They, more importantly, found that countries with better institutions, measured by the efficiency of judicial system, have larger firms.

Lindbeck and Snower (2003) view the inter-factor complementarities that give a rise to returns to scale and the associated transaction costs as the determinants of the firm. In this view, the firm is a pool of factor complementarities. When different agents collect, process, and share information at different stages within a firm, for instance, those agents complement each other and increase the returns to scale.

Firm size matters for two reasons. First, it signals about the intra-firm efficiency; firms have to operate at a size in which profits are maximized. This is reflected by the average costs and economies of scale. The issue has been analyzed through the shape of the AC (average cost) curve in a sense that only U-shaped AC curves are assumed to yield a unique firm size while others leave the firm size undetermined. Optimum firm size is assumed to be a profit-maximizing one. That is, when a firm is not operating at the optimal size, it is not maximizing long-term profits even if it makes some profits. Smallness of a firm's size does not necessarily mean that the firm is operating inefficiently. No matter how small or big a firm is, it can operate efficiently and there is no formal limit on the size except for the optimality conditions and the size of market.

Second, given the size of a market, firm size determines the number of firms in an industry. So far, the number of firms has been analyzed for the sake of market power or the level of competition in an industry. However, the number of firms in an industry also determines industry-level contractual performance since as the number of firms in an industry increases so do the costs of coordination and congestion. There should be an optimal number of firms which is determined by optimum size of the firms in an industry that maximizes the industry-wide contractual performance.

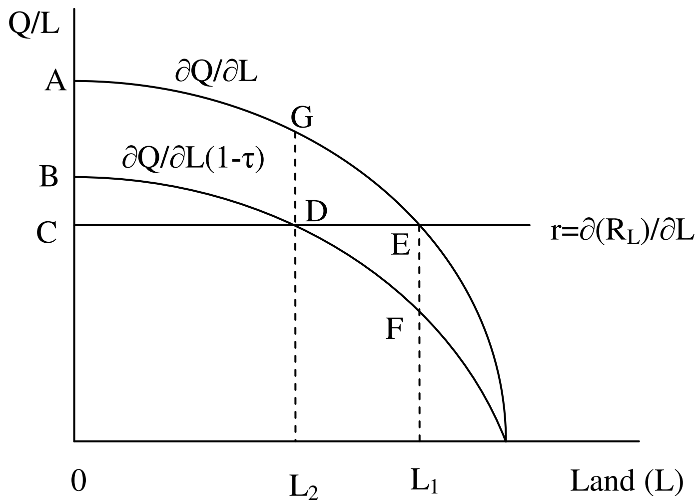
There are various measures of the size of a firm. Output, budget, market share, use of labor, and revenues can be used for specific uses. This study uses the land holding per farmer as the measure of farm size. In fact, output also could be used for the same purpose. However, output is directly related to productivity and cannot effectively reflect the effects of nature on the size. For instance, irrigation, use of fertilizers and pesticides, mechanization, use of labor, and high agricultural knowledge of the farmer can lead to higher output from the same amount of land but they may be free from dynamic natural effects.

B. Determinants of the Size of Hazelnut Farms

1. Transaction Costs and Diminishing Managerial Returns

For a production activity, transaction costs are the costs that are associated with the use of productive resources and they determine the contractual choice. Why there is no sharecropping in the hazelnut industry of Turkey, why harvesting labor is hired on a daily fixed-rate wage rather than a piece-rate, why there is no futures market, what are the effects of these on the size of the land holdings? It seems transaction costs are the common answer for these questions.

Figure 1. The Tax-Like Effects of Transaction Costs on Size



Transaction costs act like a tax on the use of productive resources and limit their use. This is also true for the use of land. The associated transaction costs are similar to taxes imposed on land and limit the farm size. Figure-1 illustrates size-limiting tax-like effects of transaction costs on a representative productive function of $Q=f(E, L)$, where Q is output, E labor, and L is land. The amount of land is measured along the horizontal axis and $\partial Q/\partial L$ shows the marginal productivity of land holding labor, E, constant. Marginal cost of land is the forgone rent, $r=\partial(R_L)/\partial L$, where R_L is the prevailing rental rates. A farmer employs land until the marginal productivity of land equals the rental rate, which occurs at E. The initial equilibrium amount of land is L_1. When the associated transaction costs τ are imposed, the frontier of marginal product of land net of transaction costs, $\frac{\partial Q}{\partial L}(1-\tau)$, will shift downward. To equilibrate the marginal productivity of land to the rental rate, the amount of land used has to decline to L_2. The new equilibrium occurs at *D* with a deadweight loss of *GDE*.

One of the biggest chunks of the transaction costs in the production process consists of the costs of contracting and the costs of contract enforcement. The structure of a contract for a farm production is classified as share contracts, piece-rate contracts (lease), or wage contracts. Paarsch and Shearer (1996) analyze profit maximization under different pay schedules. As the components and contributions change frequently or entail a variety of activities by the same worker, piece rate contracts are not applicable (Cheung, 1983: 15-16). Which contractual arrangements will be chosen is determined by transaction costs (Cheung, 1970; 1983).

Roumasset (1995) and Roumasset and Uy (1987) argue that different contractual arrangements of operations of farm lands lead to different firms according to the degree of specialization they facilitate between labor and various managerial functions. Roumasset (1995) also extends profit maximization to organizational form by considering profit maximization as equivalent to agency-cost minimization.

Tunali (1993) finds that monitoring costs, information about the parties, size of the benefits of risk sharing, managerial contributions, trust and non-land inputs, such as draft animals, are the determinants of the choice of sharecropping or rent tenants in Turkish agriculture.

Leffler and Rucker (1991) provide empirical evidence from the timber harvesting industry that selling standing trees is more profitable than harvesting the trees and selling logs to the mill owner based on the transaction costs of the two alternatives. They also argue that relative size of the transaction costs regarding the two types determine the choice over lump-sum or per unit pay schedules.

Coordination costs can be viewed as a type of transaction costs. Becker and Murphy (1992) argue that given the efficiency of the markets and the quality of contract enforcement, the limits to the division of labor, which raises productivity, are determined by the costs of "coordinating" specialized workers who perform complementary tasks rather than the size of the market as first argued by Adam Smith, and the amount and extent of knowledge.

One of the organizational responses to contractual costs is vertical integration that results in an increase in firm size. However, there is a large body of literature that analyzes the market forces and contractual remedies that reduce the costs of contract enforcement and remove the need for further organizational arrangements through the alignment of incentives. Hill (1990) argues that in the long run the invisible hand of the market mechanism will delete systematically-opportunistic agents depending on repeated dealing, the importance of the future (discount rate) for the parties, uncertainty, limits of reputation, and the efficiency of the markets in detecting and eliminating opportunistically behaving agents. He implies that transaction costs arguments for internalization has been overstated.

Umbeck and Chatfield (1982), analyze the structure of contracts regarding the transaction costs with a focus on risks and remedies that contracts bear. They particularly point out that contracts can have some remedies; "the creditors' remedies", such as collateral to reduce the risk of default.

Klein and Leffler (1981) suggest increased market price, the price premium, as one of the most influential market forces of contract enforcement. Relative price of a good is a signal of investment in non-salvageable assets, brand name, and advertising. Also, it assures contractual performance.

Jacoby and Mansuri (2004) find significant positive effects of supervision on gross productivity of land cultivated by sharecroppers in Pakistan.

Cheung (1970: 52-54) states that different physical attributes of the assets and relevant policing and monitoring costs affect the contract choice and allocation of resources. He states:

"(T)he cost of policing investment in a tree, perennially 'attached' to the common land, is high, whereas cattle are driven home at night (p. 53)".

By the same token, both farm work on hazelnut plantations and the plantation itself require close monitoring and policing. Therefore, farmers prefer lands in viewing and hearing distances from their houses. This is why farm houses are usually located on top of the hills with hazelnut fields usually lay down the valley in vertical strips.

How do the terrain and weather conditions affect transaction costs and contracting? Most of the hazelnut farming tasks are time-sensitive and they are performed outdoors. While variations in weather conditions increase the risks of crop loss each year, they also reduce the stability of the contractual arrangements and increase contractual costs. Harvesting, for instance, must be finished in a timely fashion, usually in about a month, before the early rains begin in order to secure the quality of the sun-dried hazelnuts. This short period of time invites opportunistic behavior of the temporary harvesting workers and the hold up problem. The temporary nature of the hazelnut work and the related labor market imperfections attenuate contractual problems and increase transactional and contractual costs.

In the areas where the variation in weather conditions is relatively higher, the outdoor nature of hazelnut work requires revision of mostly oral wage contracts. Given poor weather forecasting, when a farmer hires labor and if it rains, then the farmer and workers have to wait for days or weeks for good weather to come back. This is also true for partially rainy days that require make-ups on shiny days and influence fixed costs, such as the costs of transportation and communication, are higher for partial work days.

As noted earlier, transaction costs or the costs of contracting determine what type of organizational structure will be preferred for a particular production. Besides the vulnerable asset nature of the hazelnut trees, one of the main reasons for the uncommon practice of share tenancy in hazelnut farming in Turkey is the extreme variation in weather conditions. Given the fixed rent regime tenants may justify low output, poor maintenance, or damage to the property (trees) easily with weather conditions despite low labor and other intermediate inputs employed on the fields.

Capital intensiveness and mechanization are considered to reverse the so called inverse relationship. Large farms will become more profitable with the use of technology and mechanization. Along with variable weather conditions, high land slopes prevent the use of machinery in the Turkish hazelnut farming. This makes hazelnut farming a labor-intensive one and limits the land holdings by increasing transaction costs. High-sloped lands also increase the measuring-monitoring costs regarding wage contracts. Workers mostly camouflage their slackness and justify low productivity with high slope by implying that high slope is preventing them from working harder. In fact, it is true that high-sloped lands are costlier to work. However, the real question becomes, do workers slow down the job more than what the slope requires? Therefore, this study argues that these interactions, which are closely related to contractual and transactional issues, between labor, terrain, and weather conditions shape the nature of the wage contracts and affect the size of hazelnut farms in Turkey.

Finding direct measures for transaction costs is not an easy task. Therefore, proxies are used for this purpose. Evenson, et al. (2000) proxied transactions costs by the levels of urbanization and access to markets and found that village level transaction costs increase the intensity of supervision for all types of farming tasks. Moving from the idea that richer countries are located in the temperate areas and they have larger farm size, Eastwood, et al. (2004) took latitude as a proxy for the effects of agro-ecological variation or geography. They detect a roughly U-shaped relationship between average farm size and quadratic and linear latitude (p. 10,11).

2. Market Power

Lack of competition in an industry may affect the firm size. If it gains enough market power, a firm simply limits itself in size (measured by output) in order to collect the monopoly rents. Moreover, if there are effective barriers to entry in an industry, a firm can expand to the limits of the market. Kumar et al. (1999) finds that utility firms are larger because they enjoy officially sanctioned monopoly.

Firm size and the market power relationship can have different variations. Mariuzzo, et al. (2003) argues that compared to multinational ones that operate across most stores and products, small firms may have localized power within the stores and market segments they operate in even if they cover less of the market.

3. Productivity

Smaller farms are found to be more land-productive (Sen, 1962; Feder, 1985) because of the higher land to labor ratio with smaller lands. This famed inverse relationship (IR) is only about land productivity and in a broader context of productivity considers total factor productivity (TFP). Output per unit of land is not independent from output per unit of labor or labor productivity. Therefore total factor productivity should also be taken into account when the link between farm size and productivity is analyzed. Smaller farms use land more intensively (Newell, et al. 1997; Banerjee, 1985). Intensive use of land and resulting higher output to land ratio are due to traditional technology and relatively cheaper (low-shadow priced) family labor.

When Cheung (1968) suggested smaller and smaller lands for each tenant in order to increase the total amount of (integrated) rent from a parceled land, he had diminishing marginal productivity in his mind. If a landowner parcels his land among a number of tenants, he captures the higher marginal productivity with smaller lands and collects larger total rent relative to a single unit of land rented away or cultivated by him (for details and graphical illustrations see p. 110-113).

Land quality also has impacts on farm size. Given the amount of labor, with high-quality but smaller lands, farmers can produce the same output as larger lands. The

Malthusian explanation of the higher productivity of smaller lands suggests that more fertile farms will eventually be, on average, smaller in more fertile regions. Modern technology, capital intensiveness and mechanization, irrigation, and industrialization make larger farms more productive (Deolalikar, 1981; Cornia, 1985). Cornia (1986) finds supportive evidence for the positive relationship between farm size and labor productivity.

The effects of productivity on farm size also have many controversial aspects. Verma and Bromley (1987) summarize these aspects as conceptual problem, which deals with the efficiency criteria to be used; empirical problem, which deals with data difficulties, aggregation, heterogeneity, and functional form; and institutional problem, which focuses on the organizational and ownership structure of the farms and farm size. They argue that the findings, such as in Andrew, et al. (1997); Bhalla and Roy (1988), about the relationship between the farm size and productivity can go either way depending on the treatment over the mentioned three problems.

4. Policies and Institutional Effetcs

Tax and subsidy policies may provide incentives to expand or limit land holdings based on their structure. Taxes that are levied on land area, farm income, rent, or produce have various size effects depending on their rate structure (fixed, progressive, regressive, etc.) and transferability among the agents of the industry. Similarly, subsidies also affect land size based on their structure. If the transfer payments to farmers are based on the land size, then farmers may expand land holdings in order to receive more transfers. The target subject and rate structure of the subsidies will have various effects as well as taxes.

Since tax and subsidy policies affect all the sections and there are no variations between and within the sections, complex detailed effects of different tax and subsidy policies will be ignored here.

Governments may limit farm size by imposing legal restrictions on the ownership, transfer, leasing, rental rates, and inheritance of agricultural lands. The Turkish Cabinet, for instance, released the decree number 2001/3267 in order to limit the production areas and output quantity of hazelnuts. Decree number 2001/3267 permitted hazelnut production locations and forbids hazelnut farming (i) outside the permitted areas, (ii) on 1st class agricultural lands[5], 2nd class agricultural lands, and 3rd class agricultural lands slopped less than 6%, and (iii) at elevations higher than 750m. The decree suggests Alternative Crop Support Program for existing hazelnut farming on the 1st class, 2nd class, and 3rd class agricultural lands slopped less than 6%. The decree has not been implemented effectively due mainly to political economic reasons that allow farmers to keep their trees in forbidden areas and lands. Therefore, there has been no shrinkage observed in the areas of hazelnut production.

Turkish Soil Protection and Land Use Law (#5578 RG09/Feb/2007) puts restrictions on inheritance, transfer, sale, and parceling of agricultural lands such that most of the listed agricultural lands cannot be parceled into pieces smaller than 2 hectares (5 acres). However, the law assumes exceptions for special soil and climate-requiring crops of tea, hazelnuts, and olives so that their sizes can be smaller than 2 hectares based on the evaluation of the relevant ministry. The 2-hectare limit is above the average land

[5] Classification is based on soil based on the need of inputs other than soil, such as irrigation. 1st, 2nd, and 3rd class agricultural lands are the ones suitable for soil based farming.

holdings per farmer in hazelnut farming in Turkey. However, this ruling and institutional development is quite new for this study.

5. Input Constraints and Elasticity of Substitution

The assumption of convexity of the isoquants to the origin implies that there should be an optimal input mix rather than utilizing just one input for the whole production. Consider following production function:

$$Q = f(E, L) \tag{1}$$

Where Q denotes output, E labor, and L land. By definition, $f_E = \frac{\partial Q}{\partial E} > 0$ and $f_L = \frac{\partial Q}{\partial L} > 0$.

$$Q = f_E E + f_L L \quad under\ C.R.S. \tag{2}$$

Totally differentiating 2 yields:

$$dQ \equiv f_E dE + f_L dL \equiv 0 \tag{3}$$

$$\frac{dE}{dL} \equiv -\frac{f_L}{f_E} \tag{4}$$

The expression of 4 implies that when $f_E = \frac{\partial Q}{\partial E} > 0$, $f_L = \frac{\partial Q}{\partial L} > 0$, $f_L \neq 0$, and $f_E \neq 0$ the slope of the isoquant, $\frac{dE}{dL}$, is negative. $f_E = \frac{\partial Q}{\partial E} > 0$ and $f_E = \frac{\partial Q}{\partial E} > 0$ suggest that adding more of either inputs will increase output. Then, is it preferable to use only one input as adding more of it will increase the output? More specifically, should a farmer stop using only land? The answer is yes due to assumption of convexity of the isoquants that marginal value of one of an input declines as more of it is used relative to another. That is, second partials are negative, $f_{EE} < 0$ and $f_{LL} < 0$. Specifically for a farm production function, there must be a limit to land size. Cultivating more land for a farmer becomes inefficient against using labor because adding more labor to land will increase the marginal productivity of land, as shown below with the second cross partial of land and labor, in which land is held constant in the short run:

$$f_{LE} = -f_{EE} \frac{dE}{dL} > 0 \tag{5}$$

The assumption of convexity in expression (5) sheds light on almost all size-related productivity analyses that there must be an optimal mix of inputs that are guided by the elasticity of substitution, which is the curvature of the isoquant, $\frac{f_E f_L}{Qf_{LE}}$.

a. Labor Market Imperfections

Many contractual problems that limit the farm size in the hazelnut industry arise from labor market imperfections. Hazelnut farming is mostly farmer-specific and this specificity is transferred to the family labor force easily over the time. While some farmers pay too much attention to the shortness of the cut sprouts, others may not care about it that much. While many prefer large number of branches in a group, many others prefer 5 to 10 of them. When a worker is hired for a hazelnut task, the owner-farmer has to instruct all these and similar specifications to each worker and motivate them each time. Motivation costs (Milgrom and Roberts, 1992; Nooteboom, 1993; Becker and Murphy, 1992) for temporary city-workers are higher relative to family-members and neighbor-farmers. Besides, hazelnut trees are vulnerable assets and require special care and treatment in order to protect their value. Therefore, stuck with high-slope lands that are not suitable for the use of machinery, hazelnut farmers need specialized and timely labor, which only could be found from the neighbor farmers or their own households. No worker chooses to specialize and invest human capital resources into a non-standardized and highly variable job. Thus, there is no formal and stable labor supply for hazelnut farming such that the farmer calls up a labor company and hires workers whenever he needs. These imperfections of the labor supply for hazelnut farming force the owner-farmers to rely on family labor and this in turn limit the farm size. That is, larger farm sizes should be expected where the family labor force is also larger. Sen (1962, 1966) translates these imperfections into cost terms that consist of transportation costs, efficiency wage, and search costs, which arise from the difference between the opportunity cost of family labor and the wage of hired labor (the Sen's wedge).

If there are constraints on the supply of the inputs or input supply is inelastic, then the firms may adjust their size or substitute inputs depending on the elasticity of substitution. Elasticity of substitution or the curvature of the isoquants, ties the use of one factor to another. While lower elasticity of substitution means tighter substitubility, higher elasticity of substitution means easier substitubility. Leontief production functions with zero elasticity of substitution, for instance, require fixed proportional use of each factor in production. Given the land size, farmers can substitute labor with machinery in order to increase total factor productivity and reduce labor-associated transaction and contractual costs. Thus, elasticity of substitution between both land and labor and labor and machinery plays its role in determining the size of land holdings. Since high-slope terrain prevents the intensive use of machinery and reduces the elasticity of substitution between labor and machinery, labor constraints remain as one of the crucial determinants of the farm size in the hazelnut industry of Turkey.

Farm household is segregated into three different labor regimes, labor sellers, labor buyers, and labor self-sufficient. These three regimes come with their own contractions and efficiency disadvantages. Sadoulet, et al. (1998) uses this segregation in order to identify the differential labor productivity and the effects of supportive elements, such as access to tractor and animals, irrigation, and bank loans, on farm production. For this study, however, the constraints or relative efficiency disadvantages of the three regimes affect the size of the land holdings.

b. Locally Inelastic Supply of Land

In the short run, land is almost everywhere supplied inelastically "locally". In particular, there is always a piece of hazelnut land available to buy for a farmer if he plans to increase the size of his farm. However, farmers prefer their land to be in viewing and hearing distances which is consistent with Cheung's (1970) argument about walnut trees and cattle. Moreover, transportation costs are higher with the remote lots. The survey results show that the largest lots owned by the Turkish hazelnut farmers constitute only 50% of the whole holdings on average and the largest lots are 1.7 mile[6] away from the farmer's residence on average. A "farm" usually represents an agricultural land that the owner-farmer lives on; however in the Turkish hazelnut farming farmers own lots at different locations and their residence is on one of the lots. Farmer families are mostly

[6] The survey data do not report information on how many different lots a farmer owns, how disperse they are, and what their shares in the total holding are.

tied to their residence; hence a land sale in the neighborhood is a quite rare phenomenon. This local inelasticity of land supply may also limit farm size that farmers may not prefer buying remote lands due to associated transaction costs.

c. Credit Constraints

Hazelnut farmers need financial assistance for both consumption needs and working capital to invest for the next crop during the winter and bad years. If the farmers do not have access to credit markets when they are needed, they will not be able to make investments for the next year's crop and keep this lack of the input market in mind in their size choices.

Farmers have basically two alternatives to get a loan. First, there is formal or regulated credit offered by either private and public banks or public sector organizations, such as the agricultural chamber or agricultural credit cooperatives. Second, informal credit is offered by private sector dealers. Bell et al. (1997) found in a study on rural Punjab farming, that many households fail to get credit offers due to pervasive rationing in the formal market. Moreover, they argue that despite enormously higher interest rates of the informal market, low elasticity of demand for credit, pervasive rationing in the formal market and opportunities of tying output market to the credit market, which enables farmers to pay with produce, unregulated borrowing make informal borrowing more attractive. While this is also true for the hazelnut farmers in Turkey, depending on the size of the land holding, trust, and repeated business, important reasons for the additional attractiveness of the informal market are (i) the low transaction costs on top of the interest rate of borrowing such that farmers can walk-in and borrow cash in minutes with no paperwork from a known dealer, (ii) the milder consequences of default relative to harsh and mostly foreclosure-ending formal market, and (iii) high probability of renegotiation. The transaction costs argument that is applicable to hazelnut farming of Turkey is very similar to Indian village local money lending as cited in Akerlof (1970: 499, 500):

"…He (local moneylender) is always accessible, even at night; dispenses with troublesome formalities, asks no inconvenient questions, advances promptly, and if interest is paid, does not press for repayment of principal. He keeps close personal touch with his clients, and in many villages shares their occasions of weal or woe. With his intimate knowledge of those who would otherwise get no loan at all. [Parenthesis added]*."*

A Hong Kong fishing village small shopkeeper's remarks cited in Akerlof (1970: 499) also are in the same line:

"I give credit to anyone who anchors regularly in our bay; but if it is someone I don't know well, I think twice about it unless I can find out all about him."

It should be noted here, however, that the local moneylenders in the hazelnut industry of Turkey are not mere cash stores. They deal with real hazelnut business and lend money on exclusive selling promises. It seems being a local agent of the dealers plays the key role concerning local money lending in the hazelnut industry despite higher rates of interest relative to formal credit market. Akerlof (1970) explains higher interest rates relative to formal market with local moneylender's (i) easy enforcing of his contracts, and (ii) personal knowledge of the character of the borrower.

Kochar (1997) implies that because of superior input, such as irrigated land, owners enjoy the access to formal credit markets and access to formal credit markets does not affect either the amount of land leased or tenurial status. Moreover, many small sized farms need not borrow from any outside source and small amounts that are necessary to finance working capital may be available at relatively lower cost from informal sources such as relatives, friends, and other fellow farmers. Therefore, access to formal credit is low valued and lack of access to formal credit does not constrain households in their working capital requirements, and hence should not affect the farmer's production decision. Kochar's (1997) arguments about limited need for outside financial assistance is not realistic for hazelnut farming in which only one crop is harvested in a year and periodicity can put farmers in long term need of financial assistance. One can expect limited need of financial assistance for the farmers when they grow a few crops seasonally in a year and when there is no periodicity. This again shows that intensively focusing on the land per se or another input in agricultural studies yet ignoring the type of crop and its properties can be misleading.

6. Other Reasons

Hazelnut farming may not take the whole working time of farmers and thus they can allocate some of their time to alternative employment. Sixty one percent of the farmers in our survey have secondary occupations besides hazelnut farming. There are farmers who migrated to big cities for job opportunities but kept their hazelnut lots. If the productivity of these remote and part-time farmers is smaller is a question that is tested in the empirical section of this study. Remote or part-time hazelnut farmers cannot only be explained by risk averseness that farmers allocate their labor time in different employment areas in order to minimize the losses from unexpected shocks, such as bad weather. The tree-nut nature of hazelnuts allows farmers to take alternative jobs since trees do not need daily care. Then, the availability of additional income sources at low-opportunity costs should reduce the need for gaining extra land and limit the size of holdings.

High risk that comes from natural effects, such as extreme variation in weather conditions and one-night frost, may limit the farm size. In addition to transaction costs explanations, this is why this study argues that variation in weather conditions will reduce the size of the hazelnut farms. The availability of a crop insurance to compensate loss due to weather risks might increase farm size.

CHAPTER FOUR

THE MODEL

Imagine a hazelnut farm owned by a family with a household of *M* working members and a family supervisor, *F*. The household owns and operates *A* acres of land with no rental land operated or rented out. Output, *Q*, is a function of the area cultivated, *A*, and effective labor, *L*. No capital is assumed for simplicity. Effective labor *L* depends on productivity or effort exerted by working family members, e_f, and efforts exerted by hired labor, e_l, *M*, and the number of hired labor, *N*. While the effort e_f depends on supervising ability, *F*, over *M*, e_l depends on the supervising ability of *K* over N. The hired supervisor *K* is subject to *F*. That is, *F* denotes the ability of the "monitor's monitor" or the "residual claimant". Land slope, *s*, variation in weather conditions, *v*, and the area farmed, *A,* are the other determinants of both e_f and e_l. Let e^* denote the maximum amount of effort that can be exerted by either a family member or hired labor. Then, the effective labor of family members, e_f:

$$e_f(F) = F(M, A, s, v) \qquad \lim_{e_f(F)=F(M,A,s,v)\to\infty} e_f \cong e^* \qquad \lim_{e_f(F)=F(M,A,s,v)\to 0} e_f \cong 0 \qquad (1)$$

As the monitoring ability of the family head goes to infinity, the effective labor of the family will become equal to maximum possible effort by family members. As the monitoring ability of the family head approaches to zero so will do the family effective labor.

The effective labor of the hired labor, e_l, in which the hired supervisors are subject to monitoring ability and activities of the family head, is:

$$e_l(F) = F\{K(N, A, s, v)\} \qquad \lim_{e_l(F)=F\{K(N,A,s,v)\}\to\infty} e_l \cong e^* \qquad \lim_{e_l(F)=F\{K(N,A,s,v)\}\to 0} e_l \cong 0 \quad (2)$$

As the monitoring ability of the family head over the hired supervisor goes to infinity, the effective labor of the hired labor will become equal to maximum possible effort. As the monitoring ability of the family head over the hired supervisor approaches to zero, the effective labor of the hired labor will also approach zero as well.

The number of family members and number of hired supervisors are a decreasing function of the supervising abilities of the family head. That is, $\frac{\partial F}{\partial M} < 0$, $\frac{\partial F}{\partial K} < 0$. The number of hired workers is also a decreasing function of number of hired supervisors. That is, $\frac{\partial K}{\partial N} < 0$. Note that it is assumed $\frac{\partial F}{\partial M} >< \frac{\partial K}{\partial N}$. That is, monitoring the family labor force may have lower or higher costs than the costs of monitoring the hired labor by the hired supervisor[7].

Then, the combined effective labor:

$$L = A \cdot [M \cdot e_f(F) + N \cdot e_l(F)] \tag{3}$$

Output is a function of land area, *A*, and effective labor, *L*:

$$Q = Q(L, A) \tag{4}$$

Rewriting 4 in terms of 3 yields:

$$Q = Q(A \cdot [M \cdot e_f(F) + N \cdot e_l(F)]; A) \tag{5}$$

Output per acre of land can be expressed as:

[7] Family labor may not necessarily be easier to monitor or more effective relative to the hired labor due the free-riderness in the family (Peters et al. , 2004; Becker, 1981; Becker, 1988) and institutional slackness, such as the difficulty of firing a family member.

$$\frac{Q}{A} = Q\left(\frac{A \cdot [M \cdot e_f(F) + N \cdot e_l(F)]}{A}; \frac{A}{A}\right)$$
$$= q[M \cdot e_f(F) + N \cdot e_l(F)] \quad (6)$$

Where, $q = \frac{Q}{A}$ with $\frac{\partial q}{\partial A} < 0$.

Family farmers are faced with the following cash constraint, *C*, for their production:

$$C \geq w_l(s,v) \cdot N \cdot A + w_k(s,v) \cdot K \cdot A + a(s,v) \cdot A + g \cdot M \quad (7)$$

Where, $w_l(s,v)$ denotes the market wage for hired labor, $w_k(s,v)$ denotes the wage rate for the hired monitorer and team head, $a(s,v)$ denotes for intermediate input costs per acre, and g denotes for consumption expenditures per family member. Note that $\frac{\partial w_l}{\partial s} > 0$, $\frac{\partial w_l}{\partial v} > 0$, $\frac{\partial a}{\partial s} > 0$, $\frac{\partial a}{\partial v} > 0$, and $w_k(s,v) > w_l(s,v)$. That is, land slope and weather variation call for higher wage rates and higher costs of intermediate inputs.

At the outgoing price of *P*, now we can formulate a profit maximization equation for the farmer as follows:

$$\max_{A,N} \pi = P \cdot A \cdot q[M \cdot e_f(F) + N \cdot e_l(F)] - \left[w_l(s,v) \cdot N \cdot A + w_k(s,v) \cdot K \cdot A + a(s,v) \cdot A + g \cdot M\right] \quad (8)$$

Equation 8 is constrained by $A \geq 0, N \geq 0, s \geq 0$, and $v \geq 0$.

Then, the profit maximizing amount of land can be found as follows:

$$\frac{\partial \pi}{\partial A} = P \cdot q[M \cdot e_f(F) + N \cdot e_l(F)] + P \cdot A \cdot q' \cdot \left(\frac{\partial (L^M / A)}{\partial A} + \frac{\partial (L^N / A)}{\partial A}\right) - \left[w_l(s,v) \cdot N + w_k(s,v) \cdot K + a(s,v)\right] = 0 \quad (9)$$

Where $L^M = A \cdot M \cdot e_f(F)$ *and* $L^N = A \cdot N \cdot e_l(F)$.

Then, the profit-maximizing amount of land, A^*, is:

$$A^* = \frac{P \cdot q[M \cdot e_f(F) + N \cdot e_l(F)] - [w_l(s,v) \cdot N + w_k(s,v) \cdot K + a(s,v)]}{P \cdot q' \cdot \left(\frac{\partial (L^M / A)}{\partial A} + \frac{\partial (L^N / A)}{\partial A} \right)}$$

$$= \frac{P \cdot q[M \cdot e_f(F) + N \cdot e_l(F)] - [w_l(s,v) \cdot N + w_k(s,v) \cdot K + a(s,v)]}{P \cdot q' \cdot \left(M \cdot \frac{\partial e_f}{\partial A} + N \cdot \frac{\partial e_l}{\partial A} \right)} \quad (10)$$

The main theoretical interest of this study is the effects of the land slope, *s*, and weather variation, *v*, on the profit maximizing farm size, *A**, and it can be shown as follows:

$$\frac{\partial A^*}{\partial s} = \frac{\left[P. \left(\frac{\partial q}{\partial e_f} \frac{\partial e_f}{\partial s} + \frac{\partial q}{\partial e_l} \frac{\partial e_l}{\partial s} \right) - \left(\frac{\partial w_l}{\partial s} \cdot N + \frac{\partial w_k}{\partial s} \cdot K + \frac{\partial a}{\partial s} \right) \right] \cdot P \cdot q' \cdot \left(M \cdot \frac{\partial e_f}{\partial A} + N \cdot \frac{\partial e_l}{\partial A} \right)}{\left[P \cdot q' \cdot \left(M \cdot \frac{\partial e_f}{\partial A} + N \cdot \frac{\partial e_l}{\partial A} \right) \right]^2}$$

$$- \frac{\left(P \cdot q[M \cdot e_f(F) + N \cdot e_l(F)] - [w_l(s,v) \cdot N + w_k(s,v) \cdot K + a(s,v)] \right) \cdot P \cdot q' \cdot \left(M \cdot \frac{\partial \left(\frac{\partial e_f}{\partial A} \right)}{\partial s} + N \cdot \frac{\partial \left(\frac{\partial e_l}{\partial A} \right)}{\partial s} \right)}{\left[P \cdot q' \cdot \left(M \cdot \frac{\partial e_f}{\partial A} + N \cdot \frac{\partial e_l}{\partial A} \right) \right]^2} < 0. \quad (11)$$

Similarly,

$$\frac{\partial A^*}{\partial v} = - \frac{\left[P. \left(\frac{\partial q}{\partial e_f} \frac{\partial e_f}{\partial v} + \frac{\partial q}{\partial e_l} \frac{\partial e_l}{\partial v} \right) - \left(\frac{\partial w_l}{\partial v} \cdot N + \frac{\partial w_k}{\partial v} \cdot K + \frac{\partial a}{\partial s} \right) \right] \cdot P \cdot q' \cdot \left(M \cdot \frac{\partial e_f}{\partial A} + N \cdot \frac{\partial e_l}{\partial A} \right)}{\left[P \cdot q' \cdot \left(M \cdot \frac{\partial e_f}{\partial A} + N \cdot \frac{\partial e_l}{\partial A} \right) \right]^2}$$

$$- \frac{\left(P \cdot q[M \cdot e_f(F) + N \cdot e_l(F)] - [w_l(s,v) \cdot N + w_k(s,v) \cdot K + a(s,v)] \right) \cdot P \cdot q' \cdot \left(M \cdot \frac{\partial \left(\frac{\partial e_f}{\partial A} \right)}{\partial v} + N \cdot \frac{\partial \left(\frac{\partial e_l}{\partial A} \right)}{\partial v} \right)}{\left[P \cdot q' \cdot \left(M \cdot \frac{\partial e_f}{\partial A} + N \cdot \frac{\partial e_l}{\partial A} \right) \right]^2} < 0. \quad (12)$$

That is, higher slope and greater weather variation should lead to a decrease in the profit maximizing farm size, respectively, in order to be consistent with the assumptions of the size-decreasing effects of the nature-induced transaction costs. That is, nature, namely slope and variation in the weather conditions, should affect the farm's production through two dimensions. First, it reduces the managerial returns to farmers' efforts exerted in the farming. Indeed, managing the working capital and labor over a high slope land is costlier relative to the flatter ones. For climbing up and down to monitor the laborers may require more effort and it reduces the managerial returns to the farmers' efforts. High weather variance, particularly the variance of rain, may also require some more managerial inputs relative to stable conditions. Seeking, tracking, and processing weather information are costly tasks. The weather information system in Turkey has been poor in the sense that there is no frequent and zip code based forecasting. Farmers sometimes have to use the weather information which belongs to locations even 30-40 miles away. As noted earlier, while the variance of weather conditions can affect the productivity directly through risk, it can increase the transaction costs when the outdoor nature of farm production is taken care into account. When it rains, it sometimes rain for weeks and farmers have to wait for a reasonable time to be able to run labor, machinery, and draft animals on their lands. Additionally, high rain variation reduces contractual performance and requires revisions and renegotiations and this comes with time and money costs. Second, high slope and high weather (rain) variation increases the costs of using the intermediate inputs for the farm production. Moving the stuff up and down the hill is costlier in the sloppy areas relative to flatter ones. Minimum winter temperature affects the winter maintenance, for instance, that it requires proper dressing and shorter work hours. The empirical analysis of this study will scrutinize the occurrence of these effects on the hazelnut production in Turkey.

CHAPTER FIVE

DATA AND METHODOLOGY

So far, it has been argued that the transaction costs that come from natural effects might limit the size of the hazelnut farms. The tests of this main theoretical prediction through appropriate regression analyses are utilized through two separate data sets. The first data set provides a snapshot of the characteristics of farmers, such as size of their holdings, their income, working age family members, and so on, and is formed from a survey that questioned 99 randomly selected individual farmers from the locations of Unye, Fatsa, Caybasi, Ikizce, Akakoca, Duzce (merkez), Golyaka, Cilimli, Akcaabat, Arsin, Vakfikebir, Bulancak, Eynesil, Kesap, Tirebolu, Trabzon (merkez), Giresun (merkez), Terme, and Carsamba in the year 2006[8]. The second data set consists of cross sectional figures that come from hazelnut producing sub-provinces of Ordu (Merkez), Akkus, Aybasti, Camas, Caybasi, Fatsa, Golkoy, Gurgentepe, Ikizce, Kabaduz, Kabatas, Korgan, Kumru, Mesudiye, Persembe, Ulubey, Unye, Giresun (merkez), Bulancak, Çanakçı, Dereli, Doğankent, Espiye, Eynesil, Görele, Keşap, Piraziz, Tirebolu, Duzce (merkez), Akcakoca, Cilimli, Golyaka, Gumusova, Yigilca, Trabzon (merkez), Akcaabat, Araklı, Arsin, Beşikdüzü, Çarşıbaşı, Çaykara, Dernekpazarı, Düzköy, Hayrat, Köprübaşı, Maçka, Of, Sürmene, Şalpazarı, Tonya, Vakfıkebir, Yomra, Terme, and Carsamba. While these sub-provinces constitute the majority of the production locations, the rest of the locations were excluded from the analysis for data availability concerns. This data set provides information about the natural, economic, and demographic characteristics of

[8] See Appendix A for the summary statistics of the survey results.

each location in order to explore the variation in farm size and natural effects across the regions. Most of the regional data came from local agricultural offices. The data on regional hazelnut production is collected from Fiskobirlik. The weather data came from Turkish State Meteorological Service. Macroeconomic and demographic figures were compiled from Turkish Statistical Institute (TUIK), State Planning Organization (DPT), Central Bank of Turkey, and the local governor's offices and websites. The other data sources are Oregon Hazelnut Growers Union, The Black Sea Exporters Union, and Hazelnut Promotion Group.

For the first data set about the individual farmer characteristics, one of the main issues that had to be dealt with was the aggregation problem of farm size and total land holdings of a farmer. However, farmers are observed to own lands at different locations. Therefore, establishing a meaningful link between the natural effects that are associated with a piece of land owned by a farmer and his total farm size would be impossible. Sampath (1992), for instance, argues that total land area fails to reveal different properties, such as irrigated and non-irrigated characteristics, of the lands. In the case of hazelnut farming, farmers own lots at different locations with different properties. Similarly, statistical data does not provide detailed information about each land segment held by farmers. This problem has been relaxed by using the information about the largest lot owned by a farmer as a proxy. Survey results show that the largest lots constitute 49% of the total holdings per farmer on the average. When the individual farmer characteristics are analyzed empirically, climate data from the regional data was combined with this individual data set in order to reflect the effects of the natural effects of the regions that the farmers live in. Using two separate data sets will allow the study to make a cross check on the figures and regression analysis.

According to the survey results, mean farmer age is 51, mean tenure is 25, families consist of 2-3 members, and they keep 1-2 animals, mostly for dairy needs as mentioned earlier. Fifty seven percent of the farmers is found to have secondary job. This high ratio is consistent with the arguments of this study that one of the “other” determinants of the size of the hazelnut farms such as the tree-nut nature of the hazelnuts does not require day by day care. This high ratio secondary occupation also raises questions about the definition of a farmer and it is one of the sources of the debates that pop up each year over the governmental support prices. Some argue that hazelnuts do not require intensive year long care, unlike the other farmers hazelnut farmers can have secondary occupations, and therefore hazelnut farming should be subsidized. Since the effects of having a secondary job is taken into account in the empirical analysis, this definition difficulty is not a major problem for this study. Mean family income is $16,247 with of that $7,320 is from non-hazelnut sources, consistent with having secondary jobs. Twenty eight percent grows vegetables, fruits, or keep bees for income. While mean family output is around 7,200 pounds; mean productivity is 295 pounds per acre.Twelve percent keeps a draft animal, 24% owns a tractor (probably the light ones), and 49% owns transportation. Only 26% had a recent technical support such as soil test, advice on appropriate fertilizers, or pesticides. It has been stressed that land slope, a transaction cost-increasing natural effect, is one of the main interest variables of this study. Since we have no information on the number of separate lots owned by a farmer and their mean slope, the slope of the largest lot is used for a proxy along with other properties of the largest lot. The mean slope of the largest lot is 27 degrees with a maximum of 70 degrees. Regional data, however, reveals 32 degrees of mean slope and with a maximum of 47 degrees. Forty five percent the largest lots face the north. This is consistent with the north-facing nature of the mountains in the Black Sea region. Fifty one percent of the largest lots receive a river, lake, or sea effect. Mean distance from the sea is about 11-12 miles. Distance from the sea could be of an importance for two reasons. First, the sea might have direct effects on productivity through wind, temperature, and rain. Second, big cities, larger agricultural suppliers, agricultural offices, and major dealers are usually located on the coastal lane. Assuming being close to a big city is advantageous, transaction costs are higher for distant farmers. Mean altitude of the farms is 842 feet. Mean fertilizer consumption is 1,700 pounds in a year and 38% of the farmers applied organic fertilizers. Farmers have 5 trees per acre on their largest lots. Trees are basically a productivity reducing factor because of their shadows. Mean distance between farms and farm houses is about 1.7. This high distance is probably because some of the farmers live in the city and commute their farms when they need to. This is also consistent with having a secondary job. Farmers employ around 11 work days of labor per acre in a year. While 45% of the labor need is met from outside hiring on average, 58% of the harvesting is done by the family labor force. This is probably because all the family members take their vacations during the harvesting time and come together from different locations. Farmers own 1.9 acres of non-hazelnut land on average. This small amount shows there is no alternative (profitable) use of the land besides hazelnuts in the areas where the survey is done.

In the regional data set, the main farm size is about 2.6 acres. Contrary to 9 acres came out from the survey results; this figure is closer to the 3.65 acres provided by TUGEM, Hazelnut Promotion Group, and Fiskobirlik. The noticeable difference in the survey data figure may result from the fact that around 1/3 of the farmers questioned were from Unye, one of the largest hazelnut producing sub-provinces. When the mean family income is taken into account, the range of 2-4 acres per farmer seems to be unrealistically small. However, there will always be measurement difficulties with this figure because of the definition of the farmer, family head, number of family members living together, and more importantly unreported lands. Farmers try to expand their hazelnut lands by cultivating the Treasury or forest lands illegally and do not report them. Therefore, survey data, supported with a reasonable annual income range, may provide a more realistic figure of farm size[9]. In the regional data set, the mean altitude of the hazelnut producing regions is about 1,450 feet. Mean distance from the sea is 15 miles approximately. Mean productivity is 463 pounds. Mean land slope is about 32 degrees, which is close to 27 degrees of the slopes of the largest lots in the farmers data. Besides the slope data, regions have around 5% of flat lands. In the regions, 57% of the population lived in the rural area (43% in the cities) in the year of 2000. The mean variance of maximum temperature is 32.56; mean variance of minimum temperature is 50.31; mean variance of total rain 3,078; mean variance of average temperature is 38.56.

[9] The government has been running a direct payment subsidy program for about 3 years. Farmers have to report their actual lands in order to be eligible to get the benefits of the program. It is expected that more accurate farmer data will come out after the results of this program is processed.

Along with total monthly weather figures, these variance figures are very strong in a sense that they were calculated as averages over 20-30 years for the majority of the regions. The monthly break down of the data enables capturing the seasonal effects on different development phases of the hazelnut trees in a year. Temperature during the pollination, harshness of the winter, rains during the early development and temperature and rain during the late development can affect the productivity of the hazelnuts directly and indirectly through the transaction costs. Monthly break down of the data allows capturing these effects and this has been taken into account during the empirical analysis. Since there were no weather observation stations at each cross sectional unit, some of the weather data were used interchangeably between the following locations based on 20-30 miles of maximum geographical distance: Camas, Fatsa; Caybasi, Unye, Ikizce; Gurgentepe, Golkoy; Kabaduz, Ulubey; Kabatas, Aybasti; Persembe, Ordu; Canakci, Dogankent; Dereli, Yavuzkemal; Espiye, Tirebolu; Gorele, Eynesil; Piraziz, Bulancak; Cilimli, Duzce, Golyaka; Gumusova, Hendek; Besikduzu, Vakfikebir, Carsibasi; Dernekpazari, Caykara, Koprubasi; Hayrat, Of, Surmene; Salpazari, Tonya; Yomra, Arsin.

Theoretical assumptions of this study will be tested through the appropriate regression analyses. Having cross sectional and individual data sets in hand, the OLS (Ordinary Least Squares) seems to be the starting benchmark estimation method. Smallness of the sample size of the both data sets and related possible complications, such as heteroscedasticity and endogeneity, in the estimations will require appropriate treatment of the OLS estimations, such as bootstrapping and instrumental variable (IV) estimation methods.

CHAPTER SIX

EMPIRICAL ANALYSIS

So far, it has been argued in this study that natural effects may increase transaction costs and thus reduce the size of the hazelnut farms. The relevant data was explained briefly in the previous chapter. In this chapter, two regression models are estimated in order to verify if the assumptions about the relationship between the proxied transaction costs and land size hold. While the first model analyzes the farm size using the data on farmer characteristics, the second model utilizes the regional data for the same purpose. After several trials, only the best models are reported here and relevant variables explained in detail below.

It should be noted here that the wage rate, hazelnut price, the price of alternative crops, institutional effects, such as the limitations on the inheritance and the transfer of the hazelnut lands, and policy effects, such as tax and subsidy applications have been assumed constant across the regions in all of the models.

Table-4 shows the results of the OLS, bootstrapped OLS, instrumental variable (IV), and bootstrapped IV estimations of the following structural model on the characteristics of the i^{th} farmer in the s^{th} location:

$$Y_{i,s} = \alpha + \beta_1\, productivity_{i,s} + \beta_2\, tenure_{i} + \beta_3\, tenuresquare_{i} + \beta_4\, slope_{i,s} + \beta_5\, rain\ variance_{i,s} + \beta_6\, amount\ rain\ in\ august_{i,s} + \varepsilon_{i,s}$$

While the survey data had 99 observations, estimations here use 88 observations due to missing weather data for the two, Terme and Carsamba, of the locations.

Table 4. OLS and IV Estimations on Farmer Characteristics

Dependent Variable: Size of the land holdings per farmer (acre, log)

	OLS	BTSTPD-OLS	IVREG$^{\Omega}$	BTSTPD-IVREG
Productivity (output/acre)	-0.296*	-0.296*	-1.010*	-1.010*
	(0.069)	(0.071)	(0.314)	(0.353)
Tenure	0.038**	0.038**	0.050+	0.050+
	(0.018)	(0.018)	(0.027)	(0.027)
Squared tenure	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Slope	-0.036**	-0.036**	-0.063*	-0.063**
	(0.014)	(0.015)	(0.024)	(0.029)
Variance of rain (log)	-1.083+	-1.083+	-2.067**	-2.067+
	(0.631)	(0.633)	(1.012)	(1.115)
Amount of rain in August (log)	1.106**	1.106**	1.853**	1.853**
	(0.457)	(0.442)	(0.739)	(0.776)
Constant	6.988+	6.988+	14.405**	14.405**
	(3.706)	(3.782)	(6.247)	(7.243)
Observations	88	88	88	88
F-stat	5.20			
White Chi_Sq(27) p=	.99			
White, Fitted Chi-Sq(2) p=	.45			
Pagan-Hall Test for IV Chi-Sq(7) p=			.99	
B-P/C-W Test Chi-Sq(1) p=	.25			
Anderson Chi-Sq.(2) p=			.09	.09
Sargan Chi-Sq (1) p=			.17	.17
R-squared	0.28			

Standard errors in parentheses. Bootstrapped errors are robust.
+ significant at 10%; ** significant at 5%; * significant at 1%

$^{\Omega}$Instrumented : Productivity
Included instruments : Slope, tenure, squared tenure, variance of rain, rain in August
Excluded instruments: Secondary occupation, percentage of outside labor use, owning a tractor, owning a draft animal, distance of the largest lot from the farmer's residence.
Duplicates :Tenure, squared tenure, slope, variance of rain, rain in August.

In these estimations, dependent variable is the log of the hazelnut planted acres owned by each farmer. The independent variable is the output per acre. Since the dependent variable is in logs, productivity, which is basically the output divided by land area, could not be used in logs. In the OLS estimation, productivity is significant and it has a negative sign as expected based on the inverse relationship (IR) theory of land size and productivity. As it will be seen below, productivity has a negative sign in all of the estimations, implying a strong tendency toward the IR, which may mean that smaller farms are more productive due to intensive use of labor. That is in the hazelnut farming in Turkey, smaller the land size yields greater productivity. Tenure is the number of years that the farmer keeps and operates his own land. The squared term of tenure is included in the model in order to show if any nonlinear behavior of the land size holds regarding the farm size. Squared tenure is insignificant yet has a negative sign implying a downturn at a certain year of the tenure. Slope is one of the main interest variables of this study since the transaction costs will be higher with the higher-slope lands. Slope is the average land slope of the region that a farmer lives in and it is assumed to be uniformly distributed within the regions. The slope of the largest lots has been used for the same purpose, however, it has never been found significant in any of the estimations. Slope has a significant negative sign, denoting that, holding other relevant factors constant, higher the slope lower the farm size, as expected. Variance of rain is the log of the mean variance of total rainfall in the regions that the farmers live in[10]. Considering it might be correlated with minimum temperature, high rain variance would mean high risk and high

---

[10] The rain and temperature data are assumed to be uniformly distributed within the regions and within the days of the months.

transaction costs through the instability of the wage contracts, and therefore reduces the farm size. The variance of rain variable is statistically significant at the 10% significance level and has a negative sign in the OLS estimation. Rain in August is the log of the rain amount in August as averaged over 20-30 years. It is statistically significant at the 5% level and implies that holding other factors constant, higher the amount of August rain the larger the size of the hazelnut farms. This result is consistent with the idea that rains close to harvesting may increase productivity since high temperature, tropical winds, and drought reduces crop substantially in this period. Rain in September imposes transaction costs since a majority of the farmers sun-dry the hazelnuts for about 7-15 days in this month. However, the coefficient of a relevant variable, rain in September (in log), turned out to be insignificant in all of the trials. It should be noted here that the timing of harvesting and sun-drying may vary across the regions. Rain and temperature values are assumed to be uniformly distributed within the regions and across the days of a month. In fact, there are the chances that the whole amount of the rain might have fallen on a single day and a narrow location in a particular month.

Based on the F-statistics, the OLS estimation seems to be statistically significant as a whole and it seems it is not suffering from severe heteroscedasticity, which is a common problem with the cross sectional analysis, based on the B-P Test, White (Fitted, General) Test. However, running an OLS estimation on a reasonably small size of the sample may cause small sample bias and a simulation may be required. For this purpose a bootstrapped OLS estimation has been run in order to see if there is any significant difference between the standard errors. As shown in Table-4's third column, bootstrapped

OLS estimation did not produce different standard errors and significance levels. However, productivity in the OLS estimations could be endogenous and OLS estimation might have produced biased coefficients. Therefore an IV (instrumental variable) estimation has been run using the following variables: secondary occupation, the percentage share of the outside-hired labor, owning a tractor, owning a draft animal, and largest lot's distance from the farmer's house in order to get rid of a possible bias. As shown in Table-4's fourth column, IV estimation produced different coefficients and different significance levels. While productivity had a coefficient of -.30 with the OLS estimations, its value went down to -1.01 with the IV estimation but its significance level has not changed. The coefficient of tenure went down to -.05 with a decrease in the significance level as well. The coefficient of slope variable also went down but the slope variable has become more significant statistically. The same has been observed with variance of rain and rain in August. Instrumental variable estimation results show that OLS estimations have produced biased coefficients. The Sargan test shows that the instruments are correctly excluded from the estimated model, i.e., error terms and the instruments are uncorrelated. Anderson canonical correlations test rejects the null hypothesis that the model is underidentified. The Pagan-Hall Test shows there is no heteroscedasticity problem with the IV estimation. Due to the smallness of the sample size, bootstrapping has also been applied to the IV estimation and no major changes in the standard errors and significance levels have been observed. Therefore, it can be concluded that the results of the IV estimation can be used for inferences in testing the theoretical implications. Instrumental variable estimations yield that based on statistically significant coefficients and negative signs of the interest variables of slope and variance of rain, holding other factors constant, higher transaction costs lead to lower farm sizes in the hazelnut industry of Turkey. Particularly, holding other factors constant, 1 degree increase in the land slope will lead to .063 percent decrease in the farm size; a 1 percent increase in the variance of rain will lead to 2 percent decrease in the size of the hazelnut farms.

Besides the models about the individual farmer characteristics, the relationship between the farm size and transaction costs is tested with additional OLS and IV estimations of the following structural model on regional farm characteristics.

$$Y = \alpha + \beta_1 \, productivity + \beta_2 \, slope + \beta_3 \, density + \beta_4 \, urban\ population\ share + \beta_5 \, minimum\ temperature\ in\ January\ February\ and\ March + \beta_6 \, variance\ of\ rain + \varepsilon$$

Dependent variable in these estimations is the log of mean farm size within a sub-province. The results of these estimations are shown in Table-5 and the variable description is as follows.

Table 5. OLS and IV Estimations on Regional Characteristics

Dependent Variable: Mean land holdings within a region (acre, log)

	OLS	BST-OLS	IVREG§	BST-IVREG§
Productivity (100 lb/acres)	-0.049	-0.049	-0.103	-0.103
	(0.007)	(0.090)	(0.180)	(0.450)
Land slope	-0.034*	-0.034*	-0.034*	-0.034*
	(0.007)	(0.007)	(0.013)	(0.012)
Population density (10/km^2)	-0.014*	-0.014**	-0.006*	-0.006
	(0.004)	(0.006)	(0.004)	(0.015)
Share of urban population	0.796*	0.796*	0.739*	0.739
	(0.217)	(0.269)	(0.221)	(0.614)
Mean minimum temperature in January, February, and March	0.086*	0.086*	0.092*	0.092**
	(0.024)	(0.024)	(0.029)	(0.045)
Variance of rain (log)	-0.341**	-0.341+	-0.339**	-0.339
	(0.147)	(0.171)	(0.136)	(0.207)
Constant	6.063*	6.063*	6.285*	6.285**
	(1.382)	(1.541)	(1.457)	(2.601)
Observations	46	46	46	46
F-stat	9.05			
White Chi_Sq(27) p =	.07			
White, Fitted Chi-Sq(2) p =	.44			
Pagan-Hall Test for IV Chi-Sq(7) p =			.80	
B-P/C-W Test Chi-Sq(1) p =	.17			
Anderson Chi-Sq.(2) p =			.033	.033
Sargan Chi-Sq (1) p =			.640	.640
R-squared	0.58			

Standard errors in parentheses. Bootstrapped errors are robust.
+ significant at 10%; ** significant at 5%; * significant at 1%

§Instrumented : Productivity
Included instruments : Slope, population density, share of urban population, mean minimum temperature in January, February, and March, and variance of rain.
Excluded instruments : Minimum temperature in October and November, change in the rural population share.
Duplicates : Slope, population density, urban population share, mean minimum temperature in January, February, and March, and variance of rain.

In these estimations, the dependent variable of productivity is mean productivity, which is calculated as output divided by acres owned by the farmers in a particular location. Since the dependent variable is in log terms, productivity could not be used in log terms. While it has a negative sign, it is not statistically significant in the OLS estimation as shown in the second column of Table-5. One of our interest explanatory variables, slope, has a negative sign and its coefficient is statistically significant at 1% significance level. Population density (10 persons/km^2) has a negative sign, denoting that the higher the population density the lower the farm size, *ceteris paribus*. This is consistent with the intuition that populated areas will have smaller farm sizes. The coefficient of the share of the urban population has a positive sign, as expected, and it is statistically significant. That is, in the areas where more people live in the cities, farm sizes are expected to be larger. The mean minimum temperature in January, February, and March throughout 20-30 years for most of the regions has a positive sign, as expected, and its coefficient is a statistically significant one, denoting that higher minimum winter temperatures will lead to higher farm size. Considering one-night frosts usually cause substantial crop losses each year, this variable has a particular importance based on the assumption that colder winters signal a higher possibility of a one night frost. Moreover, as it was mentioned earlier, colder temperatures increase the costs of winter farm maintenance. Besides slope, variance of rain, which was calculated from the amount of monthly rain for 20-30 years, is the other interest variable in terms of its transaction costs-increasing effects. As expected, variance of rain has a negative sign and its coefficient is statistically significant at 5% significance level denoting that in the areas where the rain variance is higher, farm sizes will be smaller, holding other relevant factors constant.

The OLS estimation shown in the second column of Table-5 is significant as a whole. As based on the F-test value of 9.05, it does not seem to suffer from severe heteroscedasticity as based on the B-P and White-Fitted Tests, except for the White-General Test that shows a heteroscedasticity at the 10% significance level. However, its small sample size might cause a small sample bias and require a simulation in order to verify that error terms are distributed normally. For this purpose a bootstrapped OLS has been run and it generated slightly different standard errors and caused slight significance level changes. Besides the estimation issues that might arise from smallness of the sample size, endogeneity of productivity might cause biased coefficients. Therefore, an IV estimation has been run using the instruments of the mean minimum temperature of the months of October and November throughout 20-30 years, and change in the rural population share from the year of 1990 to 2000. While the Sargan statistics shows that the instruments are correctly excluded from the model, the Anderson canonical correlations test rejects the null hypothesis that the model is under-identified. It basically implies that holding other factors constant, 1 degree increase in slope will lead to a 0.03 percent decrease in the farm size. The Pagan-Hall test rejects that the variance of the error terms are not constant. The small sample size requires a bootstrapping on the IV estimation also and it causes changes in the standard error and significance levels by verifying small sample bias within the estimation. Based on the bootstrapped IV estimation results, it can be inferred that 1 degree increase in the average slope of the region will lead to a .03

percent decrease in the farm size. A 1 degree increase in the mean minimum temperature of January, February, and March, will lead to .09 percent increase in the size of the hazelnut farms. Besides the direct effects of winter temperature on the productivity, this result is consistent with the expectation that winter maintenance will be costlier in the colder areas. The coefficient of the variance of rain lost its significance after bootstrapping the IV estimation. However, it still has a negative coefficient. In parallel with the results from the estimations on individual farmer characteristics, these results confirm our assumptions about the size decreasing effects of nature-induced transaction costs.

CONCLUSION

This study analyzes the determinants of the size of the hazelnut farms in Turkey within the framework of the theory of firm and transaction costs. This study argues that farm production is subject to natural effects depending on their location and natural effects can increase the costs of using productive resources. Therefore, holding input prices constant, the cross sectional variation in the farm size should come from the variation of transaction costs. However, transaction costs are not easily measurable even though they are considered during decision making. This study takes land slope and variation in the weather conditions as proxies for transaction cost measurements that assert higher land slope and rain, particularly, increase the costs of using farming inputs. This link between the natural forces, transaction costs, and the farm size has been found to be supported by the empirical analysis based on the OLS and IV estimations that utilize individual and regional data sets. Negative significant relationships between the land slope, weather variation, and farm size are the main findings of this study.

Besides, the study stressed the importance of crop characteristics, which is a phenomenon that has been ignored in size and productivity analyses. In fact, the vulnerable nature of hazelnut trees affect the nature of contracts and associated transaction costs, such as monitoring costs, particularly, in the hazelnut farming. In this context, the study also argued that lump-sum pay schedules are not necessarily inferior to piece rate or rank-order tournament pay schedules under all circumstances. Moreover, the study highlighted situations in which repeated dealings and trust ensure that contracts are based on the expected performance rather than strict and continuous term-by-term monitoring.

APPENDICES

Appendix A

Farmer Survey Data Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Farmer's age	99	51.52	12.68	24.00	91.00
Years owned his owned land	99	25.21	14.72	1.00	70.00
Number of family members	99	2.62	1.65	0.00	10.00
Number of animals kept	99	1.94	6.04	0.00	60.00
Secondary job (1,0)	99	0.57	0.50	0.00	1.00
If the farmer grows vegetables, fruit, keep bees for income (1,0)	99	0.28	0.45	0.00	1.00
Annual income ($)	99	16,247.66	19,853.59	1,481.48	148,148.10
Non-hazelnut income ($)	99	7,320.24	14,807.80	111.11	111,111.10
Hazelnut income ($)	99	8,927.42	5,045.79	1,370.37	37,037.00
Hazelnut acres	99	9.27	10.16	0.66	76.04
Total crop (lb.)	99	7,204.20	6,133.57	660.79	33,039.65
Productivity (lb./acres)	99	295.78	119.84	105.73	629.33
If a draft animal is owned (1,0)	99	0.12	0.33	0.00	1.00
If a tractor owned (1,0)	99	0.24	0.43	0.00	1.00
If a transportation owned (1,0)	99	0.49	0.50	0.00	1.00
If the farmer received a recent technical support (1,0)	99	0.26	0.44	0.00	1.00
The size of the largest lot (acres)	99	4.56	5.41	0.66	41.33
Slope of the largest lot	99	27.15	18.14	0.00	70.00
If the largest lot faces North (1,0)	99	0.45	0.50	0.00	1.00
If the largest lot is nearby a sea, river, and lake (1,0)	99	0.51	0.50	0.00	1.00
Distance from the sea (mile)	99	11.60	11.68	0.04	56.13
Altitute (ft.)	99	842.41	806.92	32.81	4,265.09
Amount of fertilizer used (lb.)	99	1,703.85	1,780.20	2.20	11,013.22
Amount of pesticides used (lb.)	92	31.66	39.35	0.00	220.26
If the farmer used organic fertilizers (1,0)	99	0.38	0.49	0.00	1.00
Number of trees affecting the largest lot	99	25.12	17.16	1.00	65.00
Total crop from the largest lot (lb.)	99	4,064.88	3,624.68	440.53	22,026.43
Productivity of the largest lot (lb./acres)		891.7583	669.8373	666.2562	533.005
Labor use number of work days (hired + family labor)	99	101.98	88.01	5.00	500.00
Largest lot's distance from the farmers residence (mile)	99	1.69	5.89	0.00	46.77
Share of the outside labor use	99	45.26	40.86	2.00	100.00
Share of the harvesting done by family labor	99	58.13	40.26	5.00	100.00
Non hazelnut area (acres)	99	1.89	4.18	0.17	33.06

Appendix B

Regional Data Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Mean farm size (acres)	52	2.59	1.45	0.34	6.54
Altitude (ft.)	52	1,453.25	1,502.19	1.00	5,872.00
Distance from the sea	52	15.44	15.26	1.00	58.80
Productivity of the region (lb./acre)	52	463.85	99.91	146.14	693.76
Population (2000)	52	11,438.15	6,062.58	221.00	19,800.00
Mean slope	52	31.80	9.65	10.00	46.80
Share of the flat areas	52	4.73	8.15	0.00	50.00
Per capita GDP (1996)	52	106.47	62.95	38.61	272.18
Population 1990	52	42,931.06	39,924.24	7,270.00	216,605.00
Urban population (1990)	52	18,118.56	27,396.69	2,250.00	161,886.00
Rural Population (1990)	52	24,812.50	17,222.21	4,394.00	74,522.00
Population (2000)	52	48,322.31	49,037.54	7,477.00	283,233.00
Population (1996)	52	45,626.68	44,366.71	7,698.50	249,919.00
Urban population (2000)	52	23,347.75	34,412.97	3,728.00	214,949.00
Rural population (2000)	52	24,974.56	20,202.66	3,019.00	103,041.00
Poulation change (%, 1996-2000)	52	7.89	15.74	-23.15	49.69
Urban poulation change (%, 1996-2000)	52	28.54	28.70	-30.50	95.17
Rural poulation change (%, 1996-2000)	52	-4.87	18.56	-46.79	37.62
Variance of average temperature	52	38.71	1.09	37.71	40.08
Variance of average rain	52	2,644.12	714.52	1,979.07	3,790.60
Population density	49	196.01	188.40	24.20	1,229.52
Urban population share (1990)	52	0.36	0.15	0.10	0.75
Rural population share (1990)	52	0.64	0.15	0.25	0.90
Urban population share (2000)	52	0.43	0.15	0.16	0.76
Rural population share (2000)	52	0.57	0.15	0.24	0.84
Change in rural population	52	-0.07	0.08	-0.32	0.12
Variance of maximum temperature	47	32.56	13.15	7.98	72.21
January minimum temperature (average of 20-30 yrs.)	51	-4.34	4.16	-16.85	-0.10
February minimum temperature (average of 20-30 yrs.)	51	-5.04	4.02	-16.43	-0.67
March minimum temperature (average of 20-30 yrs.)	51	-3.03	3.45	-11.51	0.46
April minimum temperature (average of 20-30 yrs.)	51	1.82	2.22	-3.50	4.09
May minimum temperature (average of 20-30 yrs.)	51	4.93	2.76	-2.00	8.45
June minimum temperature (average of 20-30 yrs.)	51	9.91	2.81	3.00	12.98
July minimum temperature (average of 20-30 yrs.)	51	13.18	3.15	5.03	16.72
August minimum temperature (average of 20-30 yrs.)	51	13.28	3.51	4.62	17.12
Sept. minimum temperature (average of 20-30 yrs.)	51	9.25	3.46	2.17	13.19
October minimum temperature (average of 20-30 yrs.)	51	4.94	3.09	-1.89	8.95
Nov. minimum temperature (average of 20-30 yrs.)	51	0.61	3.20	-6.79	4.34
Dec. minimum temperature (average of 20-30 yrs.)	51	-2.91	3.86	-14.02	1.61
Jan. minimum temperature (average of 20-30 yrs.)	51	49.78	6.65	39.38	79.93

REFERENCES

Akerlof, George. 1970. "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism". *Quarterly Journal of Economics*. Vol. 84. 488-500.

Alchian, Armen and Harold Demsetz. 1972. "Production, Information Costs and Economic Organization". *American Economic Review*. (Dec.). 777- 795.

Allen Douglas W. and Dean Lueck. 2002. **The Nature of the Farm**. The MIT Press. Cambridge, Massachusetts.

Banerjee, B.N. 1985. "Concepts of Farm Size, Resource-use and Productivity in Agriculture: A Case Study". *Economic Affairs.* Vol. 30(1). 17-22.

Bardhan, P. 1973. "Size, Productivity and Returns to Scale: An Analysis of Farm-Level Data in Indian Agriculture". *Journal of Political Economy.* 81(6). 1370–86.

Barzel, Yoram. 1982. "Measurement Cost and the Organization of Markets". *Journal of Law & Economics*. University of Chicago Press. Vol. 25(1). 27-48.

Becker, Gary S. 1981. "Altruism in the Family and Selfishness in the Market Place". *Economica.* New Series. Vol. 48. No. 189. (Feb.). 1-15.

Becker, Gary S. 1988. "Family Economics and Macro Behavior". *The American Economic Review*. Vol. 78. No. 1. (Mar.). 1-13.

Becker, Gary S. and Kevin Murphy. 1992. "The Division of Labor, Coordination Costs, and Knowledge". *Quarterly Journal of Economics*. Vol. 57. No. 4. 1137-1160.

Bell, at al. 1997. "Rationing, Spillover, and Interlinking in Credit Market: The Case of Rural Punjab". *Oxford Economic Papers*. New Series. Vol. 49. No. 4. (Oct.). 557-585.

Bhalla, Surjit and Prannoy Roy. 1988. "Mis-Specification in Farm Productivity Analysis: The Role of Land Quality". *Oxford Economic Papers.* New Series. Vol. 40. No. 1. (Mar.). 55-73.

Cheung, Steven N. S. 1968. "Private Property Rights and Sharecropping". *The Journal of Political Economy*. Vol. 76. No. 6. (Nov.-Dec.). 1107-1122.

Cheung, Steven N. S. 1970. "The Structure of a Contract and Theory of a non-Exclusive Resource". *The Journal of Law and Economics*. Vol. 13, No. 1, (Apr.). 49-70.

Cheung, Steven N. S. 1983. "The Contractual Nature of the Firm". *Journal of Law and Economics*. Vol. 26. No. 1. (Apr.). 1-21.

Cheung, Steven N. S. 1973. "The Fable of the Bees: An Economic Investigation". *Journal of Law & Econonomics*. 16. 11-33.

Coase, Ronald. 1937. "The Nature of the Firm". *Economica*.

Cornia, G.A. 1985. "Farm Size, Land Yields and the Agricultural Production Function: An Analysis for Fifteen Developing Countries". *World Development.* Vol.13(4). 513-534.

Cornia, G. A. 1986. "Farm Size, Land Yields and the Agricultural Production Function: Resettlement Programs: A Review". 21 World Development 9.

Davis, S. J. and J. Haltiwanger. 1990. "Gross Job Creation and Destruction: Microeconomic Evidence and Macroeconomic Implications". *NBER Macroeconomics Annual*. No. 5. 123-168.

Davis, S. J. and M. Henrekson. 1999. "Explaining National Differences in the Size and Industry Distribution in Employment". *Small Business Economics*. No. 12. 59-83.

Deolalikar, A.B. 1981. "The Inverse Relationship between Productivity and Farm Size: A Test Using Regional Data From India". *American Journal of Agricultural Economics.* Vol. 63. 275-279.

Den Butter, Frank A. C., et al. 2001. "The Effects of Transaction Costs and Human Capital on Firm Size: A Simulation Model Approach". *Vrije Universiteit Amsterdam Research Momerandum.* 10. (Mar.).

Eastwood, Robert, et al. 2004. "Farm Size". mimeo. University of Sussex.

Evenson, Robert E. et al. 2000. "Supervision and Transaction Costs: Evidence from Rice Farms in Bicol, the Philipinnes". Yale University Economic Growth Center Discussion Paper. No. 814. April.

Feder, G. 1985. "The Relation between Farm Size and Farm Productivity: The Role of Family Labor, Supervision and Credit Constraints". *Journal of Development Economics*. Volume 18. Issues 2-3. August. 297-313.

Hill, Charles W. L. 1990. "Cooperation, Opportunism, and the Invisible Hand: Implications for Transaction Cost Theory". *Academy of Management Review*. Vol. 15. No. 3. (500-513).

Hodges, J. A. 1934. "Size of Farm and Business Cycles". *Journal of Farm Economics*. Vol. 16. No. 4. (Oct.). 711-714.

Jacoby, H. and G. Mansuri. 2004. "The (In)efficiency of Share-Tenancy Revisited: The Role of Supervision". Unpublished Manuscript. The World Bank. Washington, DC.

Kimhi, Ayal. 2006. “Plot Size and Maize Productivity in Zambia: Is there an Inverse Relationship?”. *Agricultural Economics*. Volume 35. Number 1. (July). 1-9(9).

Klein, Benjamin, Robert Crawford, and Armen Alchian. 1978. “Vertical Integration, Appropriable Rents, and the Competitive Contracting Process”. *Journal of Law and Economics*. 21. (Oct.). 297-326.

Klein, Benjamin and Leffler, Keith B. 1981. “The Role of Market Forces in Assuring Contractual Performance”. *Journal of Political Economy*. No. 89. (615-641).

Knight, Frank. 1921. Risk, Uncertainty, and Profit. Houghton Mifflin Company. Boston and New York.

Kochar, Anjini. 1997. “Does Lack of Access to Formal Credit Constrain Angricultural Production? Evidence from the Land Tenancy Market in Rural India”. *American Journal of Agricultural Economics*. No. 79. (Aug.). 754-763.

Kumar et al. 2001. "What Determines Firm Size?" (March 2001). *CRSP Working Paper No. 496; and USC Finance & Business Econ. Working Paper*. No. 01-1.

Lazear, Edward P. and Sherwin Rosen. 1981. “Rank-Order Tournaments as Optimum Labor Contracts”. *The Journal of Political Economy*. Vol. 89. No. 5. (Oct.) 841-864.

Leffler, Keith B. and Randal R. Rucker. 1991. “Transaction Costs and the Efficient Organization of Production: A Study of Timber-Harvesting Contracts”. *Journal of Political Economy*. Vol. 99. No. 5. 1060-1087.

Lindbeck, Assar and Dennis Snower. 2003. “The Firm as a Pool of Factor Complementarities”. *CESifo Working Paper Series*. No. 1046. IZA Discussion Paper No. 882. (Oct.).

Lipton, Michael, 1985. "Education and Farm Efficiency: Comment". in: **Economic Development and Cultural Change**. University of Chicago Press. Vol. 34(1). (Oct.). 167-68.

Lucas, Robert E. 1978. “On the Size Distribution of Business Firms”. *The Bell Journal of Economics*. Vol. 9. No. 2. (Autumn). 508-523.

Mariuzzo, Franco. et al. 2003. “Firm Size and Market Power in Carbonated Soft Drinks”. *Review of Industrial Organization*. No. 23. 283-299.

Marti, Joan Tous. 2001. World Hazelnut Production. Acotanc Papers. http://www.aoi.com.au/acotanc/Papers/Tous-1/Author-n-Text.htm

McCloskey, Donald N. 1972. "The Enclosure of Open Fields: Preface to a Study of its Impact on the Efficiency of English Agriculture in the Eighteenth Century". *The Journal of Economic History*. Vol. 32. No. 1. The Tasks of Economic History. (Mar.). 15-35.

Milgrom, P. and J. Roberts. 1992. Economics, Organization, and Management. Prentice Hall.

Newell, Andrew. et al. 1997. "Farm Size and the Intensity of Land Use in Gujarat". *Oxford Economic Papers*. 49. 307-315.

Nooteboom, B. 1993. "Firm Size Effects on Transaction Costs". *Small Business Economics*. 5. 283-295.

Paarsch, Harry J. and Bruce Shearer. 1996. "Piece Rates, Fixed Wages, and Incentive Effects: Statistical Evidence from Payroll Records". *CIRANO Scientific Series*. 96s-31. Nov. Montreal.

Peters, Elizabeth H. et al. 2004. "Free-Riding and the Provision of Public Goods in the Family: A Laboratory Experiment". *International Economic Review*. (Feb.). Vol. 45. Issue. 1. (283-299). (17).

Roumasset, J. (1995). "The Nature of the Agricultural Firm". *Journal of Economic Behavior and Organization*. Vol. 26. 161-177.

Roumasset, James and Marilou Uy. 1987. "Agency Costs and the Agricultural Firm". *Land Economics*. Vol. 63. No. 3. Aug. 290-302.

Sadoulet, E. et al. 1998. "Household Behavior with Imperfect Labor Markets". *Industrial Relations.* Volume 37. Number 1. (January). 85-108 (24).

Sampath, R. K. 1992. "Issues in Irrigation Pricing in Developing Countries". *World Development.* Vol. 20. No. 7. 967-977.

Sen, Amartya K. 1962. "An Aspect of Indian Agriculture". *Economic Weekly*. Annual Number.

Sen, Amartya K. 1966. "Peasants and Dualism with or without Surplus Labor". *Journal of Political Economy.* 74. (Oct.). 425-50.

Smith, Adam. 1776. **An Inquiry into the Nature and Cause of the Wealth of Nations**. The Modern Library (1937 ed.). NewYork.

Stigler, G. J. 1966. “The Economics of the Antitrust Laws”. *Journal of Law and Economics*. 9. (Oct.). 225-258.

Tunali, İnsan. 1993. “Choice of Contracts in Turkish Agriculture”. *Economic Development and Cultural Change*. Vol. 42. No. 1. (Oct.). 67-86.

Umbeck, John and Robert E. Chatfield. 1982. “The Structure of Contracts and Transaction Costs”. *Journal of Money, Credit, and Banking*. Vol. 14. No. 4. (Nov.). Part 1. (511-516).

Verma, B. N. and Daniel W. Bromley. 1987. “The Political Economy of Farm Size in India: The Elusive Quest”. *Economic Development and Cultural Change*. Vol. 35. No. 4. (Jul.). 791-808.

Williamston, Oliver E. 1967. “Hierarchical Control and Optimum Firm Size”. *Journal of Political Economy*. No. 75. 123-138.

World Bank. 2003. **Reaching the Rural Poor: A Renewed Strategy for Rural Development.** Washington, D.C.

Statistical Data Sources

TUIK (State Statistics Institute of Turkey)

DPT (State Planning Organization of Turkey)

Duzce Chamber of Agriculture, Duzce, Turkey.

Fiskobirlik (Hazelnut Farming and Marketing Cooperative). Giresun. Turkey.

Giresun Chamber of Agriculture, Giresun, Turkey.

Hazelnut Promotion Group

Ordu Chamber of Agriculture, Ordu, Turkey.

Oregon Hazelnut Growers Union

The Black Sea Exporters Union

TUGEM, 2005: http://www.tugem.gov.tr/tugemweb/findik_zirve_2005.html

Unye Chamber of Agriculture, Ordu, Turkey.