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Small Is Beautiful: Evidence of an Inverse Relationship between Farm Size and Yield in Turkey

by

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ABSTRACT

This paper examines the relationship between farm size and yield per acre in Turkey using heretofore untapped data from a 2002 farm-level survey of 5,003 rural households. After controlling for village, household, and agroclimatic heterogeneity, a strong inverse relationship between farm size and yield is found to be prevalent in all regions of Turkey. The paper also investigates the impact of land fragmentation on productivity and labor input per acre, and finds a positive relationship. These results favor labor-centered theories that point to higher labor input per decare as the source of the inverse size-yield relationship.

Keywords: Farm Size; Productivity; Allocative Efficiency; Turkey

JEL Classifications: O12, Q12

1. INTRODUCTION

The title of the 2008 World Development Report (WDR) is "Agriculture for Development." Published by the World Bank, the report aptly focuses on agriculture and emphasizes its importance as a "vital tool for achieving the Millennium Development Goal that calls for halving the share of people suffering from extreme poverty and hunger by 2015" (WRD 2008: v).

The report's focus on agriculture is no coincidence as three-quarters of poor people in developing countries live in rural areas, deriving their livelihood—directly or indirectly—from agriculture, creating two-thirds of the world's agricultural value added, supporting industries that generate 30% of total GDP through linkages in value chains (WRD 2008: 3).

Two of the most common characteristics of developing countries are the large share of agriculture in their economies and poorly functioning and/or nonexistent factor markets. The intersection of these two features produces the widely observed inverse size-yield relationship (IR hereafter) (Sen 1962, 1966; Mazumdar 1965; Berry and Cline 1979; Sen 1981; Cornia 1985; Eswaran and Kotwal 1986; Heltberg 1998; Benjamin 1992).

The inverse relationship between farm size and yield per acre indicates that as farm size gets larger, yield per acre gets smaller. When studying the link between farm size and yield, one needs to be careful to distinguish between the "technical input-output efficiency from the broader question of resource utilization" (Berry and Cline 1979: 5). As Berry and Cline (1979) point out, the former refers to the engineering relationship of production per inputs actually used in production process; the latter is about the overall land utilization of the available land resource and the related use of labor. In this article, we choose to focus on the second one in analyzing the inverse size-yield relationship in Turkey for 2002.

The relationship between size and yield became a focal point of agrarian debates after the 1960s when Farm Management Surveys in India first established the empirical basis. Since then, the evidence has been so widely observed by many others in different countries that IR is considered a "stylized fact" of agriculture in developing countries [Heltberg (1998) for Pakistan; Berry and Cline (1979) for Brazil, Colombia, Philippines, Pakistan, India, and Malaysia; Cornia (1985) for 15 different countries; Khusro (1973), Rudra et al. (1974), Bhalla (1979), Bharadwaj (1974), and

Sen (1981) for India; Carter (1984) for Haryana in North India; Kutcher and Scandizzo (1981) for North East Brazil; Benjamin (1995) for Java; and Masterson (2005) for Paraguay].

Inverse size-yield has many crucial and far-reaching implications for rural development policy, which is in part why it has gotten considerable attention from development researchers. The most prominent implication is that it may provide economic justification for redistributive land reforms, as policies to correct for IR imply both allocative efficiency and equity at the same time. If land productivity is higher in small farms and rural factor markets are not correcting for IR, then policies to eliminate IR and promote economic growth call for redistributive land reforms.

Land reforms have played a very important role in economic transformation, creating agricultural surplus, growing consumer demand, and creating political stability to maintain rapid industrialization for countries like Japan, South Korea, and Taiwan (Heltberg 1998).

Another important implication of IR in rural development policy is its outcome for employment. Sen (1999) argues that the choice of technology in agriculture is crucial for resource allocation and employment since, in most developing countries, the majority of the population is employed in agriculture. According to Sen (1999), certain types of technologies are more appropriate for countries in which labor is abundant relative to other factors of production. Since small-scale farming is more labor intensive than large-scale farming, it leads to more employment.

In addition to those mentioned above, another important implication of IR is deteriorating environmental conditions and disintegrating communities. Land concentration combined with mechanization in agriculture creates a class of landless laborers who, lacking alternative means of procuring a livelihood, find the solution either in cultivating ill-suited and environmentally sensitive tracts of land in forests, uplands, and arid areas, or in migrating to other places in search of employment (Heltberg 1998; Kaldjian 2001).

Due to its policy implications for employment, efficiency, equity, and sustainability, IR has been one of the most important and hotly debated topics in agricultural economics for more than 40 years. Despite the abundance of research and discussion on the topic, as yet there exists no consensus on what causes it (Heltberg 1998; Sen 1999).

The purpose of this paper is to look at the farm size-yield relationship for Turkey by utilizing a 2002 World Bank survey. In doing so, the structure of this paper is as follows: In section two we review the literature and conclude that the majority of explanations for IR are based on intensive labor-input use on smaller farms due to imperfections in factor markets. In section three we present econometric analysis and data used for the study. In section four we conclude that, despite agroclimatic, land, village, and farmer heterogeneity, there exists an inverse relationship between farm size and yield per acre in all seven regions of Turkey. Further, we claim that IR is due to existence of an inverse relationship between labor input and farm size, i.e., as farm size decreases, labor input (particularly family labor) per acre increases, resulting in higher yields per acre.

2. SIZE-PRODUCTIVITY DEBATE IN THE LITERATURE

2.1 Introduction and the Classic Equation of the Inverse Relationship in Agriculture

In the literature the most common equation that tests the inverse relationship between farm size and yield per acre is based on an ordinary least squares (OLS) regression of a simple model such as the following:

$$Log\ (Q) = \alpha + \beta \log (H) + u \tag{1}$$

where Q is either the monetary value of total output or output per acre and H is net operated farm size. Operated farm size includes owned and leased-in land for each household. An inverse relationship exists when β is less than unity if Q is total output and when β is negative if Q is output per acre.

Bardhan (2003) argues that one of the problems with such studies is the assumption of the homogeneity of farm output when, in fact, “output” is measured by the total value of a range of specific products produced. This can create biased results, particularly when crop prices vary significantly across types of crops or across regions for the same crop. Market values for cash crops, for example, are typically higher than those for subsistence crops.

Segregating the data based on regions and geographical features might address both of these problems due to the nature of agricultural production. Certain soil types and climate are more suitable to grow certain types of crops, thus homogeneity of farm products is highly likely within regions where land heterogeneity is not enormous. Turkey makes a particularly good case for very distinct regional homogeneity in agriculture as a result of its agroclimatic structure, which will be detailed in section 3.1.1.

By using either the exact or some modified version of the classical equation (1), many studies have found a significant negative relationship between per acre productivity and farm size for different developing countries. A natural question to then ask is why IR is so common in developing countries and what accounts for such a relationship?[1]

In the literature, there are two main explanations for IR: the misidentification hypothesis (Bhalla and Roy 1988; Benjamin 1995; Benjamin and Brandt 2002; Lamb 2003; Assuncao and Braido 2004; Srinivasan 1972; Chayanov 1966) and the factor market imperfection hypothesis (Sen 1962, 1966; Mazumdar 1965; Sen 1981; Cornia 1985; Eswaran and Kotwal 1986; Heltberg 1998; Benjamin and Brandt 2002).

2.2 The Misidentification Hypothesis

It is often argued that the inverse size-yield relationship is a statistical artifact due to omitted variables (Bhalla and Roy 1988; Benjamin 1995; Assuncao and Braido 2004). In the IR literature, debates center around two main reasons that are claimed to constitute the misspecification: omitted land quality and omitted farmer heterogeneity.

2.2.1 Omitted Land Quality

Land quality arose as an issue for land productivity differences because the inverse size-yield relationship has been observed as being more robust among villages than within villages (Cornia 1985; Benjamin 1995; Sen 1999). The heart of the omitted land-quality argument is the observation that fertile lands can support higher population densities, which result in higher land fragmentation; hence, smaller farms are more productive due to the inherent fertility of the land. In addition, smaller farms

[1] One of the first questions to be answered regarding IR assessment is whether increasing, decreasing, or constant returns to scale prevail in agriculture. However, we are not including this discussion in the main body of the paper. There are two reasons for this. First we have fitted a Cobb-Douglas production function to our data and confirmed that constant returns to scale prevail in Turkish agriculture in a different paper. Second, it has been well established that constant returns to scale characterize developing country agriculture. For further discussion on the topic, see Berry and Cline (1979) and Cornia (1985).

are more likely to have higher quality lands since the ones that are the first to be sold during a financial bottleneck are lower quality, resulting in higher overall land quality for the remaining plots on the farm.[2] Given fragmented plots in land and higher population densities in developing country agriculture, it is crucial to account for land quality to eliminate the possibility of systematic correlation between land quality and farm size for a robust analysis of IR.

Unfortunately, many datasets (particularly those for developing countries) lack information on land quality. Hence, indirect methods of accounting for land quality must be applied. These include relying on geographical disaggregation (Rudra 1974; Sen 1981; Carter 1984; Bhalla and Roy 1988), using price of land or share of irrigation as a proxy for land quality (Khusro 1973; Berry and Cline 1979), using village or plot fixed effects (Carter 1984; Heltberg 1998; Assuncao and Braido 2004), and employing instrumental variables to proxy for land quality (Benjamin 1995).

Studies including land quality in IR estimations divide land quality into two categories: exogenous or “nature-made,” such as soil type and existence of irrigation canals,[3] and endogenous or “man-made,” such as introduction of tube-well irrigation and fertilizer use. Some argue that a clear distinction between exogenous and endogenous land quality is important because man-made land quality incorporates labor input and has to be separated from nature-made land quality (Bhalla and Roy 1988). Consequently, when the distinction is not clear, what is observed as land quality might be a result of a blend of labor effort and land quality.

Another reason why smaller farms may have higher yield per acre may be due to crop intensity: a cropping pattern which favors crops with high value-added (Bardhan 1973; Griffin et al. 2002). Bhalla (1979) argues that since different crops require different labor and non-labor input requirements, cropping pattern and farm size may dictate a nonrandom relationship. Although after controlling for land quality, irrigation, and cropping patterns, Bhalla (1979) finds that IR remains. However, one problem in such studies is that cropping pattern is a choice variable and is part of the dependent variable.

[2] Cornia (1985) observes the opposite in Brazil. He argues that most of the large land holders have the better quality land. This argument seems reasonable when one considers the monetary opportunities of a wealthy farmer compared to a poorer one given that the price of better quality land is higher.
[3] Even though canals are man-made, they are considered exogenous because their location is determined by government mandate, not by farmers themselves.

One such study that looks at IR as an outcome of farmer choice is by Assuncao and Braido (2004). In their study, based on plot level data on India, they claim that the inverse relationship between productivity per acre and farm size diminishes when controlled for inputs, and that the "IR puzzle is solved."

From our point of view, despite the prevalence of literature, looking at technical efficiency rather than resource utilization is not very meaningful for developing countries. One reason why small farms produce more value per acre is because land utilization is much higher on smaller farms since large farms cultivate less land in proportion to their size, i.e., larger farms have more idle land. Thus, even if small and large farms produce equal value of output per acre cultivated, this does not disprove the "IR puzzle." We think that to look at technical efficiency by way of taking size of utilized land as the denominator of IR studies is not only far from solving the IR puzzle, but also not relevant in a developing country context where overall land utilization is an important factor in economic development since land is generally the scarce factor as opposed to labor.

2.2.2 The Farmer Heterogeneity and Mode of Production Hypothesis

Farmer heterogeneity hypotheses explain IR by farmer characteristics. Farmer heterogeneity literature could be divided into two groups: heterogeneity due to the agrarian structure in which farm size is a proxy for mode of production (Chayanov 1966; Sen 1966) or heterogeneity due to farmers' preferences as determined by education, attitudes toward risk, and other socioeconomic factors (Srinivasan 1972; Banerjee 1999).

According to Chayanov (1966), a peasant family worker maximizes a different objective than any other worker; s/he operates under a peasant mode of production. A peasant's objective is subsistence, thus her objective function is to minimize the effort given subsistence needs as determined by the dependency ratio within the household, i.e., the ratio of mouths to working hands. Given farm size, a crowded family with a higher dependency ratio generates higher yields per acre, and as the dependency ratio changes based on the life cycle of the household, so does the effort and yield per acre.

The peasant mode of production is particularly relavant where rural factor markets are not developed and or are totally missing. In the absence of markets, peasants cannot optimize resources or accumulate wealth by way of market exchange. Thus, there is no monetary reason to work more than what is required for subsistence.

Hence, given the objective of subsistence combined with missing rural markets, neoclassical tools would be meaningless in analyzing peasant behavior.

Despite its strength in delineating a separate mode of production for peasants based on strong empirical evidence and paving the road for labor-based theories of IR, Chayanov's (1966) pioneering work in explaining productivity per acre, founded on household demographics and life cycle, is inadequate. It does not provide much insight into why, given size and dependency ratio, some farms stay large and keep the unused land after fulfilling the household's need. In addition, it is not completely true that there are no labor markets in traditional agriculture; even among the very small farms, hiring labor during harvest is a common practice to avoid crop losses. A Chayanovian explanation for IR also ignores macroeconomic, social, and cultural determinants of labor supply such as unemployment, social norms against female laborers, and/or sociopolitical structure of the province within which the household operates (Agarwal 1994; Sen 1981; Mazumdar 1965; Cornia 1985).

The second strand of literature on farmer heterogeneity focuses on small farmers' behavioral differences compared to large ones with a particular focus on education. Education increases productivity because farmers can read the instructions on machines and thus are more able to apply productivity-enhancing techniques (Sen 1999). Furthermore, having the know-how regarding fertilizer and pesticide use could make a positive impact on productivity. Even though technology and education are important in productivity improvements, it does not explain IR since small farms are more likely to lack access to such machines and/or modern inputs such as fertilizers and pesticides, yet are still more productive than larger farms.

Risk is another feature that creates differential behavior among different farmers based on size. One explanation regarding farmers' behavior in the face of uncertainty in agriculture is put forth by Srinivasan (1972). Given two choices of income source—self cultivation (which is more uncertain) versus wage labor (which is certain). Srinivasan (1972) claims that since smaller farms are self-cultivated they are more productive because smaller farmers are more risk averse.[4] Bardhan (1973) offers a good critique, arguing that in agriculture, uncertainty due to weather or natural disasters is not only confined to small, owner-cultivated farms, but also affects

[4] The argument assumes that the farmer is an Arrow-type risk averse person, i.e., as her wealth gets smaller she will become more risk averse, hence she will devote most of her time on her land to maximize farm income.

large farms that use wage laborers. Thus, in the case of agriculture, wages are not independent of uncertainty. Hence, differentials in risk that are contingent upon size is not a convincing explanation for IR.

Banerjee (1999) indicates that farmer characteristics matter in the sense that they are related to farm size: tenants with larger land plots are more efficient because the degree of freedom attached to large land ownership enhances productivity.

Other farmer characteristics, such as gender, also play a role in productivity differences for different size farms, as women farmers tend to have smaller plots. Being a female farmer may result in different access to economic opportunities which, in turn, results in different crop choice and, subsequently, differences in output per acre (Agarwal 1994; Alderman et al. 1995; Deere and Leon 2001; Masterson 2005).

2.3 The Factor-Market Imperfections Hypothesis

The most common explanation in the IR literature is the hypothesis of imperfect factor markets. Mainstream theory suggests that through perfectly competitive markets all factors of production are fully utilized and receive their marginal contribution, and resources are allocated efficiently across alternative uses (Schultz 1964; Conning 2000). At this point, assuming all farms operate under the same production function with constant returns to scale, a really interesting question is then how come markets do not *distribute land* towards small farms where *land is relatively more productive than labor* and distribute labor towards large farms *where labor is relatively more productive than land?* A Pareto improvement, and also an increase in technical efficiency of the system as a whole, could occur when small farmers trade in labor for land with large ones up to a point where marginal *rates of technical substitution are equal* in each and every farm, and this will eliminate IR. The obvious answer is because markets are imperfect and do not allocate resources efficiently, hence IR prevails. What is less obvious is which factor market is the culprit and which factor causes IR.

On the topic of inverse size-yield relationship, the main theme in the factor market imperfection hypothesis is that small and large farms use different proportions of inputs due to different factor prices, which then give different incentives to farmers operating on different scales (Mazumdar 1965; Sen 1966; Berry and Cline 1979; Sen 1981; Cornia 1985; Eswaran and Kotwal 1986; Griffin et al. 2002; Benjamin and Brandt 2002). As argued by Cornia (1985), the prices of land and capital are generally higher for small farmers whereas the price of labor is higher for large farmers, resulting in usage of different proportions of inputs by farms according to their resource position (access to and the cost of production factors).

According to Cornia (1985), small farmers apply more labor per unit of land than large ones in several ways. First, small farmers engage in more intensive use of labor in each crop activity. Second, they cultivate a larger portion of their land. Third, they use land more intensively by employing such techniques as multi-cropping or multi-harvesting. In addition, small farmers are more apt to undertake land improvement practices such as land terracing, canalization, and other land infrastructure projects, which require more input of labor per acre.

As pointed out by Bardhan (1973), what may be the more interesting question about IR is why smaller farms use more input per acre (and hence produce higher yields per acre). Addressing this question entails assessing the institutional framework of traditional agriculture in developing countries and examining market imperfections more closely.

A detailed analysis of the reasons for factor market imperfections in developing countries is beyond the scope of this paper, however it is useful to mention a few. To start with, no market is scale neutral. Input and output prices differ based on scale. In addition, land markets may exhibit imperfections because land is more than just a productive factor. It is an asset of insurance, bondage, prestige, power, and wealth. Land is a portfolio asset, particularly in countries with undeveloped capital markets to hedge against inflation (Cornia 1985; Kaldjian 2001). It is a source of political power which, in turn, produces economic benefits (Binswanger et al. 1995; Karaomerlioglu 2000). Last but not least, it is the place of ancestral home and has nonmonetary value to people who live on or off of it. In short, the price of land is almost always above its expected economic returns.

Capital markets may be imperfect since formal credit requires collateral. Thus, capital markets favor haves over have nots. In addition, large farmers have greater access to machinery due to scale effects and/or government contacts which may provide access to cheaper capital (Cornia 1985).

Labor markets may exhibit imperfections for a variety of reasons. The first of these is transactions costs. Despite willingness to hire in or out labor, farmers may not partake in the labor market simply because they cannot afford job or worker search costs. Second, large farmers incur higher costs than the market wage rate because of the supervision required in agriculture and therefore do not hire labor as much, even in the absence of search costs.

In short, labor is generally cheaper for small farmers, and land and capital are cheaper for large farmers. Factor market imperfections that produce different prices for large and small producers may reinforce and be reinforced by the exercise of market power. Both land and capital tend to be priced higher for smaller producers in developing countries because it is much easier to form a monopoly in land and capital markets than it is in labor markets. This is not only because labor is the relatively abundant factor, but also because unemployed land and capital can survive if left idle, but unemployed labor cannot survive without food. This leaves laborers with a weaker bargaining position vis-a-vis land and capital, thus favoring large farmers.

Most researchers who identify rural market imperfections as the culprit for the inverse size-yield relationship recognize that it is the combination of imperfections in all markets that results in IR. However, Sen (1981) claims that only one factor—labor—takes the brunt of the burden of all factor market imperfections. Peasants compensate for the lack of land and credit markets by putting more labor into production, thereby resulting in higher yields per acre, i.e., IR.

2.3.1 Labor-Based Hypothesis

The first labor-based explanation in the IR debate emerged from Arthur Lewis' (1954) seminal article, *Economic Development with Unlimited Supplies of Labor*, in which he assumes zero marginal productivity or, in other words, zero marginal cost of labor in agriculture, and introduces disguised unemployment in agriculture.[5] Picking up the concept of zero marginal productivity from Lewis (1954) and applying the intersectoral duality between industry and agriculture to intrasectoral duality between large and small farms, many agricultural economists have tried to explain the existence of IR as a result of the intense use of labor in agriculture, i.e., the cheapness of labor in smaller farms leads to the intense use of it, thereby resulting in higher

[5] However, the zero marginal productivity assumption—along with the existence of surplus labor in agriculture—was later discredited by Viner (1967) by referring to the impossibility of such an assumption given the nature of agricultural work; an additional worker always adds something positive which wouldn't be there in the absence of the worker, such as better weeding, better soil preparation, etc. The solution to the bottleneck of positive marginal productivity of labor is offered by Sen (1962, 1966) who proposed that labor effort, not labor of an individual worker, should be included in calculations of marginal productivity of labor (MPL). None of the studies in this paper refer to zero MPL.

yields per acre (Sen 1966; Bhalla 1979; Bardhan 1973; Sen 1981; Carter 1984; Cornia 1985; Heltberg 1998; Benjamin and Brandt 2002).

This intrasectoral duality of wages between large and small farmers is explained through different mechanisms by different economists. Sen (1966) explains it in terms of subjective real costs of labor. Marginal disutility of labor for peasants on family farms is smaller than the marginal disutility of workers on commercialized, larger farms because there is surplus labor on small farms, which then results in fewer hours or less effort for the family worker, hence a lower real cost of labor.

Mazumdar (1965) explains the duality of wages by pointing to the lower opportunity cost of labor on small farms due to unemployment. The opportunity cost of family labor may be less than the wage rate because an outside job is not guaranteed, i.e., the wage rate on a small farm is discounted by the unemployment rate and, thus, cheaper.

Other explanations of the duality of wages are related to supervision. Labor supervision has been among the most common explanations of IR (Rudra and Bandapadhyaya 1973; Sen 1981; Feder 1985; Eswaran and Kotwal 1986; Banerjee 1999). Labor supervision in agriculture is costly since workers keep moving in a large open field, unlike industry where both the worker and the machine are confined to a relatively small area. The main argument is that labor supervision, provided mostly by the family members, is a "transactions cost" and, hence, part of the imperfect labor markets story (Feder 1985). Consequently, labor is hired on large farms to the extent that it can be supervised by family members. This puts family labor at the center of the labor-based hypotheses.

As argued by Sen (1981), two issues require special attention in IR observations; first, different tenure types and second, technology. Different tenure types have different labor dynamics. For example, in the literature, it is argued that sharecropper tenants provide less effort since they do not have full claim to the output. The reasons for the inefficiency in sharecropping range from Marshallian disincentive[6] to lower crop intensity per acre. [7] Thus, treating farms as if they have identical modes of production might result in biased results.

[6]The Marshallian disincentive argument is the following: there is less incentive on the side of the tenant due to the nature of sharecropping contracts; landlords and tenants share the output and, since the tenant's marginal returns to effort and input supply are much less than the relevant marginal products, the tenant has less incentive to supply inputs (including labor and intermediate inputs) than if he were the owner.

Second, technology is important, as given family worker per acre, land-augmenting technology (such as irrigation and use of fertilizer) increases labor input per acre, resulting in a lower ratio of family labor to total labor (assuming labor is hired to compensate for the need to increase labor input). Labor-augmenting technology, such as tractorization, would reduce labor input per acre and increase the ratio of family to total labor. Hence, if one does not control for technology, even though the family labor input is the major factor behind IR, the relationship cannot be captured statistically.

Once IR is established by equation (1)-type regressions, another way to test the validity of labor-based explanations is to analyze whether labor input has an inverse relationship with farm size using the following equation (Berry and Cline 1979; Benjamin 1995; Barret 1996; Lamb 2003):

$$Log\ (labor\ per\ decare) = \alpha + \beta\ Log\ (size) + u \qquad (2)$$

Equation (2) can also be used to test the relation between other intermediary inputs such as fertilizers, pesticides, and other non-labor, non-land inputs as dependent variables to observe if there is a systematic variation of such inputs with farm size.

After reviewing the literature on IR, our conclusion is that in the context of developing country agriculture, given empirical analysis, labor-based theories are better able to explain IR. According to Sen (1981), the crux of the debate on IR, as well as the possible solution, is not about scale advantages or unemployment. IR reflects intensive labor use on small farms and the inability to solve this through land and credit markets. Hence IR evidence is an indicator of two things: allocative inefficiency and connectedness between the ownership of assets and the distribution of resources through markets. The reason for market imperfection—the failure of markets to allocate resources efficiently—cannot be corrected through rural markets because markets function connected to existing inequalities. That is, the ownership of productive assets is connected to the distribution of productive assets. "The most important effect of credit and land market imperfections seems to be that, although the IR relations exist and would seem to reflect a very low opportunity cost of labor on

[7] Another argument for inefficient sharecropping contracts is the lesser variety of crops cultivated that increase the yield per acre. It is argued that lower intensity of crop cultivation is chosen by the landlord. For a more detailed discussion, see Sen (1981).

small farms, the degree to which land and credit is leased and let out to small farmers seems very limited" (Sen 1981). It is because of this connectedness that those who are poor in land but rich in labor (and thus can reap higher yields from their land) fail to lease-in more land to utilize their labor. In other words, it is due to connectedness that markets fail allocative efficiency, which demonstrates itself by the existence of IR. Labor-based theories point to this failure more than any other existing explanation for IR.

The following empirical investigation of IR for the case of Turkey employs a labor-based hypothesis. The set up used to test for the existence of IR in rural Turkey is a modification of classical equation (1). We used village fixed-effects regressions to control for unobservable village heterogeneity. We also employed type (2) regressions to analyze the relationship between labor and other non-labor, non-land intermediate input use intensity and farm size.

3. EMPIRICAL INVESTIGATION

3.1 Agroclimatic Features of Turkey and Descriptive Statistics of the Dataset

3.1.1 Turkey's agroclimatic features

Turkey is a major agricultural producer by international standards, with 35% of all lands in use for agricultural production, excluding pastures. With nearly 25% of the Middle East and North Africa's arable land and abundant water resources, Turkey ranks in the top five producers for chickpeas, chillies and peppers, cotton, cucumber, eggplants, green beans, lentils, nuts (pistachios, chestnuts, and walnuts), onions, sugarbeets, tomatoes, watermelons and melons, stone fruit, olives, and sheep's milk. Turkey is the world's largest producer of apricots, hazelnuts, and figs (Kaldjian 2001; Longworth 2005).

Regions in Turkey are divided geographically and climatically, hence there is substantial homogeneity within a region in terms of agroclimatic features (Aresvik 1975; Longworth 2005). South East Anatolia and Central Anatolia are the most arid regions, with a minimum rainfall of between 40mm–600mm per year. The Black Sea and Mediterranean get the highest precipitation with 2500mm to 3000mm. Most of the soils have a high pH structure of 7.5 to 8.5 and high lime content, which is considered good for agriculture. The salt content is relatively high and irrigated land is frequently saline. The soils are almost universally deficient in phosphate and nitrogen across the country.[8] Based on agroclimatic homogeneity within regions, regional analysis provides a good control mechanism for agroclimatic heterogeneity.

As pointed out by Kaldjian (2001), productivity problems in Turkish agriculture are ascribed to a number of intertwined causes, ranging from "an ill-defined 'backwardness' among farmers and peasants, the variability and vagaries of nature, declining soil fertility, and the legacy of Ottoman-era practices to a variety of much more contemporary administrative, technical, social, and operational inadequacies." Notably, FAO (1999) and Cakmak (2004) claim that due to small size "[…] farm output […] remains low in comparison to the country's enormous potential."[9] Further, in a recent OECD (2006) country report on Turkey, it is stated that "stopping land fragmentation and consolidating the highly fragmented land is indispensable for raising agricultural productivity" (OCED 2006: 186).

However, no existing study examines the size-productivity nexus in Turkish agriculture. In almost all of the works on agriculture in which size is one of the variables, it appears as a proxy for mode of production as it relates to surplus creation. The connection between size and productivity is left unexamined. Farm size is evaluated according to the potential for surplus creation and, hence, as the tool for capitalist development. The Turkish agricultural debates revolve around identifying and choosing the optimal path for agrarian transformation as a means to modern economic development (Keyder 1984; Bazoglu 1986; Aydin 1987; Akcay 1987; Aksit 1999; Boratav 2000, 1987; Toprak 1999).

Among the literature on Turkish agriculture, perhaps the only one that underlines the importance of smallholder agriculture is by Kaldjian (2001). Kaldjian views the small farm as a strategic response to the path of economic development in Turkey. In this view, the small holder is a production unit in which the knowledge and skill base is gathered locally through experience, transferred from generation to generation, and designed to reduce risk, as well as to protect food and household security. Accordingly, small farms should be seen as rational responses to the economic realities of unemployment and food insecurity in the context of Turkey.

Using a 2002 World Bank Survey, our work is the first of its kind on Turkey that looks at the size-productivity nexus.

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[8] For more detailed discussion on agricultural land features, see Aresvik (1975) and Gozenc (2006).
[9] FAO, Turkey (1999); Available online at: http://www.new-agri.co.uk/00-3/countryp.html

3.1.2 Descriptive statistics of the regression variables and the discussion of the model

The data we are using is the Quantitative Household Survey for the year 2002 (QHS),[10] which includes 5,302 rural households from 7 regions, 73 provinces, 389 towns, and 517 villages in rural Turkey.

Eighty-nine percent of all the farms in Turkey are in the small or medium category (table 1). Small refers to an amount of land between 1 and 19.99 decares,[11] medium refers to 20 to 199.99 decares, large refers to 200 to 499.99 decares, and very large refers to an amount of land that is in excess of 500 decares.

Turkish peasants work on a farm that is, on average, 93 decares (table 1). The three Anatolian regions—the Central, the East, and the South East—have much larger farms with 168, 135, and 128 decares per household, respectively (table 1).

Farms are fragmented in rural Turkey. The highest fragmentation is found on very large farms with an average of twenty-one different plots of land and the smallest fragmentation is on the small farms with three plots on the average per farm (table 2).

On average, small farmers irrigate 25% of their land holdings, whereas very large farmers irrigate 24% (table 3). The highest ratio for irrigated land to total land belongs to very large landlords in the Mediterranean region with 67%, followed by small landlords in the East Anatolia with 50%.

The sharecropping ratio is low in Turkey in general (4%). It is highest in South East Anatolia with 7% and lowest in the East Anatolia region with only 1% (table 4).

Farms in all regions are operated mostly with family labor and depict a declining pattern as land ownership gets larger. On average, 81% of all labor input is from family members for small farmers (table 5); for farms larger than 200 decares family labor ratio is around 68%. The remainder of labor input is obtained through labor markets, communal labor, institutional labor (such as government help), or a mixture of family and hired labor (QHS 2002).

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[10] The sampling method employed was cluster sampling, prepared according to eight project crops: wheat, tobacco, hazelnut, sugarbeet, maize, cotton, olives, and tea. Four hundred and ninety-nine villages were selected by random sampling from the lists of State Institute of Statistics (SIS) that are divided according to regions where crops are grown. The sample has 71 provinces: 11 in the Marmara region, 13 in Central Anatolia, 6 in the Aegean, 12 in the Mediterranean, 6 in Southeast Anatolia, 10 in East Anatolia, and 13 in the Black Sea region. Random selection of the farm holders was based on a "village list" generated after an interview with the *muhtar* (village headman). After completion of the village *muhtar* questionnaire, eleven households were selected for interviewing. Agricultural-business households were randomly selected from the village household list with a systematic sampling method while implementing the survey (World Bank Turkey Report 2004).

[11] One decare= 0.2474 acres.

Educational attainment of household heads in rural Turkey seems to show an interesting pattern based on farm size. Small farmers, interestingly, are not the group that is least educated. Seventy-two percent of small farmers have a household head with a primary school degree, which is 2% more than the national average and 14% more than the average of the largest farmers. This difference is especially pronounced in Central Anatolia with 86% of the small farmers having primary school degrees, whereas this number is only 64% for largest farmers (table 6).

The average age of the head of household is fifty. Heads of small-farmer households are one year younger on the average (table 7). A typical household has 5.7 members in Turkey; however the larger the farm, the more populated the household is, with 7.7 for very large farms. In some regions, households have a lot more members, such as 12.7 in South East Anatolia. The least populated households are the small farmers in Marmara and the Aegean with four members (table 8).

The dependency ratio is 1.45 mouths per a pair of hands, on average, nationally. It is highest among small farmers in South East Anatolia with 2.16 mouths for a pair of hands and lowest in Marmara with 1.16 for very large farms (table 9).

As can be seen from table 10, productivity per acre for small farms is substantially higher compared to large farms in all regions of Turkey. On the average, small farms are nine times more productive per decare than the very large ones. This is very pronounced in the Black Sea region (279 times more) and in the South East Anatolia (22 times).

The same inverse trend is also observed in labor and non-labor input per decare (table 11). Small farms are putting 44 times more labor input per decare compared to the largest ones, on average, in Turkey. In the Black Sea region this ratio is strikingly high, with 170 times more mandays per decare. In addition, nationally, small farms spend six times more than the largest farms. In the Black Sea region this difference becomes striking, with smaller farms spending 88 times more on non-labor inputs than the largest ones (table 12).

Small farmers also use more credit per decare than large ones (table 13). The national average for small farms is 16 New Turkish Lira (YTL) per decare as opposed to YTL 6 for the very large ones. This is particularly pronounced in the Mediterranean, with YTL 40 for small farmers as opposed to YTL 5 for very large farms. Only in the Aegean region do farms larger than 200 but smaller than 500 decares use more credit per decare than smaller ones (a difference of YTL 3 more).

One could say that the general demographic picture depicted by the dataset is a typical one for developing countries: middle aged, male,[12] uneducated household heads managing small family farms.

From this initial analysis of the descriptive statistics of the regression variables a clear pattern emerges—there is an inverse relationship between farm size and productivity, size and labor input, and size and non-labor input.

3.2 Regression Model

Based on the observed patterns in the dataset and to test if IR exists in Turkey, we undertook a village fixed-effect OLS estimation of the form similar to the classical form (1). We test for pooled data (Turkey) and for each region: Mediterranean, Aegean, Marmara, Central Anatolia, East Anatolia, Southeast Anatolia, and Black Sea.[13] The model is as follows:

$$Log\ q = \alpha + log\ (H) + \beta\ log\ (X) + u \qquad (3)$$

where q is output per decare; α is the intercept; H is farm size; X is a matrix consisting of household head's age, household head's educational attainment, household size, provincial land ownership inequality, dependency ratio, dependency ratio squared, share of sharecropped land to total land holdings, share of family labor and its square, and land fragmentation; and *u* is the error term.

Auxiliary to the main regression (3), to further analyze the role of labor input, we will test to see if an inverse relationship exists between labor input per decare and farm size utilizing the following log-log equation, which is a modification of type (2) equations:

$$Log\ l = \alpha + log\ (H) + \beta\ log\ (Y) + u \qquad (4)$$

where α is the intercept; *l* is total labor input per decare in man-days; *H* is farm size; matrix *Y* consists of household head's age, household head's educational attainment, household size, dependency ratio, dependency ratio squared, share of sharecropped

[12] Only 1.59% of the household heads are female.

[13] We further tested this relationship after disaggregating the data into nine agricultural regions and will discuss the findings in the following sections.

land to cultivated land, regional average for agricultural wage rate, and land fragmentation; and *u* is the error term.

To test whether other non-labor inputs also exhibit an inverse-size relationship we will test the following:

$$Log\ k = \alpha + log\ (H) + \beta\ log\ (W) + u \tag{5}$$

where *k* is the monetary value of costs for non-labor, non-land input costs (such as fertilizer and pesticide use, irrigation, veterinary costs, as well as other infrastructure related spending such as electricity and gas for the agricultural production); *α* is the intercept; *H* is farm size; the matrix *W* consists of household head's age, household head's educational attainment, household size, share of sharecropped land to cultivated land, credit per decare, and land fragmentation; and *u* is the error term.

We expect *k* to have a negative relationship with farm size if markets are imperfect. If small farmers cannot buy land to utilize their labor and produce more, they might choose to spend more money on intermediary inputs to utilize their land and labor more, consequently resulting in IR. Regressions (3), (4), and (5) are tested for each region and for Turkey as a whole.

It is necessary to elaborate on each variable that is utilized in regressions (3), (4), and (5). The variable q is the total monetary value of farm production per decare. It includes the value of total crops, animal sales, and secondary products produced on the farm, such as diary products or processed grains.[14] To overcome the problem of different valuation of the same products in different regions we calculated a national average price for each crop, each secondary product item, and for animals by way of utilizing the dataset and employed these imputed prices to come up with the total value of farm output.[15] Farm size is the size of operational holdings, i.e., the total area of land that is owned and leased-in (-out) by the household and not the net area under cultivation.

[14] Output can be measured in two units: physical weight or volume, or in money units, i.e., in terms of "value." Measuring output in terms of weight or volume could only be plausible for highly specialized monocrop or monoproduct farms. Most farms produce multicrops and dairy products, therefore this is not a convenient method to be used for the developing country agrarian context, definitely not for the Turkish context.

[15] We also ran the regressions with given prices; discussion on this will be in the following sections.

Household head's age and educational attainment are introduced to control for farmer heterogeneity. We expect the education level of the household head to be positively related to productivity per decare since better educated farmers may have improved access to knowledge and tools that enhance productivity. We expect age to have a positive relationship since age is used as a proxy for experience. However, old age might pose disadvantages in agriculture because most of the work is physically demanding and also because older household heads might be too conservative to try new, more efficient techniques. Given these two possible effects, depending on which one is dominant, the sign of age variable may be positive or negative.

The dependency ratio is the ratio of the total number of household members to workers in the household.[16] To test Chayanovian arguments regarding the peasant mode of production, we introduce the dependency ratio and its square to test if the dependency ratio within a household makes a difference in the productivity per decare by adding extra stress and, hence, motivation to work. The square term is introduced because we suspect a nonlinear, diminishing relationship between the dependency ratio and yield per decare, since too many mouths to too few hands might create a negative effect on output per decare if household labor is devoted mostly to reproduction of labor power and not for production of agricultural output. It is also important to note that women are very active participants to agricultural production in Turkey and caring for the elderly/sick/children is strictly women's job. Therefore, when the dependency ratio is high, availability of female labor might be limited, which would impact labor input and, hence, productivity, negatively.

The variable, "family labor ratio" is the share of family labor in total labor input. Labor supervision is an important factor in hiring decisions in agriculture; the more family members work as supervisors, the more labor will be hired. Given the fact that agriculture is a labor intensive production in countries such as Turkey, more labor input would increase productivity. Hence, we expect a positive relationship between family labor ratio and productivity per decare.

The ratio of sharecropped land to total cultivated land is included to control for land tenure type. Following the Marshallian disincentive argument, we expect a

[16] We calculated the number of workers in the household counting members younger than 15 but older than 11 as half workers. The same method was applied to people who are older than 65, but younger than 75. People who are on the two extremes of these ranges are considered full dependents.

negative relationship between the ratio of sharecropped land and productivity per decare.

Credit per decare is the total amount of credit divided by the farm size and is used in regression (5). Credit access allows for better and more intermediary inputs (i.e., non-labor, non-land) such as fertilizers, pesticides, and also more land access, therefore we expect a positive relationship between credit per decare and intermediary input per decare. However, if credit is used for land access, then intermediary input per decare might fall since the farmer may not need to cultivate the land as intensively. In this case, the relationship would reverse.

Finally, fragmentation is claimed to reduce yield per decare not only because labor, fuel, and time is spent moving in between plots rather than on them, but also larger farm size is more convenient for application of farm machinery (FAO 1999; OECD 2006). However, it is also argued that land fragmentation benefits farmers because it reduces the risks of drought, frost, floods, pests, and other uncertainties as a result of separated plots (Kaldjian 2001). Helburn[17] claims that for Central Anatolia, fragmentation benefits small farmers in terms of decreasing risk, since "having all one's land in a single soil type, in a single location, and single exposure is considered risky." We introduce land fragmentation in our regression analysis to test which of these claims holds for Turkey.

4. REGRESSION RESULTS AND DISCUSSION

The results suggest a very strong inverse size-yield relationship (IR) in rural Turkey. The summary results of the regressions for Turkey and for each region are illustrated in table 14. The relationship prevails and is significant even after disaggregation of the data and controlling for village fixed effects. Doubling the farm size results in a 51% decrease in productivity per decare nationally. The IR is most pronounced in the Black Sea region with -0.68 elasticity and least pronounced in the Marmara with -0.27.[18]

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[17] Discussion in Kaldjian (2001).

[18] Even though this paper focuses on the broader question of resource utilization, we further tested the inverse relationship based on different definitions of farm size, such as area cultivated rather than hold.We also tested IR using two other definitions of farm output, and tested for 7 regions and 9 agricultural regions. First we have defined farm output by total monetary value of crop production and did not include any other farm proceeds from animal production or from secondary farm production. Second, we have defined output as the total monetary value of crop and animal production and

Contrary to the claims of the Organization for Economic Cooperation and Development (OECD 2006) and the Food and Agriculture Organization of the United Nations (FAO 1999) reports on Turkey, land fragmentation is positively and significantly correlated to productivity. Doubling the number of parcels results in an approximately 24% increase in output per decare at the 1% level of significance. Furthermore, when data is disaggregated based on geographical regions, significance still remains for the Aegean (5%), the Mediterranean (1%), Central Anatolia (5%), and the Black Sea (1%). In all other regions the coefficient is not significant; however, it stays positive, indicating a positive correlation between land fragmentation and productivity per decare. Our study confirms Helburn's claims [in Kaldjian (2001)] regarding his observation that fragmentation affects productivity in Central Anatolia positively.

In addition to the findings discussed above, other interesting findings emerge from the analysis. The Chayanovian argument of a life-cycle hypothesis which is captured by the dependency ratio in the regressions is not significant nationally, but shows dramatic regional variation. In the Mediterranean and Central Anatolia the relationship is negative and significant; in the Black Sea and East Anatolia it is positive and significant; and in all others it is positive, but not significant. There is a diminishing relation between the dependency ratio and IR nationally, which suggests that after a certain point, the presence of too few hands to work for too many mouths limits the hours for farm production, impacting productivity negatively.[19]

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excluded secondary production. Furthermore, we have calculated both definitions of farm output by using two different assumptions about prices: first with varying, farm-gate prices for each household and second with national average prices. In the model which we calculated the crop value only using national average prices and disaggregated the data by agricultural regions, we observed that farm size lost its significance in the 3rd agricultural region, i.e., Marmara. In addition, in Marmara, the sign of the farm size has turned positive when the denominator of the dependent variable was area cultivated and the numerator was value of crop production or crop and animal production only. In all other agricultural regions IR relationship prevails and significant at the 1% level. When we used farm-gate prices, IR relationship prevailed at the 1% significance in all regions and in Turkey, except one; in the 3rd agricultural region. In this region, i.e., Marmara, farm size's significance is reduced to 10% level. In the Marmara region, when the denominator was cultivated area, (and not area hold) and when the numerator excluded secondary production, IR relationship stayed significant at the 5% level. We also tested IR using physical output and not monetary value for specific crops using area cultivated for all seven regions and observed that IR relationship prevails and it is significant for all the crop types except corn. For corn, the sign was reversed but it was not statistically significant. The specific crops we ran regressions for are: wheat, alfalfa, barley, tea, tobacco, sugar beet, corn, hazelnut, sun flower, raw cotton, and lint cotton. All the results on these aforementioned regressions can be provided upon request.

[19] Results of the square of dependency ratio is not reported in the Tables and can be provided upon request.

Other demographic variables are significant as well. Household size and the household head's educational attainment are positively related to productivity, whereas the household head's age is negatively related both nationally and regionally.

The ratio of family labor is significant at 10% for farm productivity. A 1% increase in the ratio results in 0.6% increase in productivity for Turkey. When we disaggregate the data regionally, the coefficient stays positive except for the Black Sea, however it is not significant in any of the regions. To our surprise, there is also a nonlinear relationship between the family labor ratio and productivity per decare, both nationally and regionally. Up to a threshold point (>.95), family labor has a positive impact on productivity. This relationship inverts as the family labor ratio gets closer to one. The nonlinearity of the relationship may point to the fact that when farmers cannot employ hired labor during extremely busy times such as harvest, they might be losing a large portion of their output since harvesting crops is an extremely time sensitive process and hence, the negative relationship.

The estimate of the relationship between the ratio of sharecropped land and per-decare productivity confirms our expectations. It is negative and significant at the 10% level nationally, with some regional variation. It is only significant in Central Anatolia at the 10% level and not significant in other regions. However, the relationship is negative in five out of seven regions. Using type (4) regressions, we explore possible causes of the sharecropping-productivity relationship.

Examining the determinants of labor input per decare using regression (4) suggests that labor input per decare does not present a significant and consistent relationship based on the tenure type (table 15). All else equal, the ratio of sharecropping is not significant anywhere with the exception of Marmara. Our results make a case against the Marshallian disincentive explanation of inefficiency in sharecropping. On the contrary, when one studies the regression results for (5) in table 16, the ratio of sharecropping is significantly negative for determining variations in non-labor, non-land input expenditures per decare [20] in South East Anatolia, where land inequality is among the highest and feudal relations are prevalent (Yakin 1981). These findings are in support of arguments made by Sen (1981), Cornia (1985), and

[20] In calculating the value of k, we were not able to apply the same price rule as we did in estimating farm output due to data related issues. We believe this does not create a problem, since prices for electricity, oil, fertilizers, and pesticide do not fluctuate as much. Fertilizers and pesticides are provided by six major producers who command 70% of the market and electricity is a state monopoly in Turkey. Oil prices also do not fluctuate among geographical regions and it could be said that law of one price holds for oil in Turkey.

Rao (2005) that the landlords' choice of input and crop type, not the tenant's choice of labor input, is the explanation for lower productivity on sharecropped land.

Another important finding pertains to land fragmentation. All else equal, for Turkey, a 1% increase in land fragmentation results in a 0.19% increase in labor input per decare. This relationship is significant at the 1% level. The relation stays positive across all regions and stays significant in all but Marmara. In all other regions except Southeast Anatolia the relationship is significant at the 1% level; in Southeast Anatolia it is significant at the 5% level.

It is clear that the culprit of IR is the intensive labor use per decare as farm size gets smaller, as indicated by regression results for equation (4) (table 15). On average, a 1% rise in farm size results in a 0.75% decline in labor input per decare. The inverse relation and its magnitude seem to be similar across all regions, ranging between 0.81 (Black Sea) and 0.65 (Marmara) at the 1% level of significance.

One further finding of regression (4) is that nationally the wage rate in agriculture has a negative impact on labor input per decare, i.e., as the wage rate increases by 1%, labor input per decare decreases by 0.61%. This negative relation could be the result of farms hiring fewer hands because price is higher.

There is also a consistent and widely observed negative and significant relationship between farm size and intermediary input, as illustrated by the results of regression (5) (table 16). For Turkey, a 1% increase in farm size results in a 0.47% decrease in non-labor input usage per decare. The relationship is significant at the 1% level for all regions, between the ranges of -0.56 (Black Sea) and -0.29 (South East Anatolia). This finding is in agreement with Berry and Cline (1979) and Cornea (1985), where both studies find a significant inverse relationship between per acre non-labor input and farm size for different developing countries.

5. CONCLUSION AND POLICY IMPLICATIONS

Several interesting conclusions came out of this study. First, this paper's main contribution to the continuing debate over inverse size-yield relationship is an affirmation of a very strong inverse relationship in the case of Turkey. Clearly, our findings do not confirm the claims by FAO (1999), Cakmak (2004), and OECD (2006) on the need to consolidate land to reach higher productivity in agriculture.

Second, this study suggests that labor-based hypotheses conform well to the Turkish data. Labor input per decare seems to be driving the inverse size-yield relationship. Third, the Chayanovian argument of peasant mode of production and farmer heterogeneity are small parts of the IR puzzle for Turkey; both educational attainment and dependency ratio are significant nationally, but not for each region. Fourth, even though land heterogeneity explains part of the inverse size-yield relationship, IR is still very robust and significant despite controlled land heterogeneity. Fifth, land fragmentation seems to be impacting land productivity positively for the country in general. At the very least, our regional analysis does not support OECD (2006) and FAO (1999) claims regarding this relationship.

The findings in this study raise some important questions about the most recent reforms in the agriculture sector in Turkey. The Agricultural Reform Implementation Program (ARIP) has been in effect since 2001 with the purpose of transforming agriculture via "market-friendly" policies (Aysu 2002; Cakmak 2004).[21] Turkey faces the potential for major socioeconomic change with possible accession to the European Union (EU). With a large proportion (30%) of the population living in rural areas, agriculture has become the most "hotly" debated issue surrounding this development due to the sector's low productivity. Currently, agricultural production accounts for only 11.5% of the gross domestic product (GDP), while employing 30% of the labor force (State Statistics Institute 2006). Suggesting land consolidation and concentration as a solution to low productivity in agriculture seems to be an ill-advised policy for Turkish agriculture.

Given the inverse productivity-size relationship in agriculture, what is needed for increased productivity in agriculture and overall growth doesn't seem to be so-called "market-friendly reforms," but land redistribution supported by technical and financial assistance for farmers. Given current macroeconomic policy on agriculture, in our point of view, Turkey will experience rising inequality and poverty in the years to come. Indeed, the most recent poverty study conducted by the State Institute of

[21] "By the end of 2003, the reform program reduced the fiscal outlays on agricultural subsidies by about US$5.4 billion to US$0.7 billion annually. Roughly 70% of the subsidy cuts were associated with measures aimed at reducing agricultural commodity price subsidies. The changes to agricultural output subsidization took the form of greater market deregulation through the phasing out of state-set prices and reduced intervention purchases financed by the budget. Reforms also imposed hard budget constraints on state marketing and processing enterprises and the quasi-state Agriculture Sales Cooperative Unions. The remaining 30% of the cuts were aimed at reducing agricultural input subsidies, notably for credit and fertilizer." Agricultural Reform Implementation Project (Loan 4631 - TU) Proposed Amendment of the Loan Agreement., p.1 (World Bank 2005).

Statistics in 2005 indicates that this might already be the case. Agrarian transformation initiated by implementation of ARIP may be occurring, but at the expense of a great majority of the people. Transformation ought not and need not be accompanied by the crippling of agriculture. As we argue, there is little economic justification to pursue development policies that inflict economic crisis on the vast numbers of people who depend on this crucial sector. This is exactly what market-friendly reforms seem to be doing despite evidence of market failures in the form of an inverse relationship between farm size and yield per acre.

APPENDIX A

TABLE 1. Farm Size by Region, 2002 (in decares)

	FARM TYPE									
	Small: 1–19.99		Medium: 20–199.99		Large: 200–499.99		Very Large: 500+		TURKEY	
REGIONS	**%**	**Avg. Size**	**%**	**Avg. Size**	**%**	**Avg. Size**	**%**	**Avg. Size**	**Total**	**Avg. Size**
Mediterranean	24%	10	68%	63	7%	267	2%	837	**633**	**79**
Aegean	26%	11	71%	56	2%	272	1%	2,403	**852**	**62**
SE Anatolia	12%	11	71%	71	14%	301	4%	962	**459**	**128**
Marmara	18%	10	73%	73	7%	275	1%	808	**758**	**118**
Central Anatolia	4%	10	67%	90	23%	292	6%	718	**836**	**168**
E. Anatolia	15%	12	62%	79	18%	271	5%	686	**308**	**135**
Black Sea	35%	10	63%	53	1%	283	1%	1,654	**1157**	**51**
TURKEY	**21%**	**10**	**68%**	**67**	**9%**	**285**	**2%**	**902**	**5003**	**93**

Source: Quantitative Household Survey (2002)

TABLE 2. Farm Fragmentation by Region, 2002

REGIONS		FARM TYPE: Small: 1–19.99	Medium: 20–199.99	Large: 200–499.99	Very Large: 500+	AVG.	N
Mediterranean	**AVG. NUMBER OF LAND PLOTS**	2.40	5.98	9.76	15.4	5.56	**633**
Aegean		3.00	7.81	19.64	7.80	6.77	**852**
SE Anatolia		1.96	3.41	6.40	13.11	4.00	**459**
Marmara		3.07	9.72	19.15	17.77	9.32	**758**
Central Anatolia		3.05	8.13	18.28	30.61	11.50	**836**
E. Anatolia		2.93	5.30	10.53	13.94	6.33	**308**
Black Sea		4.20	9.16	20.31	16.57	7.62	**1157**
TURKEY		**3.33**	**7.67**	**15.07**	**21.11**	**7.71**	**5003**

Source: Quantitative Household Survey (2002)

TABLE 3. Ratio of Irrigated Land to Total Farm Size by Region, 2002

REGIONS		FARM TYPE: Small: 1–19.99	Medium: 20–199.99	Large: 200–499.99	Very Large: 500+	AVG.	N
Mediterranean	**PERCENT OF IRRIGATED LAND**	47%	40%	41%	67%	42%	**633**
Aegean		38%	34%	41%	1%	35%	**852**
SE Anatolia		41%	27%	31%	27%	29%	**459**
Marmara		16%	13%	10%	0%	13%	**758**
Central Anatolia		38%	20%	17%	19%	20%	**836**
E. Anatolia		50%	33%	21%	29%	33%	**308**
Black Sea		8%	12%	22%	1%	10%	**1157**
TURKEY		**25%**	**23%**	**22%**	**24%**	**24%**	**5003**

Source: Quantitative Household Survey (2002)

TABLE 4. Percent of Sharecropped Land on the Farm by Region, 2002

REGIONS		FARM TYPE: Small: 1–19.99	Medium: 20–199.99	Large: 200–499.99	Very Large: 500+	AVG.	N
Mediterranean	RATIO OF SHARECROPPED LAND	3%	1%	6%	4%	2%	**633**
Aegean		6%	4%	2%	0%	4%	**852**
SE Anatolia		4%	8%	7%	5%	7%	**459**
Marmara		3%	1%	3%	3%	2%	**758**
Central Anatolia		0%	3%	10%	16%	5%	**836**
E. Anatolia		0%	2%	0%	1%	1%	**308**
Black Sea		4%	3%	0%	0%	4%	**1157**
TURKEY		**4%**	**3%**	**7%**	**8%**	**4%**	**5003**

Source: Quantitative Household Survey (2002)

TABLE 5. Ratio of Family Labor in Total Labor by Region, 2002

REGIONS		FARM TYPE: Small: 1–19.99	Medium: 20–199.99	Large: 200–499.99	Very Large: 500+	AVG.	N
Mediterranean	RATIO OF FAMILY LABOR	75%	68%	53%	40%	69%	**633**
Aegean		80%	77%	68%	89%	77%	**852**
SE Anatolia		94%	74%	53%	48%	72%	**459**
Marmara		83%	83%	76%	74%	83%	**758**
Central Anatolia		81%	76%	72%	79%	76%	**836**
E. Anatolia		76%	70%	74%	62%	71%	**308**
Black Sea		81%	79%	55%	90%	79%	**1157**
TURKEY		**81%**	**77%**	**68%**	**68%**	**76%**	**5003**

Source: Quantitative Household Survey (2002)

TABLE 6. Educational Attainment of Household Heads by Region, 2002

	FARM SIZE (in decares)								
	Small: 1–19.99			Medium: 20–199.99			Large: 200–499.99		
REGIONS	Illiterate	Primary	High School	Illiterate	Primary	High School	Illiterate	Primary	High School
Mediterranean	10%	70%	3%	8%	68%	8%	5%	52%	19%
Aegean	5%	80%	1%	6%	77%	4%	0%	47%	29%
SE Anatolia	17%	74%	2%	20%	61%	3%	13%	55%	8%
Marmara	7%	72%	4%	5%	75%	4%	2%	61%	19%
Central Anatolia	5%	86%	3%	8%	74%	5%	6%	72%	7%
E. Anatolia	17%	59%	0%	10%	65%	5%	11%	73%	2%
Black Sea	8%	69%	7%	9%	64%	5%	13%	63%	0%
TURKEY	8%	72%	4%	9%	70%	5%	7%	65%	10%

	Very Large: 500+			TURKEY		
REGIONS	Illiterate	Primary	High School	Illiterate	Primary	High School
Mediterranean	0%	42%	33%	8%	67%	8%
Aegean	0%	80%	0%	5%	77%	4%
SE Anatolia	6%	53%	12%	5%	77%	4%
Marmara	0%	44%	11%	5%	73%	5%
Central Anatolia	0%	64%	9%	7%	73%	6%
E. Anatolia	6%	50%	25%	11%	65%	5%
Black Sea	0%	71%	0%	9%	66%	5%
TURKEY	2%	58%	13%	8%	70%	5%

TABLE 7. Age Composition of Household Heads by Region, 2002

REGIONS		FARM TYPE: Small: 1–19.99	Medium: 20–199.99	Large: 200–499.99	Very Large: 500+	AVG.	N
Mediterranean	**AVERAGE AGE OF THE HOUSEHOLD HEAD**	49	51	52	46	50	**633**
Aegean		46	49	47	47	48	**852**
SE Anatolia		47	47	45	47	47	**459**
Marmara		51	52	50	57	52	**758**
Central Anatolia		49	49	49	45	49	**836**
E. Anatolia		47	47	48	48	47	**308**
Black Sea		51	53	53	48	52	**1157**
TURKEY		**49**	**50**	**49**	**47**	**50**	**5003**

Source: Quantitative Household Survey (2002)

TABLE 8. Household Size by Region, 2002

REGIONS		FARM TYPE: Small: 1–19.99	Medium: 20–199.99	Large: 200–499.99	Very Large: 500+	AVG.	N
Mediterranean	**HOUSEHOLD SIZE**	5.4	5.7	6.3	6.5	5.7	**633**
Aegean		4.0	5.0	4.7	2.8	4.7	**852**
SE Anatolia		6.9	8.1	9.6	12.7	8.3	**459**
Marmara		4.0	4.6	5.5	6.6	4.6	**758**
Central Anatolia		4.7	5.6	6.6	6.5	5.8	**836**
E. Anatolia		6.9	7.6	9.7	10.2	8.0	**308**
Black Sea		4.8	5.8	7.2	7.7	5.7	**1157**
TURKEY		**4.8**	**5.8**	**7.2**	**7.7**	**5.7**	**5003**

Source: Quantitative Household Survey (2002)

TABLE 9. Dependency Ratio by Region, 2002

REGIONS		FARM TYPE: Small: 1–19.99	Medium: 20–199.99	Large: 200–499.99	Very Large: 500+	AVG.	N
Mediterranean	**DEPENDENCY RATIO**	1.50	1.38	1.40	1.70	1.41	**633**
Aegean		1.36	1.36	1.37	1.24	1.36	**852**
SE Anatolia		2.16	1.77	1.78	1.62	1.81	**459**
Marmara		1.31	1.31	1.31	1.18	1.31	**758**
Central Anatolia		1.48	1.45	1.46	1.47	1.45	**836**
E. Anatolia		1.67	1.72	1.94	1.47	1.74	**308**
Black Sea		1.38	1.41	1.70	1.23	1.40	**1157**
TURKEY		**1.44**	**1.44**	**1.54**	**1.47**	**1.45**	**5003**

Source: Quantitative Household Survey (2002)

TABLE 10. Productivity per Decare by Region, 2002 (in YTL)

REGIONS		FARM TYPE: Small: 1–19.99	Medium: 20–199.99	Large: 200–499.99	Very Large: 500+	AVG.	N
Mediterranean	**TOTAL OUTPUT PER DECARE**	753	211	162	106	334	**633**
Aegean		405	220	102	34	265	**852**
SE Anatolia		1,231	146	59	55	259	**459**
Marmara		389	275	367	196	302	**758**
Central Anatolia		547	119	61	45	121	**836**
E. Anatolia		225	59	19	45	121	**308**
Black Sea		499	156	103	2	275	**1157**
TURKEY		**528**	**181**	**108**	**59**	**245**	**5003**

Source: Quantitative Household Survey (2002)

.

TABLE 11. Labor Input per Decare by Region, 2002

REGIONS		FARM TYPE Small: 1–19.99	Medium: 20–199.99	Large: 200–499.99	Very Large: 500+	AVG.	N
Mediterranean	LABOR INPUT PER DECR. IN MANDAYS	23.0	3.2	1.1	0.9	7.7	**633**
Aegean		22.5	5.9	1.3	0.4	10.2	**852**
SE Anatolia		8.6	2.2	0.6	0.5	2.7	**459**
Marmara		14.0	2.8	0.8	0.5	4.7	**758**
Central Anatolia		12.3	1.6	0.5	0.3	1.8	**836**
E. Anatolia		8.4	2.0	0.4	0.3	2.6	**308**
Black Sea		17.0	3.8	0.6	0.1	8.4	**1157**
TURKEY		**17.7**	**3.3**	**0.7**	**0.4**	**6.4**	**5003**

Source: Quantitative Household Survey (2002)

TABLE 12. Non-Labor Input per Decare by Region, 2002 (in million YTL)

REGIONS		FARM TYPE Small: 1–19.99	Medium: 20–199.99	Large: 200–499.99	Very Large: 500+	AVG.	N
Mediterranean	NON-LABOR NON-LAND EXPENDITURE	266	77	56	51	120	**633**
Aegean		185	67	56	6	98	**852**
SE Anatolia		64	38	21	32	38	**459**
Marmara		167	63	40	35	80	**758**
Central Anatolia		364	52	25	20	57	**836**
E. Anatolia		80	34	14	10	36	**308**
Black Sea		88	35	27	1	53	**1157**
TURKEY		**153**	**54**	**28**	**23**	**72**	**5003**

Source: Quantitative Household Survey (2002)

.

TABLE 13. Credit per Decare by Region, 2002 (in million YTL)

REGIONS		FARM TYPE					
		Small: 1– 19.99	**Medium: 20– 199.99**	**Large: 200– 499.99**	**Very Large: 500+**	**AVG.**	**N**
Mediterranean	**CREDIT PER DECARE**	40	6	3	5	14	**633**
Aegean		7	7	10	0.02	7	**852**
SE Anatolia		2	2	0	0.2	2	**459**
Marmara		21	3	2	4	6	**758**
Central Anatolia		0	1	2	1	1	**836**
E. Anatolia		0	1	0	1	1	**308**
Black Sea		16	4	0	0	8	**1157**
TURKEY		**16**	**4**	**2**	**1**	**6**	**5003**

Source: Quantitative Household Survey (2002)

TABLE 14. Summary Results for Regression (3), 2002

SUMMARY RESULTS FOR REGRESSION (3) DEPENDENT VARIABLE: GROSS FARM OUTPUT PER DECARE											
Region	**Constant**	**ln farmsize**	**ln hh size**	**ln hhhh education**	**ln hhh age**	**ln dependency ratio**	**ln share family labor**	**ln ratio shrcrp**	**ln fragmentation**	**Adj. R^2**	**N**
Turkey	19.52***	-0.51***	0.34***	0.13**	-0.24***	1.41	0.60*	-0.41*	0.24***	0.46	5,003
Mediterranean	28.09***	-0.43***	0.46***	0.18	-0.38*	-22.15*	0.47	-0.44	0.29***	0.38	633
Aegean	17.95**	-0.49***	0.29***	0.09	-0.25*	4.45	1.11	0.22	0.17**	0.43	852
SE Anatolia	16.24**	-0.47***	0.26*	-0.09	-0.42*	10.65	1.21	-0.19	0.21	0.38	459
Marmara	14.99***	-0.27***	0.11	0.08	-0.27	11.2	0.99	0.16	0.15	0.36	758
Central Anatolia	27.49***	-0.48***	0.43***	0.30	-0.42**	-18.52*	0.50	-1.87*	0.23**	0.33	836
East Anatolia	10.27**	-0.60***	0.40**	0.41**	-0.30	18.31*	1.38	-0.74	0.31	0.49	308
Black Sea	16.13**	-0.68***	0.36***	0.11	-0.11	12.63*	-0.23**	-0.23	0.26**	0.45	1,157

Notes: *Significant at the 10 % level.
** Significant at the 5 % level.
*** Significant at the 1 % level.
Robust standard errors, controlled for village fixed effects

TABLE 15. Summary Results for Regression (4)

SUMMARY RESULTS FOR REGRESSION (4) DEPENDENT VARIABLE: LABOR INPUT PER DECARE											
Region	**Constant**	**Infarmsize**	**In hh size**	**In hhhh education**	**In hhh age**	**Independency ratio**	**In wage rate**	**In ratio shrcrp**	**In fragment.**	**Adj. R^2**	**N**
Turkey	17.97***	-0.75***	0.24***	0.16***	-0.06	-7.83***	-0.61***	0.04	0.19***	0.69	5,003
Mediterranean	9.94***	-0.66***	0.25***	0.16	-0.19	6.41**	-0.06	-0.03	0.22***	0.50	633
Aegean	15.26***	-0.80***	0.32***	0.17	-0.15	-3.49	-0.53***	0.04	0.19***	0.61	852
SE Anatolia	5.05	-0.71***	0.24***	0.16	-0.02	-2.13	-0.11	0.09	0.21*	0.55	459
Marmara	-3.06	-0.65***	0.25***	0.35***	0.18	3.53	0.33	0.73*	0.01	0.66	758
Central Anatolia	14.03***	-0.77***	0.24***	0.09	-0.18	-20.03***	-0.17	-0.13	0.23***	0.55	836
East Anatolia	-1.10	-0.74***	0.13	0.06	0.01	-4.14	0.32**	-1.17	0.33***	0.76	308
Black Sea	11.25***	-0.81***	0.23***	0.15**	0.07	5.48**	-0.16	0.04	0.17***	0.64	1,157

Notes: *Significant at the 10 % level.
** Significant at the 5 % level.
*** Significant at the 1 % level.
Robust standard errors, Controlled for Village Fixed Effects

TABLE 16. Summary Results for Regression (5)

SUMMARY RESULTS FOR REGRESSION (5) DEPENDENT VARIABLE: NON-LABOR INPUT EXPENDITURE PER DECARE										
Region	**Constant**	**lnfarmsize**	**ln hh size**	**ln hhhh education**	**ln hhh age**	**credit per acre**	**ln ratio shrcrp**	**ln fragmentation**	**Adj. R^2**	**N**
Turkey	4.84***	-0.47***	0.27***	0.18***	-0.12**	0.01***	-0.07	0.16***	0.46	5,003
Mediterranean	4.93**	-0.49***	0.21**	0.1	-0.32**	-0.003	0.10	0.28***	0.42	633
Aegean	4.40***	-0.49***	0.40***	0.25**	-0.002	0.01***	0.12	0.18***	0.44	852
SE Anatolia	3.85***	-0.29***	0.14	0.21**	0.06	0.02*	-0.74**	0.06	0.35	459
Marmara	5.11***	-0.352***	0.31***	0.18	-0.24	0.01	0.46	-0.003	0.32	758
Central Anatolia	4.81***	-0.43***	0.25***	0.1	-0.22**	0.01	0.12	0.12	0.41	836
East Anatolia	2.81***	-0.55***	0.19	0.36**	0.44**	-0.01	-1.19**	0.17	0.41	308
Black Sea	5.37***	-0.56***	0.25***	0.14*	-0.15	0.01**	-0.01	0.18***	0.44	1,157

Notes: *Significant at the 10 % level.
** Significant at the 5 % level.
*** Significant at the 1 % level.
Robust standard errors, Controlled for Village Fixed Effects

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