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Three Essays on the Political Economy of Live Stock Sector in Turkey

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THREE ESSAYS ON THE POLITICAL ECONOMY OF LIVESTOCK SECTOR IN TURKEY

A Dissertation Presented

by

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DEDICATION

To my loving parents, brother and all other relatives and friends for their unwavering support and patience

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I used to look down on beggars. Partly, I thought they were lazy and partly, I was irritated by their poverty. I definitely did not understand what it means to be down on your luck. In the process of my research, On the one hand, I hope I gained a better understanding of causes of poverty. On the other hand, I surely learnt nothing about being down on your luck. On the contrary, in this moment of reflection I realize that I am a truly lucky person. I never really wanted to be anything but a scholar, and I am among the very few who are lucky enough to pursue their dream. I am blessed with a caring and loving family that has supported me in whatever pursuit I choose to. I was never hampered by any kind of financial, health or familial obligations in pursuing my dream.

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THREE ESSAYS ON THE POLITICAL ECONOMY OF LIVESTOCK SECTOR IN TURKEY

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ABSTRACT

My dissertation consists of three empirical essays where I analyze animal products consumption and marketing. First using cross-sectional household data, I investigate the importance of consumption from home produce (self-provisioning) and conclude that studying food consumption decisions in isolation from production is not warranted for Turkey. I develop a testing procedure incorporated into linear approximation of the almost ideal demand system (LA/AIDS) model to formally test the relevance of food self-provisioning. Studying consumption in isolation from production leads significant overestimation of rural households' responsiveness to price and income signals especially for the dairy and egg products. Second I investigate the contribution of consumption from home produce to alleviate vulnerability to undernutrition in rural areas. I find that the level, depth and severity of food poverty to be least among rural households who engage in food self-provisioning and food self-provisioning reduce vulnerability to undernutrition. Moreover, food self-provisioning is concentrated in expensive calories from vegetables and dairy so self-provisioning rural households also have a more balanced diet. Finally I investigate whether milk processing firms abuse their oligopsony power to excessively profit themselves to the expense of milk farmers and final consumers. I look for evidence whether the speed of adjustment of processed milk price is same when farm-gate milk prices increase and decrease. I find no evidence that will point out any price gauging on the part of milk processors to benefit themselves. Actually I detect a long-term downward trend in processed milk prices coinciding with new major entries to milk processing industry.

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LIST OF ABBREVIATIONS

AHM	Agricultural Household Models
ADF	Augmented Dickey-Fuller test
AIDS	Almost Ideal Demand System
ARIP	Agricultural Reform Implementation Project
APT	Asymmetric Price Transmission
ARCH	Autoregressive Conditional Heteroscedasticity
CAP	Common Agricultural Policy
CBCA	Cattle Breeders Central Association
ECM	Error Correction Model
ECT	Error Correction Term
FAO	Food and Agriculture Organization of the United Nations
FGLS	Feasible Generalized Least Squares
FPE	Final Prediction Error
HBS	Household Budget Survey
IR	Inverse size-yield relationship
IV	Instrumental Variable
KPSS	Kwiatkowski, Phillips, Schmidt, & Shin test
LA/AIDS	Linearly approximated Almost Ideal Demand System
MARA	Ministry of Agriculture and Rural Affairs, Turkey
ML	Maximum Likelihood
M-TAR	Moment Threshold Autoregressive
OLS	Ordinary Least Squares
PDF	Probability Density Function
SEK	the publicly owned dairy company in Turkey
SIS	Turkish Statistical Institute
SUR	Seemingly Unrelated Regression
TAR	Threshold Autoregressive
TL	Turkish Lira
TZOB	Union of Turkish Chambers of Agriculture
UHT	Ultra High Temperature milk
VAR	Vector Autoregressive
WB	The World Bank

CHAPTER 1

INTRODUCTION

The recent literature on the animal husbandry sector in Turkey is motivated largely by the potential of EU accession. The general liberalization of international trade – symbolized by World Trade Organization and the latest Doha Round of negotiations that focus on agricultural products – provides an additional impetus to inquire into the likely effects of further integration of agricultural markets in Turkey into world markets.

Valuable and insightful works have been undertaken in recent years that address different aspects of the issue Eruygur & Çakmak (2008), Grethe (2007), and Çakmak (2004) try to answer the question, what will happen at the macro level as a result of liberalization of trade? by simulating the impact of market integration on agricultural prices, trade and redistribution between producers and consumers. These studies reveal that Turkey is already competitive in fruit and vegetable exports, sectors that are relatively open and already well-integrated into European markets. However, cereals production and livestock sector are not competitive at current EU and world prices. In a simulation study of market integration between Turkey and EU as of 2006, Grethe (2007) predicts that agricultural prices (especially grain and animal products) in Turkey will decline, and that as a result of lower prices, agricultural production will decline and consumption will increase. Producer surplus will decline roughly by €1 billion per annum and consumer surplus will increase by €1.5 billion per annum (Grethe, 2007: 451).

If market integration is a result of EU accession, and not merely an extension of current customs union, the producers in Turkey will be more than compensated by direct transfer payments from the EU Common Agricultural Policy (CAP) budget. In a more recent study assuming integration by 2015, Eruygur & Çakmak (2008) predict an eight percent increase in consumer surplus if EU and Turkish markets are fully integrated by 2015 compared to non-integration, and a 13 percent decline in producer surplus (almost two-thirds of this decline due to losses from the livestock sector). Nevertheless, in absolute terms the gains in consumer surplus are more than the losses in producer surplus. Moreover, if the integration of markets results from EU membership with the accompanying CAP payments going to farmers, producers will be compensated for the losses. Furthermore, Grethe (2007) claims that if the margins between farm-gate and wholesale prices within Turkey are reduced by 10 percent due to increased efficiency in the marketing chain, the resultant dynamic welfare gains will be more than the static gains from market integration.

Çakmak, Dudu, & Ocal (2008) approach the issue from a microeconomic perspective and try to devise policy proposals on what should happen in rural Turkey to increase the effectiveness of agricultural production in order to compete in EU and world markets? Unlike the above-mentioned studies, they employ household level data[1] to answer this question. Applying the technical input-output efficiency approach to resource utilization, they utilize various versions of stochastic frontier production functions to find out whether the agricultural factors of production are used effectively. They calculate that the effectiveness of Turkish agriculture in utilizing the productive factors was between 33 and 45 percent during 2002 – 2004. They also find that land has the highest marginal

[1] Quantitative Household Survey (QHS, 2002) is jointly administered by Ministry of Agriculture and Rural Affairs (MARA) and the World Bank prior to the implementation of the Agricultural Reform Implementation Program (ARIP) which has been in effect since 2001.

contribution of all factors, and that the marginal contribution of labor is statistically insignificant at the margin. These findings are not surprising for a developing country with abundant labor and relatively scarce land resources. Since all potential arable land is already under cultivation in Turkey, they propose to increase the utilization of inputs that augment land productivity. They also argue that Turkish agriculture should shed labor in order to increase labor effectiveness in agricultural production. These twin goals can be achieved by modernizing and rationalizing production units (i.e., consolidation and land concentration). They conclude by arguing that the most important task for policymakers in Turkey is to implement productivity-increasing policies that will move Turkish agriculture closer to its technical potential, despite the fact that current economic units within the agricultural sector are likely to oppose such policies (Çakmak et al., 2008: executive summary).

Ünal (2008) works with the same data set as Çakmak et al., (2008) and within the same household microeconomic framework. Unlike Çakmak et al., (2008), she tries to answer the question, why households choose to devote a seemingly ineffective amount of labor into agricultural production? That is, Ünal (2008) tries to understand "overall land utilization of the available land resource and the related use of labor" (p. 7). She shows that the inverse size-yield relationship (IR) – the widely observed phenomenon in developing countries where yield per acre gets smaller as farms get larger,– holds for Turkey. Even though land heterogeneity and farmer skill (measured by educational attainment) are significant variables, the most important variable explaining land productivity is intensive labor input use.

The IR phenomenon can be viewed as a symptom of rural market imperfections. Unal argues that even though imperfections in land, labor, and credit markets are abundant in rural areas, labor takes the brunt of the adjustment to all factor market imperfections because it has the least bargaining power. In short, peasants compensate for imperfections in land and credit markets by working harder on their small plots, thereby obtaining higher yields per acre (Sen, 1981). Ünal's (2008) empirical findings parallel Çakmak et al., (2008) conclusion that the marginal contribution of labor is very low. But the policy implications she draws from this are vastly different:

> Turkey faces the potential for major socioeconomic change with possible accession to the EU… 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. (p. 25)

We are sympathetic to this view. During most of the 2000s official unemployment rate was around 10 percent and the labor force participation ratio was below 50 percent despite sustained economic growth. By 2009, with the worldwide economic crisis, the unemployment rate increased to 14 percent (State Institute of Statistics (SIS), 2010). Rural households were engaging in low productivity activities not because they preferred backbreaking agricultural work over better paying non-agricultural work, but because such non-agricultural work is not available. We think that it is ill-advised to advocate rapid consolidation in agriculture under these macroeconomic conditions.

Many previous studies (an exception is Ünal (2008)) base their policy recommendations based on total social welfare. We want to contribute to this literature by bringing distributional concerns to the forefront. Even if total social welfare is expected to increase, there are ethical, social and political reasons to be concerned if the increase in social welfare is accompanied by redistribution from poor to non-poor. These studies consider agriculture primarily as a site of production. In the second and third chapters of this dissertation, we focus instead on the consumption behavior of rural households, and use the Household Budget Survey from 2003 (SIS, 2003) to promote our arguments. In the fourth chapter, we study the milk marketing chain, taking our cue from Grethe (2005) and Grethe (2007) and use monthly farm-gate and wholesale milk price data to promote our arguments.

In chapters 2 and 3, we employ household-level data to investigate the importance of consumption from home produce ("self-provisioning" for brevity). Calories from food self-provisioning constitute 19 percent of all calories consumed by rural households in 2003. Moreover, self-provisioned calories come primarily from more expensive sources such as dairy products and green vegetables. In Chapter 2, in order to measure the influence of domestic production factors on food consumption, we employ the budget share of self-provisioned food as a proxy for productive factors. We construct an Almost Ideal Demand System (AIDS) and show that self-provisioning rural households have a statistically significantly different composition of the food basket from other households. Specifically, they consume more dairy products, more green vegetables, and more of certain cereal products (like bulgur) compared to other rural households and urban households. Our explanation is that the price differentials between the shadow prices of self-provisioned quickly perishable products and corresponding retail prices – i.e., a type of market imperfection – are such that many rural households choose to rely on their own production instead of markets.

Eruygur & Çakmak (2008), Grethe (2007), and Çakmak (2004) all predict that prices for and production of animal products will decline in Turkey as a result of an eventual integration with the world market, and that consumers will benefit from this integration due to declining prices. On the production side, the overwhelming majority of farmers in Turkey engage in dairy production as a secondary activity to crop production. (FAO, 2007)[2] reports that more than one-third of dairy products are consumed by the producing households and another one-third are marketed through informal channels. The report concludes that the Turkish dairy sector needs modernization and consolidation of farms; substantially larger herd size; and shedding of part-time smallholders in order to successfully integrate to EU and world markets (p. 71). In other words, in the case of integration of Turkish and EU animal products markets, the likely losers will be small-scale farmers who engage in animal husbandry as a complementary activity to crop production.

Against this backdrop, in Chapter 3 we explore the implications of food self-provisioning for poverty and vulnerability to poverty and undernutrition. We show that after correcting poverty line calculations for food self-provisioning, and even though poverty is more prevalent in rural areas than in urban areas, the self-provisioning rural households no longer are poorer than other rural households. Moreover, self-provisioning rural households are substantially less vulnerable to undernutrition. In the literature on animal husbandry in developing countries, it is well recognized that animals also serve as

[2] This report is commissioned by Ministry of Agriculture and Rural Affairs (MARA) to devise a plan in order to prepare the Turkish dairy sector, including dairy farmers and dairy processors, to EU Accession. Hence, the authors of the report primarily concern themselves with what needs to be done to reduce the discrepancy between EU and Turkish dairy sectors.

quasi financial assets in addition to being a source of income. Moreover, revenue from dairy products and other animal products eases the liquidity constraints of smallholders between annual harvests (Dercon, 1998; Fafchamps, Udry, & Czukas, 1998; Rosenzweig & Wolpin, 1993). In keeping with these insights, our findings in Chapter 3 also suggest that the majority of rural households in Turkey engage in food self-provisioning (of which dairy production constitutes a substantial part) in order to reduce their vulnerability to undernutrition by reducing their exposure to market price risk. Even if Grethe (2007), Çakmak (2004), and Eruygur & Çakmak (2008) assertion that integration to EU and world markets will increase the total consumer surplus by reducing animal product prices, our findings suggest that the distribution of these welfare gains will not be neutral. The chief beneficiaries of lower prices will be urban non-poor. On the other hand, the loss of a source of in-kind and cash income will make the current rural poor both poorer and more vulnerable to income poverty and undernutrition.

In Chapter 4, we investigate the fluid milk marketing chain in Turkey from farm-gate to wholesale prices. Due to data limitations, we are not able to establish whether if dairy processing firms operate as a cartel and exercise oligopsony power vis-à-vis dairy farmers. Nevertheless, by employing Asymmetric Price Transmission (APT) models we show that, even if dairy processing firms are enjoying oligopsony powers vis-à-vis dairy farmers, they are passing all of these price concessions and more to their customers. The processing firms are able to reduce the real fluid milk prices and expand their business during the study period, 1994 – 2006 thanks to the increasing returns to scale they enjoy in the growing dairy products sector.

In the final chapter, we review the findings of chapters 2 to 4 in detail and draw policy conclusions.

CHAPTER 2

TESTING SEPARATION OF CONSUMPTION AND PRODUCTION DECISIONS OF FOOD

2.1 Introduction

The phenomenon of peasants'/farmers' production of a great variety of food for home consumption violates some of the basic tenets of economics like specialization and gains from trade. Also, policy makers in developing countries with large peasantries are frustrated that peasants do not appear responsive to price incentives or opportunities to modernize (De Janvry, Fafchamps, & Sadoulet, 1991). Economists understand well that this unresponsiveness to prices is not because of the traditional mind-set of peasants but due to constraints that are not visible to outsiders yet are very real to peasants themselves. We discuss some of these constraints below in detail, but it is clear that ignoring the constraints facing peasants will lead to misguided policy advice and expectations.

A potential drawback of recent household food consumption and food demand studies pertaining to Turkey (Akbay Boz, & Chern, 2007; Sengul & Tuncer, 2005) is that they implicitly assume that households are mere price takers when it comes to food consumption. This assumption is implicit in the sense that the food production is not a part of empirically estimated models despite the fact that previous studies employ nationally representative surveys that cover rural areas. In developed countries, where the agricultural labor force is a very small part of the total labor force and the overwhelming majority of agricultural production takes place in specialized commercial farms, the assumption that all consumers are price takers is reasonable. Using 2003 household budget survey data for Turkey, however, we observe that food consumption from home produce (self-provisioning for brevity) supplies almost 19 percent of calories for rural households (see Section 2.4). This suggests that self-provisioning is important for rural households in Turkey and should not be assumed away.

Our contribution in this chapter is to develop a formal procedure to test whether households are mere price takers or not. We are able to develop this procedure thanks to a newly available data on the breakdown of food consumption according to its source. We follow the literature on agricultural household models (AHM) which study the consumption and production decisions of peasant households. Starting with the observation that peasant households supply most of their food themselves and employ productive factors from within their own households, AHM advances models where households decide what to produce and consume simultaneously.

We test whether self-provisioning affects the food consumption decisions. We find that it does, and conclude that implicit an assumption of separation of consumption and production decisions of food is unwarranted. We then re-estimate demand for food, incorporating the productive factors into consumption decisions, and find that the expenditure and own-price elasticities estimated initially (by disregarding the production side) overstate the true elasticities, especially for the dairy and egg food group.

In addition to policy makers, the issue of self-provisioning is critical to political economists who are concerned with poverty reduction. Griffin, Khan, & Ickowitz, (2002) Griffin, Khan, & Ickowitz (2004) and Boyce, Rosset, & Stanton (2007) note that in many developing countries, countryside is characterized by market imperfections that go beyond transactions costs. According to Griffin et al., (2002) and Griffin et al., (2004) the market failures do not just happen: they are by and large mechanisms of labor control, helping to ensure the dependence of peasants on the landlord class. Landlords can exert control of the local populace by strategically handing out employment in the form of wage labor or sharecropping. Deprived of employment opportunities other than self-employment, peasant households expend their energy to get the most from their small plots. Working with a data set collected in 2002[3], Ünal (2008) finds overwhelming evidence for an inverse relationship between farm size and land productivity for Turkey. These findings lead us to suspect that incomplete markets in rural areas are still relevant in Turkey, even though De Janvry et al., (1991) and De Janvry, Sadoulet, Fafchamps, & Raki (1992) were referring to much poorer countries. Complementing Unal (2008) in this study, we look at the consumption side of rural household reality.

In the rest of the paper we first review the literature on AHM with a special emphasis on separable and nonseparable household models. Then, given the limitation of the current data set for constructing a proper AHM, we develop a procedure to test for the implicit assumption of separation. In the third section we flesh out the empirical model for estimation. Section 2.4 presents data on food consumption with a special emphasis on self-provisioning. Section 2.5 presents the econometric findings. In Section 2.6 we discuss the policy implications of our findings. Section 2.7 recaps and concludes the chapter.

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[3] Ministry of Agriculture and World Bank collected the data set before the start of the Agricultural Reform Implementation Project (ARIP) in 2002 (QHS 2002 hereafter).

2.2 Theoretical Framework and Hypothesis Testing Strategy

2.2.1 Agricultural Household Models

An agricultural household is one which engages in agricultural production as well as being a site of food consumption. Very often the major inputs - land and labor - are supplied by the household. If there were no transaction costs that lead to imperfect functioning of markets, we could assume that production and consumption decisions are made sequentially; first production is decided, and then consumption. Sadoulet and de Janvry (1995) put this as follows:

> As is typical when all markets work and there are no transaction costs, it is immaterial to whether the household consumes its own products or sells them to buy what it needs to consume… Under these conditions, the household behaves *as if* production and consumption/work decisions were made sequentially. …, there is separability whenever prices are exogenous and markets are used, even if sale and purchase prices are not identical. When a household model is separable it can be solved recursively in two steps (p. 145) (italics are added).

The following figure is taken from Sadoulet and de Janvry (1995) and depicts the sequential process of production and consumption decisions (p. 146). This does not necessarily mean that production and consumption decisions are always sequential; all it shows is that production and consumption decisions can be studied separately.

Figure 2.1: Causal ordering in the separable household model

Production decisions:

$$p_a, p_x, w, z^q$$

$$\downarrow$$

$$q_a, x, l$$

$$\downarrow$$

$$----------\pi^*---------\,hinge$$

Consumption decisions:

$$\downarrow \text{exogenous variables}: w, E$$

$$y^* \qquad\qquad\qquad\qquad ↵$$

$$\downarrow \text{exogenous variables}: p_a, p_m, w, z^h$$

$$c_a, c_m, c_l \qquad\qquad\qquad\qquad ↵$$

In the above simplified figure, farmer produces commodity *a*, which is traded at price p_a taking into account market wage w, input prices p_x and the farm-firm characteristics z^q like fixed capital and farm size. Given exogenous prices, the farmer determines how much to produce q_a, how much input x to use and how much labor l to exert in order to maximize profits π^*. Profits are the *hinge* between production and consumption decisions because farm profits are a part of household income and hence affect the consumption decision via a budget constraint. Households maximize utility by allocating their full income among agricultural goods c_a, manufactured goods c_m, and leisure c_l given the household characteristics z^h like household size, age, and education, subject to total income and time constraints. Mathematically all of this can be expressed as:

First production problem is solved by the following rule:

Maximize $\underset{q_a, x, l}{\pi} = p_a q_a - p_x x - wl \;\; s.t.: g(q_a, x, l; z^q) = 0,$ production function. (2.1)

Second, the consumption/work problem is solved by maximizing utility, u, given the level of profit π^* achieved in production:

$$\text{Maximize} \underset{c_a, c_m, c_l}{u}(c_a, c_m, c_l; z^h), \tag{2.2}$$

$$s.t.: p_x x + p_m c_m + wc_l = \pi^* + wE, \text{full income constraint; } c_l + l^s = E, \text{ time constraint}$$

Yet in practice, incomplete markets are generally the rule rather than the exception in rural areas in developing countries. We adopt the definition by Sadoulet & de Janvry (1995) for an incomplete market as: "a market may fail for a particular household when it faces wide price margins between the low price at which it could sell a commodity or the factor and the high price at which it could buy that product or factor" (p. 149). Complete self-sufficiency of the idealized peasant is one extreme of incomplete markets. In this case peasants produce all of the consumption needs of a household employing only the productive factors (land and labor) available within the household.

According to Sadoulet & de Janvry (1995) the most common reasons for incomplete markets are (i) transaction costs due to poor infrastructure, high marketing costs due to merchants' local monopoly power, and supervision costs of hired labor; (ii) shallow local markets because of a high covariation between household supply and prices[4]; (iii) due to price risks and risk aversion of farmers, sales prices are discounted negatively and purchase prices are revised upward to hedge against risk; (iv) and finally limited access to working capital means that the budget balance becomes a constraint, and this leads to self sufficiency because actions that require cash outlays like hiring outside labor or using fertilizer implicitly carry the cost of financing, while cash-

[4] During the harvest time prices are low because everybody is selling in the locale and during the low season prices are high because of low supply.

generating activities – even if seemingly unprofitable, like selling milk – become sought after to ease the cash constraint especially in the lean season. Under market imperfections, exogenous market prices no longer accurately reflect the full opportunity cost of goods and services. In the presence of imperfect markets, some goods become nontradeable (pp. 149-150). Their prices are determined internally by the household; and hence the decisions of production and consumption are no longer separate: they are decided jointly. This finding has direct relevance for the policy analysis. In their simulation study, de Janvry et al., (1991) show that when the impact of market price change on food consumption and production is strongest when market function properly imperfections. Whereas if market for food and labor are incomplete than the impact of market price changes will be muted. In other words, the food price elasticity is much lower when the markets are incomplete.

In empirical applications using production and consumption equations, an AHM should be estimated simultaneously rather than sequentially. However, such a model is complex and even the minimum data required are monumental. In the presently employed data set, we do not have enough information to construct the production-side AHM (more on this in Section 2.6.1). Instead we develop a procedure to test for separation of production and consumption decisions. Then we try to gauge the significance of ignoring nonseparation in empirical applications for Turkey.

2.2.2 Test of Separability

Studying rural labor markets in Java, Benjamin (1992) uses household demographic attributes to identify nonseparation: "… identification of nonseparation relies on the observation of a correlation between demographic composition and observed farm employment" (p. 292). If the household exhibits Chayanovian characteristics – that is, if all or most of the labor is sourced within the family – then total labor exerted will depend on household characteristics like household size and the number of working age adults. However, if there is an active labor market then family size is not a binding constraint and laborers can be hired as needed[5]. To test this theory empirically, Benjamin (1992) estimates the impact of demographic variables on labor demand after taking into account wage, area harvested, inputs used, and controls for soil and climate conditions[6].

We develop a similar procedure using the budget share of self-provisioned food as a means to identify nonseparation[7]. In doing so, we apply a logic akin to that of Hoddinott & Haddad (1995), who propose that if household members pool their income and spend it to maximize joint household utility, then who controls income within the household should not matter. When they estimate the determinants of household spending on food, clothing, etc. they include wives' share of cash income as an explanatory variable, in addition to total expenditure and a host of demographic characteristics. They find that when women have income independent of their husbands, the household's spending on food and children's needs increases significantly.

In our case, we hypothesize that if the households' consumption and production decisions are separable, then the budget share of self-provisioned food should not affect the amount of food consumed. In the empirical tests, the coefficient estimate for the budget share of self-provisioning should be statistically insignificant. In the case of

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[5] Alternatively family members are not limited by size of agricultural holding for employment and can find employment for excess labor.
[6] He finds that they are not statistically significant in rural Java; i.e., the labor market functions well in rural Java.
[7] James K. Boyce suggested this solution.

separable decisions, observed self-provisioning is merely a case where a household treats itself as another supermarket. However, if the production and consumption decisions are nonseparable, then the coefficient estimate for budget share of self-provisioning will be economically and statistically significant.

2.3 Empirical Model

Studies on food demand in Turkey using micro household data are fairly rare. Recent examples are the studies by Akbay et al., (2007), Armagan & Akbay (2008), and Sengul & Tuncer (2005). The first two of these studies use data sets compiled by the State Institute of Statistics (SIS). Sengul and Tuncer (2005) use the 1994 Household Budget Survey (SIS 1994) and Akbay et al., (2007) use the survey from 2003 (SIS 2003). We also use the SIS 2003 data set. Unlike SIS 1994, the SIS 2003 data set allows us to identify the source of food: bought from the market or self-provisioned. Both Sengul and Tuncer (2005) and Akbay et al., (2007) use two-step estimating procedures, where in the first step they deal with censored data[8] issues. Sengul and Tuncer (2005) use the methodology developed by Heien & Wessells (1990), whereas Akbay et al., (2007) follow a consistent two-step procedure developed by Shonkwiler & Yen (1999), who show that Hein & Wessells (1990) methodology yields inconsistent and inefficient estimates.

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[8] Many households do not purchase various food items during the survey month. This can be either due to they cannot afford or preferences or they deplete their stocks. In other words, the survey observations are censored due to the existence of stocks. We want to distinguish between the households who cannot afford such food items from the ones who simply consume from purchases made prior to survey month. For example, in the SIS 2003 data set, one-third of households do not have any purchase in the “other food” category – which includes prepared meals, salt, spices, etc.

After taking care of censored data issues, in the second step both papers employ the linear approximation (LA) of the almost ideal demand (AID) system, i.e. LA/AIDS, developed by Deaton & Muellbauer (1980). We utilize the same data set as Akbay et al., (2007), and follow their strategy in estimating the benchmark demand system. The rest of this section explains the empirical methodology in detail, closely following the exposition in section two of Akbay et al., (2007).

2.3.1 Linearly Approximated Almost Ideal Demand System (LA/AIDS)

Deaton & Muellbauer (1980) introduced the workhorse model for estimating demand systems:

$$w_i = \alpha_i + \sum_{j=1}^{11} \gamma_{ij} \log p_j + \beta_i \log\left(\frac{x}{P^*}\right) + \sum_{j=1}^{25} \lambda_{ij} D_j + \rho_i S + e_i \qquad (2.3)$$

where w_i denotes the budget share of food group *i*, p_j represents the price of the *jth* food group, *x* is the total expenditures on food, $\alpha_i, \gamma_{ij}, \beta_i, \lambda_{ij}$ and ρ_i are parameters to be estimated, P^* is the price index approximated by Stone's index (Equation 2.4), and e_i is the disturbance term. D_j are the demographic variables, including household size, a dummy variable for households with young children (younger than 14), dummies for age, education, marital status and gender of household heads, and employment status of housewives and seasonal and regional dummy variables[9]. *S* is the budget share of self provisioning for each household and it is the only additional variable that we introduce

[9] Pollak & Wales (1981) test the alternative methods and conclude that using dummy variables to account for demographic variables (translating approach) fares better among alternatives.

apart from those used by Akbay et al., (2007), allowing us to extend their model in order to perform the separability test:

$$\log P^* = \sum_{i=1}^{11} w_i^0 \log p_i, \tag{2.4}$$

where w_i^0 represents the mean budget share for each food group.

2.3.2 Estimating a complete demand system with censored variable problems

Estimating demand systems where a large number of zero purchases exist[10] will yield biased and inconsistent estimates of demand parameters because of large numbers of dependent variables valued at zero. One way to deal with latent variables of this nature is to employ a two step-procedure. In the first stage, a probit model is used to determine the probability of consumption of the good in question for a given household. In the second stage, the regressors are transformed using the information from the initial probit model. In this paper, we follow the two-step methodology developed by Shonkwiler & Yen (1999).

In the first step, the decision to consume is modeled as a dichotomous choice problem (Hein and Wessells, 1990) with a linear probit model (Equation 2.5):

$$w_i^* = f(x_i, \mu_i) + u_{i,} \qquad w_i = d_i w_i^*$$

$$d_i = \begin{Bmatrix} 1 \text{ if } d^* > 0 \\ 0 \text{ if } d^* \le 0 \end{Bmatrix} \qquad d_i^* = z_i' \theta_i + v_i \tag{2.5}$$

[10] Table 2.2 shows that for this sample zero purchases are clustered in non-perishable food groups: for other food group (33 percent), for non-alcoholic beverage (28 percent), for tea and coffee (24 percent), and for vegetable oils (17 percent). The survey period is one month and it is very possible that many households continued to consume previously purchased goods from storage, like vegetable oils or tea, despite the fact they did not make any purchases during the survey month.

where i stands for food group, w_i and d_i are the observed dependent variables, and w_i^* and d_i^* are the corresponding unobserved (latent) variables. Following Akbay et al., (2007), z_i are the vectors of socio-economic and demographic factors such as age, education, gender and marital status of the head of household, and household size. Also we used total household spending (which is not used in the second stage), since Jackson (1984) showed that variety increases with total spending. μ_i and θ_i are the vectors of parameters to be estimated and u_i and v_i are the random errors.

Assuming that for each i, the error terms (u_i and v_i) are distributed as bivariate normal with cov $(u_i,v_i) = \phi$, Shonkwiler and Yen (1999) corrected for inconsistency in estimates by defining the second-stage regression:

$$w_i = \Phi(z_i^{'}\theta_i)\, f(x_i, \mu_i) + \delta_i \phi(z_i^{'}\theta_i) + e_i \tag{2.6}$$

where $\phi(\ )$ is the univariate standard normal probability density function (PDF) and $\Phi(\ )$ is the cumulative distribution function calculated by inserting $\hat{\theta}_i$ in place of θ_i which are obtained using Equation 2.5 in the first step and e_i is the error term. Shonkwiler and Yen (1999) suggest estimating the demand system in the second stage using either Maximum Likelihood (ML) or Seemingly Unrelated Regression (SUR)[11]. Equations 2.7 and 2.8 present Equation 2.6 in full detail:

$$\begin{aligned} w_i = {} & \alpha_i \Phi(z_i^{'}\theta_i) + \sum_{j=1}^{11} \gamma_{ij} \log p_j \Phi(z_i^{'}\theta_i) + \beta_i \log\left(\frac{x}{P^*}\right)\Phi(z_i^{'}\theta_i) + \\ & \sum_{j=1}^{25} \lambda_{ij} D_j \Phi(z_i^{'}\theta_i) + \rho_i S \Phi(z_i^{'}\theta_i) + \delta_i \phi(z_i^{'}\theta_i) + e_i \end{aligned} \tag{2.7}$$

[11] Akbay et al., (2007) employ iterated SUR.

In the above model the error terms are defined as follows:

$$e_i = u_i + \left[\Phi(z_i^{'}\theta_i) - \Phi(z_i^{'}\hat{\theta}_i)\right] f(x_i \mu_i) + \delta_i \left[\Phi(z_i^{'}\theta_i) - \Phi(z_i^{'}\hat{\theta}_i)\right] \quad (2.8)$$

The LA/AIDS is the workhorse model of estimating demand systems, yet the issue of how to deal with censored variables is not settled. In a commentary on Akbay et al., (2007), Drichoutis, Klonaris, Lazaridis, & Nayga Jr. (2008) point out that error terms are heteroskedastic, as Equation 2.8 suggests, and therefore the second step SUR estimator will be inefficient (p.95). They suggest using Feasible Generalized Least Squares (FGLS), instead of currently popular ML or SUR procedures, after Tauchmann (2005). In their response to Drichoutis, et al., (2008), Akbay Boz, & Chern (2008) recalculate the own-price elasticities and food expenditure elasticities for whole sample with coefficient estimates obtained from the FGLS procedure in the second step. In this chapter, we also employ the FGLS approach for the second-stage estimation[12]. Any estimate by Akbay et al. in this chapter are to their most recent elasticity estimates with the FGLS results (Akbay et al., 2008), not to their original 2007 paper.

Demand theory requires the imposition of the following three constraints (adding-up, symmetry and homogeneity) on the parameters of Equation 2.7:

Adding up: $\sum_i \alpha_i = 1, \ \sum_i \gamma_{ij} = \sum_i \beta_i = \sum_i \lambda_{ij} = \sum \ \delta_i = 0,$

Symmetry: $\gamma_{ij} = \gamma_{ji}$,
Homogeneity: $\sum_j \gamma_{ij} = 0$ (2.9)

[12] We applied the 3SLS procedure in the STATA package to perform FGLS.

Marshallian own and cross-price elasticities and food expenditure elasticities are computed from the parameters of the LA/AIDS for the variables at sample means (see (Yen, Kan, & Su, 2002)):

Own-price: $\varepsilon_{ii} = \frac{(\gamma_{ii} - \beta_i w_i^0)\Phi(z_i^{'}\theta_i)}{w_i^0} - 1,$,

Cross-price: $\varepsilon_{ii} = \frac{(\gamma_{ij} - \beta_i w_j^0)\Phi(z_i^{'}\theta_i)}{w_i^0},$

Food expenditure: $\varepsilon_i = 1 + \frac{\Phi(z_i^{'}\theta_i)\beta_i}{w_i^0}$ (2.10)

2.4 Self-provisioning

For the first time, Turkey's Household Budget Survey for 2003 (SIS 2003) data set allows us to distinguish among the sources of food for the household. The SIS 2003 data set classifies the food available to households as shown in Table 2.1. The amounts in the last three categories are trivial, but self-provisioning accounts for 7 percent of total available food in Turkey as a whole, and roughly 19 percent of rural consumption (calculated in terms of calories).

The food produced and consumed within the household obviously has no market price. In this case, SIS researchers assigned production costs in order to calculate the amount spent on each food category[13]. Due to imputing production costs (instead of retail prices) to monetize all consumption, self-provisioned food has a lower share of total food spending vis-à-vis its share of calories.

[13] There is no direct explanation for the pricing of self-provisioned food in the survey manual. But in explaining other instances of in-kind payments to individuals, the manual explains that they are valued at production cost. For example, see individual section manual, question 8.32d. Likewise we verified that wholesale prices are imputed for self-provisioned food with SIS officials.

Table 2.1: Ratio of calorie intake and food liras of household food consumption

	All sample		Urban		Rural	
Definition	**calories**	**food liras**	**calories**	**food liras**	**calories**	**food liras**
1- Purchased	0.91	0.92	0.97	0.96	0.80	0.82
2- Self-provisioning[14]	0.07	0.05	0.01	0.01	0.19	0.15
3- Produced for market but consumed in the household	0.01	0.01	0.01	0.01	0.01	0.01
4- Payments in kind by employer	0.00	0.00	0.00	0.00	0.00	0.00
5- Purchased for the purpose of donation	0.01	0.02	0.01	0.02	0.01	0.02

Two characteristics about self-provisioning stand out. First, self-provisioning is concentrated in several commodities. On the one hand, there is no self-provisioning of some highly processed products like sugar and vegetable oils. On the other hand, 60 percent of fluid milk, 76 percent of yogurt, 70 percent of butter, 40 percent of cheese, 27 percent of eggs, 36 percent of other grain products, and roughly 15 percent of fruits and vegetables consumed in rural areas are self-provisioned (again percentages are calculated in caloric terms). These initial observations suggest that for some rural households the production and consumption decisions may not be separable. Second, the retail and imputed price differentials vary depending on the product. For dairy products, the imputed price is roughly 74 percent of retail price. In the "other grains" category, the imputed price is 70 percent of rural retail prices. For fruits and vegetables, the imputed prices are roughly 66 percent of retail prices. However, for highly industrialized products like, chicken and eggs, the retail prices are lower than imputed prices.

[14] This category also includes the food donated to relatives etc. from household production. However, it is not possible to discern the actual consumption from donations from the survey data. So I assumed that all of it consumed in the household. At the very least, we can speculate that household members are choosing to donate some of their produce with their free will which would imply that donations are as valuable to them at the margin as personal consumption.

Table 2.2 shows the percentage of non-zero purchases and summary statistics for the food budget share of each food group (the third column presents summary statistics for the dependent variables in the demand system). Table 2.3 presents similar statistics for the self-provisioned products. In light of the concentration of self-provisioning in certain animal products, we grouped the food items slightly differently than did Akbay et al., (2007, 2008). In their papers butter belongs to fats and oils, and eggs are classified under other foods. In this chapter we classify dairy products, butter and eggs under one heading, while the rest are constructed exactly like Akbay et al., (2007). We believe that butter and eggs display more common characteristics with cheese and yogurt than with vegetable oils or highly processed food products (in the other food category) for rural households.

Table 2.2: Percentage of non-zero purchases, mean food expenditure shares and monthly spending by food group

Food Groups	Households purchasing (%)	Mean exp. Share (%)	Mean exp. by all households (TL/month)	Mean exp by purchasing households (TL/month)
Bread*	94.9	15.8	27.6	29.1
Cereals*	94.8	9.1	18.4	19.4
Meat & meat products*	89.8	13.6	34.3	38.2
Vegetable oils	83.1	5.7	11.3	13.6
Vegetables*	99.7	16.9	32.0	32.1
Fruits*	97.7	9.1	17.8	18.2
Dairy products and egg	99.3	15.1	28.5	28.7
Sugar, confectionary and jams*	94.7	7.9	15.9	16.8
Tea and Coffee*	76.3	3.0	5.6	7.3
Non-alcoholic beverages*	72.1	2.7	5.3	7.3
Other food products	66.6	1.2	2.4	3.6

*: same as Akbay et al., (2007), Table 3. TL: Turkish Lira

Table 2.3: Self-provisioning budget share, mean food expenditure shares and monthly spending by food group

	entire sample				rural only			
Food Groups*	Self-prov. % of hhs	Mean exp. Share (%)	Mean exp. by all hhs (TL/ month)	Mean exp. by self-prov. hhs (TL/ month)	Self-prov. % of rural hhs	Mean exp. Share (%)	Mean exp. by all rural hhs (TL/ month)	Mean exp. by self-prov. rural hhs (TL/ month)
Cereals**	8.2	5.6	2.0	24.4	27.0	18.5	6.6	24.6
Meat	1.4	0.9	0.6	47.1	4.3	2.9	2.1	48.2
Vegetables	9.0	3.1	1.3	14.8	26.3	9.2	4.0	15.3
Fruits	3.9	2.1	0.5	13.2	11.3	6.1	1.4	12.5
Dairy & egg	14.9	12.0	5.0	33.4	47.2	38.7	16.1	34.2
Sugar	0.5	0.3	0.1	14.1	1.5	1.0	0.2	14.3
Tea & Coffee	0.1	0.1	0.0	5.6	0.4	0.4	0.0	5.6

*: There is no self-provisioning of bread, vegetable oils, non-alcoholic beverages and other food groups.
**: Cereals includes other grain products which in turn include flour used for making bread at home.

2.5 Empirical Results

2.5.1 Estimation of the Model

The SIS 2003 survey is designed to be nationally representative and a stratified multi-stage systematic cluster sampling method is used. The survey covered a sample of 25,764[15] households from 12 regions without replacement (to minimize seasonal influences on consumption), and was conducted over 12 months from January 1 to December 31, 2003. The survey includes detailed demographic characteristics for each household that allow us to control for heterogeneity in preferences and some production-related variables (e.g., land owned and labor, more on these later). Table A1.1 in the Appendix presents the summary statistics for all of the variables in the two-step procedure.

As explained in the previous section, we constructed food groups especially relating to animal products differently than Akbay et al., (2007). This regrouping caused

[15] There is no detail of food consumption for 17 households, so we conducted empirical tests with 25,747 observations.

some drop in the share of non-zero purchases for the fats and oils category (from 86.2 percent in Akbay et al., (2007) to 83.1 percent in our case); a significant drop in the share of non-zero purchases in the other food category (from 95.8 percent to 66.6 percent) and an increase in the share of non-zero purchases in dairy and egg category (from 97.7 percent to 99.3 percent). In other words, in our case the percentages of censored variables in these categories are different than Akbay et al., (2008)[16]. This change may affect the results. In order to gauge the effect of regrouping, we construct Table 2.4. Columns 2 and 4 are taken from Akbay et al., (2008) and columns 3 and 5 are calculated using the same regressors as Akbay et al. (2008).

The comparison in Table 2.4 shows that the calculated elasticities between the two studies are close. This gives us confidence that both Akbay et al.'s (2008) and our elasticity estimates are robust to alternative groupings of food. Moreover, where the difference is largest – the food expenditure elasticity of the "other food" category - the change is in the expected direction, since once purchases of eggs (a cheap and widely consumed perishable product) are removed from this category, the rest is composed of highly processed products like prepared meals or spices, so that the increase in the food expenditure elasticity is expected.

[16] Since the content of these three food groups have changed so to the corresponding prices.

Table 2.4: Comparison of our model to Akbay et al., (2008) without including the self-provisioning instrument

	Food Expenditure elasticities		**own price elasticities**	
All sample	Akbay 2008	Tekguc	Akbay 2008	Tekguc
Bread	0.70	0.65	-0.87	-0.89
Cereals	1.11	1.10	-0.90	-0.84
Meat & meat products	1.66	1.76	-0.62	-0.75
Vegetable oils	1.03	1.16	-0.89	-0.93
Vegetables	0.93	0.87	-0.89	-0.78
Fruits	0.90	0.82	-0.79	-0.80
Dairy products and egg	0.82	0.82	-0.81	-0.74
Sugar, confectionary and jams	0.99	1.08	-0.68	-0.70
Tea and Coffee	0.67	0.77	-0.75	-0.90
Non-alcoholic beverages	0.71	0.76	-0.96	-1.09
Other food products*	0.40	0.92	-0.87	-0.80

*: Akbay et al. (2008) do not report the elasticities for other food products in 2008 paper so the elasticities for other foods are taken from the original 2007 paper.

Table 2.5 presents the uncompensated own-price, and food expenditure elasticities estimated from Equation 2.7 (including the share of self-provisioning for each household in every equation)[17]. All estimated own-price and food expenditure elasticities are consistent with demand theory. Uncompensated own-price elasticities are between -0.7 and -1 except for non-alcoholic beverages which is -1.09. The own-price elasticities are highest for tea and coffee and beverage groups, which is not surprising since their consumption is relatively discretionary. Nevertheless, own-price elasticities point to high responsiveness to price changes. The food expenditure price elasticities are slightly greater than unity for cereals[18], vegetable oils, and sugar and confectionary. Moreover, according to our estimates a one-percent increase in total expenditure on food will increase the spending on meat by 1.75 percent. Elasticities calculated for rural and urban

[17] Table A1.4 in Appendix presents the coefficient estimates for the whole demand system. Also see Table A1.5 in Appendix for cross price elasticities.
[18] Cereals group is a relatively heterogeneous food group including home-made bread, cookies, and patisserie products.

areas show considerable differences. In general, households residing in rural areas are more responsive to own-price changes than are urban households, and urban households are more responsive to changes in expenditure.

Table 2.5: Expenditure and own price elasticities for Rural and Urban Areas estimated including the self-provisioning instrument.

	Food Expenditure			Own-price		
Food Groups	**All sample**	**Rural**	**Urban**	**All sample**	**Rural**	**Urban**
Bread	0.67	0.58	0.70	-0.86	-0.99	-0.80
Cereals	1.09	1.14	1.08	-0.82	-1.02	-0.69
Meat & meat products	1.75	1.88	1.68	-0.76	-0.74	-0.79
Vegetable oils	1.17	1.04	1.20	-0.93	-1.21	-0.81
Vegetables	0.88	0.85	0.90	-0.78	-0.80	-0.77
Fruits	0.81	0.72	0.86	-0.80	-0.79	-0.80
Dairy products and egg	0.81	0.87	0.80	-0.74	-0.76	-0.75
Sugar, confectionary and jams	1.08	1.10	1.07	-0.71	-0.74	-0.69
Tea and Coffee	0.77	0.59	0.87	-0.90	-0.84	-0.91
Non-alcoholic beverages	0.76	0.71	0.76	-1.09	-1.07	-1.08
Other food products	0.90	0.84	0.88	-0.80	-0.84	-0.79

2.5.2 Testing Separability

Inspection of Table A1.4 reveals that the budget share of self-provisioning is significant in nine out of eleven food groups at the 5 percent significance level or less (budget shares of self-provisioning are individually insignificant only for the fruits and other food groups). We also test whether addition of the food budget share of self-provisioning to the demand system is jointly significant. Table 2.6 presents Wald tests for various specifications. The null hypothesis is that all of the self-provisioning budget share coefficients are equal to zero in the demand system. The results of Wald tests invariably show that self-provisioning food budget share coefficients are significant in the demand system.

The first three rows in Table 2.6 employ the self-provisioned food budget share as defined above. The fourth row uses the self-provisioning budget share of each food group in the respective equation, instead of the average of self-provisioning. In four out of eleven food groups there is no self-provisioning (i.e., bread, vegetable oils, non-alcoholic beverages and other foods). See Table 2.3 for details of remaining seven. In the fifth row, we broaden the content of self-provisioning and include the categories three and four as defined in Table 2.1. The inclusion of in-kind payments by employers; especially increased the number of households with non-zero self-provisioning by more than 1,000 observations (from 4,960 to 5,989 observations or roughly 4 percent of sample, with 882 of the new additions coming from urban areas). This broadened definition does not fit neatly with the theoretical discussion in the Section 2.2 for self-provisioning, but we want to double check our results with an alternative definition. The conclusion is still the same: the coefficients of self-provisioning are significant.

As an additional robustness test for the last row, we calculate the predicted values for self-provisioning. In the first stage, we estimate the budget share of self-provisioning with regressors including the food budget (negative coefficient), a host of production-related variables (land, labor, grazing areas in the region, (production-side variables discussed further in the next section)), and a host of demographic variables like age, education, household size that can influence production decisions. The purpose of this final exercise is to control for measurement errors. It is possible that many households are not reporting self-provisioning, especially if their primary income-generating activity is not farming and yet they engage in some amount of self-provisioning via kitchen gardens. We believe that women, especially, tend to under-report how long they work[19], partly due to the fact that the SIS 2003 is designed to elicit the labor force participation as conventionally defined. There are 14,095 non-zero observations for the predicted self-

[19] Personal communication with B. Akbulut who is doing field work in rural Central Turkey and G. Ünal.

provisioning category. The conclusion from the Wald test is still the same: the coefficients of the predicted self-provisioning budget share are jointly significant in the LA/AIDS[20].

Table 2.6: Wald test whether all of the self-provisioning variables are jointly equal to zero

Wald Test	Sample	D.F.	Chi2	Critical value (0.05)	Prob >Chi2
Self-provisioning budget share	whole	11	5,324.8	19.68	0.00
Self-provisioning budget share	urban	11	505.9	19.68	0.00
Self-provisioning budget share	rural	11	3,261.3	19.68	0.00
food group self-provisioning*	whole	7	969.1	14.07	0.00
Self-provisioning alternative#	whole	11	2,969.1	19.68	0.00
Self-provisioning predicted variable^	whole	11	1,811.0	19.68	0.00

*: We use the food budget share of corresponding food groups instead of an overall average. Please see Table 2.3 for food groups with non-zero self-provisioning.
#: We construct an alternative budget share of self-provision variable by combining rows 2, 3 and 4 from Table 2.1.
^: The R-Square of the first stage is 0.55. The result of the first stage is available upon request.

2.6 Economic and Policy Significance

2.6.1 Estimation in the Presence of Nonseparability

In the previous section we showed that the implicit assumption of separation of previous studies on food consumption in Turkey is not warranted. However, statistical significance does not always translate into economic policy significance, and we may wonder whether it is worthwhile the effort to build a more complicated nonseparable model (Sadoulet and de Janvry, 1995; p. 159). In particular, we want to measure the potential effect of ignoring versus allowing nonseparation by incorporating production-side variables into consumption functions and recalculating the food expenditure and own-price elasticities.

[20] Table A1.3 in the Appendix presents results of a likelihood ratio test where we test and reject separation. We reach the same conclusion with Wald tests presented in Table 2.6 for every specification.

In case of nonseparation, Sadoulet and de Janvry (1995) suggest a reduced-form approach:

$$q = q(p, z^q, z^h, T, K) \text{ for production,}$$
$$\text{and } c = c(p, z^q, z^h, T, K) \text{ for consumption} \qquad (2.11)$$

where in Equation 2.11, p stand for prices, z^q represents the household's agricultural production-related assets; z^h represents household characteristics pertaining for consumption decisions; T stands for income transfers; and K stands for credit constraints, if any. The important feature of Equation 2.11 is that productive factors are included into the consumption equation (and vice versa), in addition to other household characteristics that affect consumption decisions.

Here we focus on estimating the reduced form of the consumption equations including productive factors like labor and land for the three food groups with most self-provisioning: dairy and egg, cereals and vegetables (we pay special attention to dairy and egg food group, and use the cereals and vegetables groups for comparison purposes). In order to construct even the simplest nonseparable agricultural household model both with production and consumption equations, one would need to have information on (for the production side): food crop, cash crop, the respective allocation of land, labor and other inputs separately for each productive activity. The available data do not provide this level of detail. Furthermore, we only have information on total agricultural income, not its breakdown across the activities generating this income.[21].

[21] Please refer to de Janvry, Fafchamps and Sadoulet (1991) or Taylor & Adelman (2003) for such agricultural household models. We are aware of only one data set which potentially has rich enough data on agricultural households' production and consumption from Turkey: QHS 2002. Constructing an AHM is beyond the scope of this chapter.

Given all these caveats, we solely focus on estimating the budget share of selected food groups while incorporating production-related variables into the demand equation. Our aim is to compare the elasticity estimates obtained from demand model with estimates obtained when production-related variables are explicitly included to consumption equation. We use Equation 2.12 as the empirical model:

$$\begin{aligned} w_i = {} & \alpha_i \Phi(z_i^{'}\theta_i) + \sum_{j=1}^{11} \gamma_{ij} \log p_j \Phi(z_i^{'}\theta_i) + \beta_i \log\left(\frac{x}{P^*}\right)\Phi(z_i^{'}\theta_i) + \\ & \sum_{j=1}^{25} \lambda_{ij} D_j \Phi(z_i^{'}\theta_i) + \delta_i \phi(z_i^{'}\theta_i) + \sum_{k=1}^{7} \tau_{ik} F_k \Phi(z_i^{'}\theta_i) + e_i \end{aligned} \tag{2.12}$$

This is similar to Equation 2.7 except for two changes: since we are no longer interested in testing separation, we drop the budget share of self-provisioning from the model, and we include seven production-related variables discussed below (represented by F in Equation 2.12). Since there is no justification for any specific restrictions in the reduced-form equations, we employ the most straightforward model, OLS. As Equation 2.12 shows, we still transform the explanatory variables by multiplying them by the cumulative distribution of the probit model from the first step. The sole purpose of this is to make the estimates as comparable as possible to those from the previous section[22]. Then we re-calculate the food expenditure and own-price elasticities in order to compare them to the elasticities obtained in the previous section. (We again use the elasticity formulas from Equation 2.10).

Moreover, QHS 2002 was administered only to rural households, which would not allow us to obtain estimates to urban areas.

[22] Table 2 shows that censoring is not a great problem for cereals (95 percent non-zero budget shares); vegetables (99.7 percent); and dairy and egg (99.3 percent).

2.6.2 Production Variables

SIS 2003 is a household consumption data set and does not include detailed production/income generation-related information but it is possible to obtain farm labor (male and female labor separately) and land values from SIS 2003 as productive factors. We want to disaggregate labor according to gender because of the potential gendered division of labor as an aspect of incomplete markets. We expect to find female labor more crucial for the consumption of dairy and egg, other cereals, and vegetables food groups (i.e. positive and greater coefficient estimate than the male labor coefficient).

The values of agricultural land, orchards and greenhouses are the only agricultural assets in the SIS 2003 data set. We aggregate all of these land-related assets by value instead of acreage. We believe using land values will also incorporate the productivity differences of different plots. We also include the squared values of land assets into the consumption function, expecting a concave relationship between ownership of land and consumption (i.e. we expect to obtain positive coefficients for the land value and negative for the squared term). Our focus is especially on dairy and egg consumption, and hence it would have been much better to have information on animal ownership but such data are not available in SIS 2003. Moreover, in Turkey the petty production of dairy products is heavily dependent on public grazing lands, but SIS 2003 does not include public land available for farm households for grazing their animals. For these reasons, the value of farm land owned may be a poor proxy for productive assets employed in the dairy production. In an effort to address the latter problem, we obtained summary statistics[23] from the 2001 General Agricultural Census (SIS 2001) the closest available year, and

[23] Summary statistics for SIS 2001 is freely available on SIS website: www.tuik.gov.tr

calculated the average grazing area for each region of the country. In calculating this, we included unused and undeveloped land, permanent meadows, fallow land and pastures. Then we divided the total grazing area by the number of farm households in each region. The results range from 26 hectares in the Mediterranean region to 222 hectares in the northeast region.

The literature on peasant animal husbandry stresses the importance of animals as quasi-saving assets to be liquidated in times of hardship (Rosenzweig & Wolpin, 1993). To account for this insurance function of animal husbandry, we created a health insurance dummy for households to indicate if any member of the household has health insurance. We expect that households with access to formal health insurance will have less incentive to keep animals for insurance purposes.

Finally, literature on income, wealth, and power inequality Boyce (2002) suggests that in regions where poverty and inequality are prevalent, poor rural households will rely more on non-market sources of income like public lands to meet their basic needs like firewood or fodder for their animals, because they less access to both formal employment and public services. Since income inequality is a strong proxy for wealth and power gaps, Boyce (2002) uses the share of lowest quintile in total expenditure (“poor share” in the following tables) as a proxy for ill distribution of political power[24]. We expect a positive coefficient for this variable: as the share of the poorest quintile in total expenditure increases, so does the share of budget devoted to dairy and egg.

We took the logarithm of labor, land values and grazing area variables before using them in the regression analysis because all other continuous variables in the model

[24] The share of each quintile in total regional spending is also available from SIS web-site: www.tuik.gov.tr

(prices and food budget) are already in log form. Health insurance is a dummy and poor share is in percentages. Table A1.2 presents the summary statistics for non-zero observations.

Table 2.7 presents the results of OLS regressions when the dependent variable is food budget share of dairy and egg food group for the whole sample, and for urban and rural areas[25]. The second, four and sixth columns contain only the variables traditionally associated with consumption. Columns three, five and seven also include the above-mentioned production-related variables.

First, most of the production-related variables are individually significant at a 5 percent significance level or less. Second, all of the variables except for value of land, significant or not, have the expected signs. Third, production variables are jointly significant in each specification[26]. Fourth, the coefficient estimate for female farm labor is greater than the coefficient estimate for male farm labor in each case, and the difference is statistically significant at 5 percent significance level for the whole sample. Collectively, these findings support our previous conclusion of nonseparation: consumption decisions rely not only on the conventional consumption-relevant household characteristics but also on productive factors available to the households.

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[25] Similar tables for cereals and vegetables food groups are available from the author upon request.

[26] For cereals food group, the production variables are also jointly significant for all specifications and have the expected signs except for poor share and grazing area. However, in the case of vegetables they are jointly significant only for rural areas and the coefficients of field and field-squared have the opposite of expected signs.

Table 2.7: OLS regressions for Share of Dairy and Egg Food Group in the Food Basket

	Total		Urban		Rural	
Constant	-0.1031**	-0.2511***	-0.2235***	-0.3178***	0.3523***	0.0032
Bread price	0.0077***	0.0056***	0.0031	0.0023	0.0109***	0.0091***
Cereal price	-0.0076***	-0.0056***	-0.0042***	-0.0039***	-0.0164***	-0.0113***
Meat price	-0.0045***	-0.0040***	-0.0030**	-0.0027**	-0.0087***	-0.0071***
Veg. oil pr.	0.0035*	0.0050***	0.0078***	0.0076***	-0.006	-0.0022
Vegetable pr.	-0.0018	-0.0001	0.0027	0.0036*	-0.0121***	-0.0096**
Fruit price	-0.0009	-0.0007	-0.0011	-0.0013	-0.001	0.0003
Dairy & egg p	0.0384***	0.0385***	0.0354***	0.0352***	0.0417***	0.0419***
Sugar pr	-0.0021**	-0.0012	-0.0022**	-0.0020*	-0.002	0.0001
Tea & coffee	-0.001	-0.0004	0.0003	0.0004	-0.0054*	-0.0044
beverage pr	-0.0027***	-0.0027***	-0.0021**	-0.0021**	-0.0047*	-0.0056**
Other food pr	-0.0002	-0.0002	-0.0007	-0.0005	0.0003	0.0006
Food expen.	-0.0336***	-0.0368***	-0.0348***	-0.0353***	-0.0321***	-0.0384***
Hh size	0.0022***	0.0008**	0.0001	0.0000	0.0047***	0.0024***
Child dummy	0.0103***	0.0113***	0.0146***	0.0148***	0.0037	0.0046
Male head	-0.001	-0.0016	-0.0017	-0.0013	-0.0027	-0.005
Married	-0.0048*	-0.0003	0.0000	0.0005	-0.0144***	-0.0028
Education 2	0.0006	0.0023**	0.0025**	0.0028**	-0.0063**	-0.0013
Education 3	0.0046***	0.0082***	0.0064***	0.0073***	-0.0026	0.0072
Age 2	-0.0054***	-0.0035*	-0.0035	-0.0035	-0.0062	-0.0015
Age 3	-0.0075***	-0.0065***	-0.0067***	-0.0069***	-0.0068	-0.0049
Age 4	0.0059***	0.0036*	0.0077***	0.0068***	-0.0008	-0.0034
Wife empl.	0.0276***	0.0028	0.0048***	0.0008	0.0432***	0.0068*
Urban	-0.0113***	0.0035**				
Quintile 2	-0.0041**	-0.0021	0.0083***	0.0085***	-0.0146***	-0.0123***
Quintile 3	-0.0049**	-0.0011	0.0121***	0.0127***	-0.0231***	-0.0190***
Quintile 4	-0.0033	0.0014	0.0135***	0.0141***	-0.0181***	-0.0128***
Quintile 5	-0.0051*	0.0012	0.0122***	0.0134***	-0.0251***	-0.0179***
Quarter 2	0.0086***	0.0090***	0.0055***	0.0057***	0.0163***	0.0163***
Quarter 3	0.0067***	0.0073***	0.0057***	0.0060***	0.0096***	0.0097***
Quarter 4	-0.0018	-0.0008	-0.0037**	-0.0034**	0.003	0.0044
Istanbul	0.0063***	0.0183***	0.0031	0.0182***	0.0255***	0.0528***
Marmara	-0.0065***	-0.0026	-0.0101***	-0.0078***	0.0153***	0.0250***
Aegean & West	-0.0037*	0.0028	-0.0039*	0.0061*	0.0042	0.0169**
Mediterranean	-0.0044*	0.0048	-0.0057**	0.0044	0.0100*	0.0303***
Cent. Anatolia	0.0024	-0.0026	-0.0088***	-0.0166***	0.0355***	0.0207**
Black Sea	-0.0078***	-0.0053*	-0.0169***	-0.0138***	0.0132**	0.0253***
NE & C East	-0.0025	-0.0066**	-0.0127***	-0.0145***	0.0275***	0.0098
PDF	0.0563	0.0583	0.2139**	0.2082**	0.0004	-0.0001
F. farm labor		0.0093***		0.0047***		0.0087***
M. farm labor		0.0062***		0.0012		0.0073***
Field		0.0017*		-0.0021		0.001
Field Squared		-0.0002*		0.0002		-0.0001
Health ins.		-0.0019*		-0.0016		-0.0003

continued

Table 2.7, continued

	Total		Urban		Rural	
Average grazing area		0.0052***		0.0033		0.0175***
Poor share		0.4382**		0.7153***		0.6541**
F Production (7, n)^		73.08		6.53		36.08
		0.00		0.00		0.00
F (1, n) ffarm=mfarm		6.31		2.38		0.88
		0.012		0.1226		0.3489
Observations	25,747	25,747	18,267	18,267	7,480	7,480
R-squared	0.80	0.81	0.83	0.83	0.77	0.78

^: Joint F test for production variables. * significant at 10%; ** significant at 5%; *** significant at 1% (evaluated with robust standard errors).

2.6.3 Elasticity estimates

Finally, we want to evaluate the difference in the elasticity estimates calculated when the production-related variables are taken into account. Table 2.8 summarizes our findings for the three food groups in which self-provisioning plays a significant role. We should stress that the purpose here is not to pin down exact elasticity estimates when productive factors are taken into account. As explained in Section 2.2, once nonseparation is accepted, the production and consumption decisions take place simultaneously and should be estimated as such. In this section we were only able to extend the consumption function by adding production-related variables. Given these caveats, nevertheless we proceed with this following exercise:

Table 2.8 presents three alternative calculations of food expenditure and own price elasticities. The ‘demand system’ columns are obtained from estimation of demand systems after dropping self-provisioning from the demand system[27]. The ‘OLS’ columns are calculated using coefficient estimates from Table 2.7, columns two, four and six for

[27] These estimates are almost identical to estimates in Tables 2.7. In calculating Tables 2.7, we obtained the coefficient estimates from a demand system which included the self-provisioning variable.

the dairy and egg food group to ensure that the differences between elasticity estimates are not due to employing OLS instead of FGLS estimation but rather due to the addition of new variables. A quick inspection of Table 2.8 reveals that elasticities calculated using the coefficient estimates from the demand system and single equation OLS regressions are close. Finally, the "OLS with production" columns are calculated from columns three, five and seven from Table 2.7. The comparison of columns 'demand system' and 'OLS with production' reveals that the elasticity estimates for cereals and vegetables are almost identical in both specifications. The situation is different for the dairy and egg food group, especially for rural areas. The food expenditure elasticity estimate without including the production-related variables is 0.80, whereas when the production-related variables are introduced the elasticity estimate is 0.76 for rural areas. We infer that demand system overestimates both the food expenditure and the own-price elasticities for the dairy and egg food group. The difference in estimates is greatest for expenditure elasticity in rural areas.

Table 2.8: Comparison of elasticities calculated when production side variables excluded and included

		Food expenditure elasticity			own-price elasticity		
		Demand system	**OLS**	**OLS with production**	**Demand system**	**OLS**	**OLS with production**
Cereal	Total	1.09	1.14	1.10	-0.82	-0.87	-0.84
	Urban	1.08	1.10	1.09	-0.69	-0.71	-0.70
	Rural	1.14	1.21	1.16	-1.02	-1.14	-1.10
Vegetable	Total	0.88	0.90	0.90	-0.78	-0.79	-0.79
	Urban	0.90	0.90	0.90	-0.77	-0.80	-0.79
	Rural	0.85	0.89	0.89	-0.80	-0.80	-0.79
Dairy & Egg	Total	0.81	0.78	0.76	-0.74	-0.71	-0.71
	Urban	0.80	0.76	0.76	-0.75	-0.73	-0.73
	Rural	**0.87**	**0.80**	**0.76**	**-0.76**	**-0.71**	**-0.70**

In this last exercise, we find no evidence that elasticity estimates would have been different if nonseparation was not ignored for the cereals and vegetables food groups.

However, this is not the case for dairy and egg consumption. Ignoring nonseparation of consumption and production decisions of dairy and egg products leads overestimation of expenditure and own-price elasticities. The direction of change is parallel to the findings of de Janvry et al., (1991) for Morocco. In the presence of market failures, households are less responsive to incentives through market mechanisms (e.g., price changes) than the perfect-markets case would predict.

2.7 Concluding Remarks

In this chapter we present evidence that self-provisioning of certain food groups accounts for a significant portion of rural household food baskets. Especially, the self-provisioning of more than 50 percent of dairy products is a tell-tale sign of incomplete markets in the production and consumption of dairy products.

We test for separation of production and consumption decisions using the SIS 2003 data set. Following the framework outlined by Benjamin (1992), we test and reject the null hypothesis of separation, and conclude that the production and consumption decisions are nonseparable. Inspired by the technique used by Hoddinott & Haddad (1995) to test for different effects of male and female incomes on household consumption, in these tests we employ the budget share of self-provisioning (and alternative versions) as means to test separation. If decisions to produce and consume are indeed separable, then the budget share of self-provisioning should not influence the consumption decision. In the case of well-functioning markets and separation of production and consumption decisions, the household treats itself as any other retail outlet. The existence of an in-house supermarket should not affect the decisions about the budget share of food groups. The tests reveal that separation is not the case for Turkey.

Next we shift our attention to the policy relevance of nonseparation. Due to data limitations we are unable to construct models for both production and consumption and solve them simultaneously. Instead, we simply extend the consumption model to include some production-related variables. For cereals and vegetables, the inclusion of production-related variables in the food consumption model does not change the elasticity estimates. However, the conclusion is different for the dairy and egg food group. We find that ignoring nonseparation leads to significant over-estimation of own-price and expenditure elasticities in this group.

Consumption of animal products is especially important for Turkish policy makers. On the one hand, independent researchers like FAO (2001), Pekcan & Karaağaoğlu (2000), Sengul and Tuncer (2005), and Akbay et al., (2007) all agree that there is no shortage of food in Turkey; the nutrition problem is mal distribution of food. On the other hand, the panel put together by State Planning Institute (OIK, 2006) concludes that Turkey is short of animal products and that Turkish consumers are at risk of under-consuming animal-sourced calories and proteins, and strongly advocates reforms to modernize the animal husbandry sector to boost domestic supply. Leaving aside the issue of whether plant-sourced calories and proteins are good substitutes for animal-sourced calories and proteins, if the policy goal is to ensure the availability of enough animal calories then ignoring the nonseparation of production and consumption decisions in rural households is a more serious matter than just the over-estimation of elasticities. In Turkey, fifteen percent of the food budget is devoted to dairy products and eggs (and an additional 13.6 percent is devoted to meat and meat products). Since self-provisioning of animal products is especially crucial for these rural areas where poverty is more severe (Sengul and Tuncer, 2005), ignoring the nonseparation of consumption and production decisions is an especially costly mistake from a nutrition perspective. Policies that discourage small-scale animal husbandry in the name of modernization and efficiency can have the unintended effect of reducing animal-sourced food consumption among poor rural households.

CHAPTER 3

THE IMPLICATIONS OF FOOD SELF-PROVISIONING FOR POVERTY MEASUREMENT IN TURKEY

3.1 Introduction, Motivation and Hypothesis Formulation

In this chapter we show that poverty lines and the corresponding poverty measures that are conventionally calculated suffer from being not grounded in economic theory appropriate to rural areas. When constructing poverty lines and the corresponding poverty measures, all rural households routinely are lumped together. However, in the previous chapter we have shown that self-provisioning rural households face different prices for the food items produced and consumed within households, and as a result have significantly different food consumption baskets vis-à-vis other rural and urban households. We observed that food self-provisioning forms a significant portion of total consumption, especially for dairy products, vegetables and some cereal products. These observed differences in the food basket were shown to be statistically significant in an almost ideal demand system that includes the share of self-provisioned food as an instrumental variable.

Statistical significance does not always mean economic or policy significance. Assessing economic and policy significance is one of the chief goals of this dissertation. In this chapter, we recalculate poverty lines by taking into account food self-provisioning among rural households and show that corresponding poverty measures differ significantly. The composition and the cost of food basket is a key determinant of the poverty line. Food self-provisioning affects both the composition of the food basket (as shown in previous chapter) and the corresponding cost. Hence it should affect the estimation of poverty line, the corresponding poverty measures and the resulting poverty profile.

3.1.1 Background

Sadoulet & De Janvry (1995) explain the existence of food self-provisioning in terms of incomplete markets: “a market may fail for a particular household when it faces wide price margins between the low price at which it could sell a commodity or the factor and the high price at which it could buy that product or factor” (p. 149). They cite as the most common causes of incomplete markets transaction costs due to poor infrastructure, local merchants’ monopoly and monopsony power, shallow local markets because of high covariation between local supply and prices, risk aversion of farmers who are wary of price risk of products and household needs, and limited access to credit that leads to substitution of cash outlays with home grown food (Sadoulet and de Janvry, 1995; pp. 149-150). In other words, food self-provisioning is regarded as a symptom of limited integration into national and global markets. As a result, self-provisioning rural households are regularly considered to be backward and poor. In this chapter, we show that, on the contrary, self-provisioning households in rural Turkey are not poorer than other rural households, and that they are much more secure nutritionally.

3.1.2 Motivation and Hypothesis Formulation

Poverty lines are regularly calculated separately for urban and rural households, as long as the sample size is large enough and the sampling method is appropriate to allow representation. For example, Haughton & Khandker (2009) note the following while discussing the approach taken for Cambodia in 1999:

> Separate poverty lines were constructed for each of three major regions [Phnom Penh, other urban, rural], based on the prices prevailing in those areas; whether a household in any given region is poor is then determined by comparing its expenditure per capita with the appropriate regional poverty line. (p. 42)

When the prevailing prices differ between regions, it is common sense to take this difference into account in poverty line calculation. We have shown in the previous chapter that the average food basket of self-provisioning rural households in Turkey is statistically significantly different than that of other rural households who are exclusively dependent on retail purchases, because they face different prices (i.e. shadow prices for some food items instead of retail prices). If so, calculating separate poverty lines for rural households according to whether or not they consume home produce is also common sense and the theoretically correct approach. Rural households who self-provision decide on what to produce and consume simultaneously, taking into account not only the market prices for factors and products but also the shadow prices for internally supplied factors of production, notably land and labor. Since self-provisioning rural households do not decide which food items to consume solely on retail food prices, it follows that the corresponding food basket for the calculation of the poverty line applied to them should not be based solely on the basis of retail prices.

We find that the rate of poverty for self-provisioning rural households declines when we reconstruct the poverty line according to the theoretically correct approach. This is because of the way that self-provisioned food is treated in the Turkish survey data. Since there is no observed price for food consumed in-kind, researchers at State Institute of Statistics (hereafter SIS) decided to impute regional wholesale prices to self-provisioned food. As a result, when we compare two similar households – the only difference being one of the households produces and consumes some of its own food – who consume exactly the same quantities of food and non-food items, we will incorrectly conclude that self-provisioning household is poorer than the one that relies solely on retail purchases, because retail prices are higher than wholesale prices[28]. In other words, the total consumption of the self-provisioning household is undervalued. At the same time, because the SIS uses compared to a poverty line which is constructed using a weighted average of in-kind and retail food prices, poverty among rural households that rely entirely on retail purchases is underestimated because these households have no access to in-kind food which is cheaper. In other words, a one-size-fits-all rural poverty line that ignores this distinction is higher than correct the self-provisioning rural poverty line and lower than the poverty line for other rural households who buy food exclusively from retail outlets.

3.1.3 Extension: Vulnerability to Poverty

From year to year, some households are likely to move into and out of poverty. Many households who are just above the poverty line are very likely to move below the poverty line in the event of a negative shock like unemployment, unfavorable weather, or

[28] Instead of calculating separate poverty lines for self-provisioning and other rural households we could have imputed the regional retail prices of substitute food products. Unfortunately this is easier said than done. SIS 2003 includes almost 300 food items where on average households report consuming 66 different items. Imputing average regional retail prices of so many items is a very arduous process. More importantly, food self-provisioning is not evenly distributed among regions or food items. Rather it is very concentrated in certain commodities (especially dairy, leafy greens and certain cereals) and regions. In practice this means that for regions and food items that self-provisioning is especially important, e.g. fluid milk in Eastern Black sea region, there are not many observation of retail prices to obtain reliable estimates.

a sudden illness. Among the poor, some households are likely to be chronically poor due to lack of assets, education or debilitating illness, while others are transitionally poor due to unfavorable weather or life-cycle characteristics (e.g., they are just about to graduate from college). From a policy perspective, it is important to identify not only who is currently poor but also who is vulnerable to poverty.

Poor and potentially poor households are exposed to many risks that can push them to poverty. As a result, households try to mitigate their exposure to risks by diversifying their production and income sources. Households use their assets and endowments to derive incomes in different forms (including in-kind income), which in turn entitles them to goods and services that allow them to obtain different levels of well-being (Dercon, 2001: 16-17). Households face risks at every stage of this process: the security of assets, converting household's endowments to income, securing desired goods and services with income, and converting goods and services to well-being. We propose that food self-provisioning is a risk-mitigating strategy that allows households to eliminate food price risk to which they are exposed while converting income to desired goods and services. By consuming from home produce, households ensure that they will have access to some food no matter what happens in product markets.

Studying food self-provisioning allows us to contribute to the literature on vulnerability to poverty by highlighting multiple dimensions of vulnerability to poverty:

- First, we find that self-provisioning rural households are much less vulnerable to undernutrition than other sub-groups of population.

- Second, we find that these households are as vulnerable as other rural households to income poverty. Indeed, engaging in low-risk, low-return activities can reduce overall income.
- Third, food self-provisioning can also shed light on the contribution of the commons in reducing vulnerability to poverty and undernutrition. In Turkey, the most common self-provisioned food group is dairy products. The small-scale farmers who are most likely to raise farm animals for home consumption as a secondary activity[29] rely heavily on the surrounding grazing commons.
- Fourth, studying food self-provisioning illuminates the usefulness of livestock as quasi-financial assets in time of macro shocks. Dercon (2001) notes that "Livestock [is] in many areas the favored source of savings for (not so) rainy day" (p. 44). However, livestock cannot fulfill its function of a rainy day fund as effectively when the negative shock is a macro shock (sometimes also called common, systemic, aggregate shock, or covariate risk) where the whole region is affected and many households in the region try to sell their animals simultaneously substantially depressing prices.

This chapter focuses on the first two dimensions, presenting a detailed picture of vulnerability to undernutrition and income poverty broken down to subgroups. Data limitations prevent a comparable in-depth treatment of the availability of commons and vulnerability to negative shocks.

The rest of the chapter is organized as follows. We explain the construction of poverty lines and poverty measures in detail in Section 3.2.1. In the remainder of Section

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[29] The overwhelming majority of small-scale farmers in Turkey are crop producers.

3.2 we present and discuss our findings. Section 3.3 opens with a more detailed discussion of vulnerability to poverty. We then explain the methodology used in our vulnerability analysis, discuss the explanatory variables in the models, and present the results. Section 3.4 concludes by tying together and recapping the findings of this chapter.

3.2 Poverty Measures

In this chapter, we employ Turkey's Household Budget Survey from 2003 (hereafter SIS 2003). This is a cross-section data set with 25,764 households, of whom 7,486 reside in rural areas. The State Institute of Statistics classifies 4,154 of those rural households as consuming to some extent from home produce (hereafter "self-provisioning rural") and the rest, 3,332 rural households, as relying entirely on market purchases for food (hereafter "other rural")[30].

In Sections 3.2.2 and 3.2.3, we calculate poverty lines according to two different approaches that exist in the poverty literature for Turkey. In Section 3.2.2 we follow the more common approach, known as basic needs, where the poverty line is constructed based on the observed consumption patterns of sample households. This methodology is also called the "welfare approach" because the starting point is the observed decisions of sampled households. The second approach calculates poverty lines based on a pre-conceived food basket that is deemed to be well-balanced and nutritious by nutrition experts. This food basket – taken from Baysal (1995) – is priced at median prices paid by second quintile households. This approach ignores non-food consumption, and defines

[30] There are 656 urban households who consume some amount of home produce but the share of self-provisioned food is so small that we ignore them in this study.

poverty in terms of whether the actual monthly spending on food is enough to afford the well-balanced and nutritious food basket[31]. Since the starting point is not actual consumption behavior of sample households but a pre-conceived food basket, this approach is sometimes called the "non-welfare approach".

In calculating the welfare and non-welfare poverty lines, it is conventional to calculate separate lines for rural and urban areas. We follow this convention and then expand it by calculating two poverty lines (both in the case of basic needs and non-welfare approaches) for rural households according to whether or not they engage in food self-provisioning. In Section 3.2.2 we present and compare poverty measures that are calculated both by a single poverty line for all rural households and alternatively poverty measures calculated by employing differing poverty lines for self-provisioning rural households and other rural households. In Section 3.2.3 we present a parallel analysis of the non-welfare poverty line. Finally, in Section 3.2.4 we sum up what we have discovered by calculating these alternative poverty measures.

[31] It is always possible for a household to spend a lot on food and still not have a proper diet because of consuming unhealthy food, etc. In this study, like the previous one, we ignore all the issues relating to utilization of food; for example proper preparation and cooking; waste; buying nutritious food and instead we focus on access to food. That is whether the observed food budget is enough to cover the food needs of household. Likewise, we also ignore all the issues that are likely to arise during the allocation of food between household members. Even though all the analysis in this paper is presented in per capita terms the actual observations are at household level and hence we do not observe individual's actual consumption.

3.2.1 Constructing the Basic Needs Poverty Line

We closely follow the methodology of the *Turkey Joint Poverty Assessment Report* (WB & SIS, 2005)[32] to construct the welfare poverty line for Turkey, except with one major improvement. The Joint Report calculates one poverty line for all Turkey because it uses a smaller sample collected during 2002. We employ the much larger and more nationally representative SIS 2003 and calculate separate poverty lines for urban and rural areas as the reference case[33]. Then we further split the rural households into two groups - self-provisioning and non-self provisioning – calculate separate poverty lines for both groups, and compare the corresponding poverty profiles to the reference case.

The first step in determining the welfare poverty line is to sort the households into quintiles according to their total per capita monthly food spending. Once the households in the sample are sorted into quintiles, we use the consumption behavior of the second quintile to determine the calorie share of each food group in the food basket.

The second step is to make sure that the representative food basket contains enough calories. We choose a level of 2,100 calories per capita per day[34]. By determining the total calorie amount independent of sampled observations, we assure that the poverty line will ensure access to adequate calories. At the same time, by determining the calorie share of food basket by observing second-quintile households, we ensure that the food

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[32] The report was jointly prepared by World Bank's Human Development Sector Unit, Europe and Central Asian Region and Turkey State Institute of Statistics (SIS); hereafter Joint Report.

[33] Calculating the poverty line separately for rural and urban areas is the default approach for many other World Bank studies. Please see Chapter 3 of World Bank's Handbook on Poverty and Inequality (Haughton & Khandker, 2009) for examples from Cambodia, Vietnam, and Indonesia etc.

[34] SIS also bases their calculations on 2,100 calories per day. The Joint Report calculates poverty line based on both 2,100 and 2,450 calories per day. The poverty lines satisfying 2,450 calories a day is simply 16.7 percent higher than poverty line for 2,100 calories.

basket represents the consumption habits of poor and near-poor. Third, we price the representative food budget. To do so, we consider three groups one-by-one and determine the mean price paid by second-quintile households in each group.

- The *urban* representative food basket is priced by the mean prices second quintile urban households pay.
- The representative food basket of *self-provisioning rural households* is priced with the mean price second quintile self-provisioning rural households face. Since the wholesale prices are imputed for shadow prices, in practice the mean prices paid by self-provisioning rural households are a weighted average retail and imputed prices. The weights differ for food groups. For example, 42 percent of all cereals consumed by self-provisioning rural households in the second quintile are from home produce, compared to 83 percent of yogurt, 66 percent of fluid milk and zero percent of sugar.
- *Other rural households'* food basket is also priced by the mean price second-quintile other rural households pay. Since these households rely on market purchases, the corresponding prices are rural retail prices.

At the fourth step, we multiply the food basket by a constant to account for the non-food needs of households. SIS reports that in 2003 on average food accounts for 40.3 percent of total spending for the households just above poverty line[35]. Hence we multiply

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[35] The food share of each sub-group is significantly different than the 40.3 percent. However, multiplying each sub-group with the inverse of corresponding food share in the total expenditures would add one more dimension to the difference in poverty lines. By multiplying all sub-groups with the inverse of 40.3 percent we ensure that the corresponding differences in poverty lines is surely due to corresponding prices and differences in food baskets.

representative food basket by 2.48 to obtain the poverty line for each corresponding group.

The final step is to convert the per capita household expenditure to adult equivalents. There is no consensus in the literature about how to convert the raw family size to adult equivalents (Deaton & Zaidi, 2002). In practice, there are as many equivalence scale formulae as there are international organizations: for example, different formulae are used by the World Bank, OECD, FAO, etc. We choose to follow SIS's methodology in the Joint Report (2005) with the World Bank for the purpose of comparability.

$$AE\_ADJ_i = \frac{A_0 + C_0}{(A_0 + \alpha C_0)^{\theta}} AE_i \qquad (3.1)$$

where AE_ADJ is adjusted adult equivalent; subscript *i* stands for household numbers; A_0 is the number of adults in modal household (two); C_0 is the number of children in the modal household (two); α is taken as 0.9; and θ is taken as 0.6; and $AE_i = (A_i + \alpha C_i)^{\theta}$. The modal household in Turkey is the nuclear family with two adults and two children. In this formulation the adjusted adult equivalent of the modal household is still four. The adjusted equivalent of a one person household is 1.8. Even though our observations are household level, every calculation in this chapter – except Table A2.1 – is done on adult equivalent per capita basis.

We report various poverty measures. The headcount rate reports the percentage of households that are below the corresponding poverty line. The poverty gap index adds up the percentage by which per capita expenditures fall below the poverty line on average (averaged over all observations – not only for poor households):

$$P_1 = \frac{1}{N}\sum_{i}^{N}\frac{(z-y_i)}{z} \qquad \text{if} \qquad y_i < z \tag{3.2}$$

where z is the poverty line, N is the total sample size and y_i is the adult equivalent per capita expenditure. Intuitively, multiplying poverty gap index by poverty line will yield the minimum necessary amount of money to lift all poor people above poverty line. Both the headcount poverty rate and poverty gap index violate the transfer principle for a good measure of welfare formulated by (Dalton, 1920). Dalton's transfer principle states that transfers from a poorer to a richer person should increase the poverty measure. For example, the headcount rate will decline by transferring income from a person at the bottom of the scale to push a person just below the poverty line over it. An alterative poverty measure that satisfies Dalton's transfer principle is the poverty severity index, where poverty gaps of the poor households are squared, which effectively gives greater weight to the gaps of the poorest:

$$P_2 = \frac{1}{N}\sum_{i}^{N}\left(\frac{(z-y_i)}{z}\right)^2 \qquad \text{if} \qquad y_i < z \tag{3.3}$$

A general formula that encompasses headcount rate, poverty gap index, and poverty severity index is proposed by (Foster, Greer, & Thorbecke, 1984):

$$P_\alpha = \frac{1}{N}\sum_{i}^{N}\left(\frac{(z-y_i)}{z}\right)^\alpha, \ (\alpha \geq 0) \text{ and } \mathrm{y_i} < z \tag{3.4}$$

When α is equal to zero, the FGT measure is simply equal to headcount rate. When α is equal to one the FGT measure is equal to the poverty gap index. When α is greater than one, the FGT measure captures the severity of poverty[36].

[36] For measuring the severity of poverty, α equaling two is the usual rule of thumb, although there is no a priori theoretical basis for preferring this to other values for α.

3.2.2 Consumption Poverty in Turkey, 2003

Table 3.1 presents the poverty lines calculated according to the basic needs approach. All four food baskets add up to 2,100 calories a day. The bread and cereals food groups account for slightly more than half of calories in every specification. As can be seen from the Table 3.1, the distribution of consumption indeed varies due to urban / rural differences and depending on whether rural households are self-provisioning or not. The first notable difference in cereals consumption between self-provisioning rural households and the rest is due to home-grown grains for bulgur and flour for home-made bread. The second notable difference is in the consumption of vegetables: tomatoes and cucumbers account for almost all of the rural-urban difference, there is not much difference in the availability of leafy greens. Third, consistent with our discussion in the previous chapter, the self-provisioning households consume substantially more dairy products (210 grams versus 130 grams) yet the corresponding difference in expenditure on dairy products is much smaller. Second quintile self-provisioning rural households on the one hand consume more cereals –the cheapest source of calories – vis-à-vis other groups, and on the other hand more dairy products, a relatively expensive source of calories (even when sourced from home produce). The net result is monthly food budget of 64 Turkish Lira (TL), 17 percent less than urban food budget (77 TL).

Based on these results, we construct two sets of poverty lines: the base case includes only the urban and rural distinction and ignores self-provisioning; in the second set, rural households are further differentiated according to whether they self-provision or rely solely on retail purchases for food needs. Our aim is to compare the resulting poverty measures to see if the extra computations required for calculating a separate poverty line for self-provisioning households are justified by the new insights this can provide.

Table 3.1: Representative food basket satisfying 2,100 calories per day

	Urban		Rural		Self-provisioning Rural		Rural other	
Food group	kg	daily cost	kg	daily cost	kg	daily cost	kg	daily cost
Bread	0.27	0.33	0.11	0.15	0.07	0.09	0.18	0.24
Cereals	0.12	0.16	0.24	0.24	0.28	0.25	0.18	0.22
Meat	0.03	0.15	0.02	0.09	0.02	0.07	0.03	0.13
Fats and oils	0.04	0.09	0.03	0.08	0.03	0.08	0.04	0.09
Vegetables	0.34	0.33	0.29	0.27	0.28	0.26	0.30	0.30
Fruits	0.16	0.15	0.13	0.12	0.12	0.10	0.14	0.14
Dairy & egg	0.15	0.19	0.18	0.19	0.21	0.19	0.13	0.16
Sugar, Jam & Honey	0.05	0.11	0.05	0.11	0.05	0.11	0.05	0.11
Tea and coffee	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01
Beverage	0.02	0.03	0.01	0.02	0.01	0.01	0.01	0.02
Other food	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.16	1.55	1.07	1.27	1.06	1.17	1.08	1.41
days in a month		30.417		30.417		30.417		30.417
adult equivalent*		1.80		1.80		1.80		1.80
food poverty line, TL		85		69		64		77
food share		40.3%		40.3%		40.3%		40.3%
Basic needs monthly poverty line, TL		210		172		159		191
Mean expenditure, TL		272		174		159		187
sample size		18,278		7,486		4,154		3,332

*: see Equation 1 for the formula for the calculation of adult equivalence scales. The average exchange rate for 2003 is 1.5 TL for $1 at current prices, and 0.732 TL for $1 at PPP.

Table 3.2 presents the poverty measures,[37] calculated using ADEPT software released by the World Bank. The left half of the table presents the poverty measures calculated using the reference poverty lines for urban and rural areas, and the right half of the table shows the poverty measures calculated using the three poverty lines: urban, rural self-provisioning, and rural other. Since the poverty line for urban areas is the same in

[37] Other poverty measures like Sen Index etc. are also available upon request. They yield results similar to the squared poverty gap.

both calculations, the calculated urban poverty measures are identical. Furthermore, the overall poverty measures for rural areas are very close.[38]

Table 3.2: Overall Basic Needs Poverty

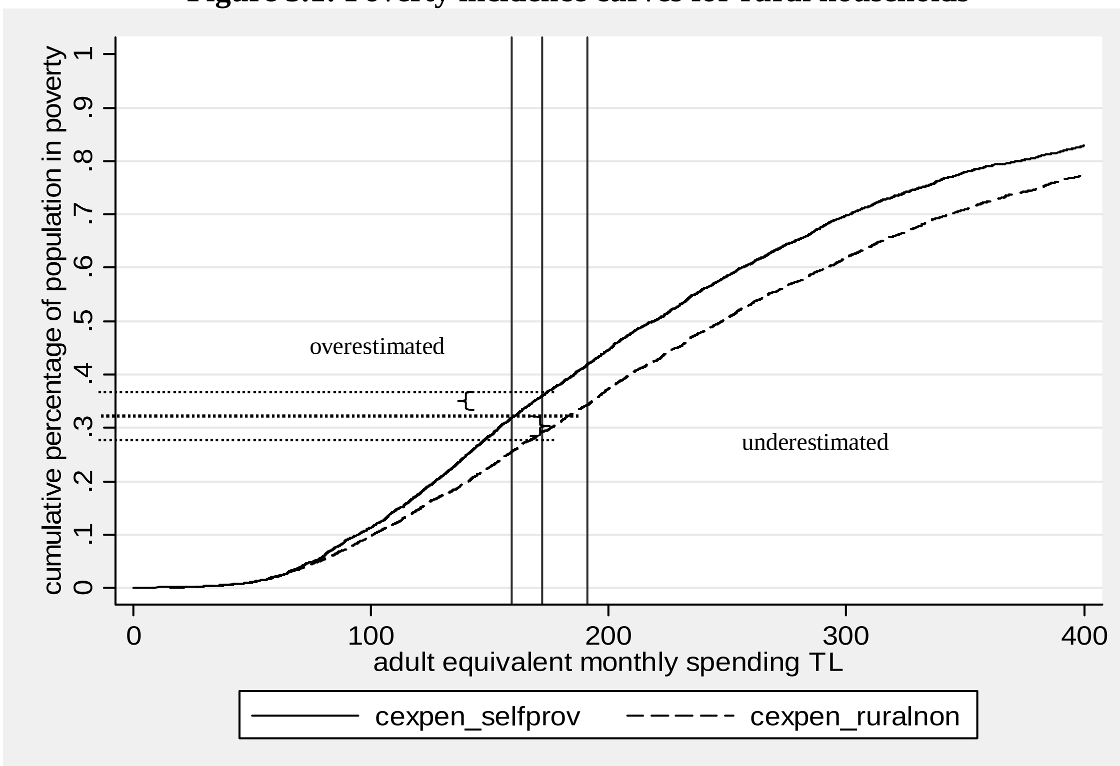
	urban and rural poverty line			Urban, self-provisioning, and other rural poverty lines		
	Headcount Rate (P0)	**Poverty Gap (P1)**	**Squared Poverty Gap (P2)**	**Headcount Rate (P0)**	**Poverty Gap (P1)**	**Squared Poverty Gap (P2)**
Urban	0.22	0.07	0.03	0.22	0.07	0.03
Rural	0.31	0.10	0.04	0.31	0.10	0.04
Rural self-provisioning	0.34	0.11	0.05	0.30	0.09	0.04
Rural other	0.27	0.09	0.04	0.32	0.11	0.05
Total	0.25	0.08	0.04	0.26	0.08	0.04

However, when we calculate the poverty measures separately for each rural sub-group, it becomes clear that selection of poverty lines does make a difference for identifying the rural poor: with separate poverty lines, measured poverty for self-provisioning households goes down, while measured poverty for other rural households goes up. Figure 3.1 illustrates the point. In Figure 3.1, three vertical lines represent alternative poverty lines. The middle poverty line is the rural poverty line (at 172 TL) obtained when rural households are not differentiated according to whether they self-provision for food or not. The vertical line on the left represents the poverty line for self-provisioning rural households (at 159 TL) and the vertical line on the right is the poverty line for other rural households (at 191 TL). The curved lines represent the cumulative percentage of self-provisioning and other rural households at every monthly spending

[38] Because of rounding the overall rural poverty measures looks identical both on the left and right half of Table 2, they are not nevertheless the differences are statistically insignificant. SIS reports overall poverty rate for 2003 as 28.1 percent for Turkey; 22.3 percent for urban areas and 37.1 percent for rural areas. SIS's findings are somewhat higher than our findings both for urban and rural areas.

level[39]. The fact that the solid line (representing the self-provisioning rural households) is above the dashed line (which represents the other rural households) at every spending level means that the self-provisioning rural households are relatively concentrated at the lower spending levels.

Figure 3.1: Poverty incidence curves for rural households



When the rural households are not differentiated according to whether they self-provision or not, the corresponding poverty line is the middle vertical line and as can be seen from Figure 3.1, the corresponding headcount rate for self-provisioning rural households is significantly higher (at 34 percent) than headcount rate for other rural

[39] We truncate the data set at 400 TL monthly spending because a couple of observations at the top of income scale stretch the x-axis towards 30,000 TL and make the lower level spending unreadable. As Figure 1 shows roughly 80 percent of all rural households in our data set spends less than 400 TL per month.

households (at 27 percent). However, when rural households are compared to the differentiated poverty lines, the headcount rate is 30 percent for self-provisioning rural households and 32 percent for other rural households. In other words, not differentiating rural households according to whether they self-provision overstates the headcount rate for self-provisioning rural households by four percent and understates the headcount rate for other rural households by five percent. The change is in the expected direction.

As we mentioned earlier, theoretically it is appropriate to compare self-provisioning rural households to the self-provisioning poverty line because these rural households effectively face different prices (the shadow price that they face when allocating household resources between food products destined to market and home consumption). These different prices in turn lead to different food consumption baskets as is evident in Table 3.1. In principle, comparing rural households to different poverty lines according to whether they self-provision or not is the correct approach. In practice, it makes a significant difference in our diagnosis of rural poverty. Hence we conclude that the additional burden required to follow the differentiated approach is justified.

3.2.3 Non-welfare Food Poverty in Turkey, 2003

We repeat a similar comparison of food poverty with the "non-welfare" poverty measurement method. This was the preferred methodology of SIS before 2002. Sengul & Tuncer (2005) apply this methodology to calculate various poverty measures for SIS 1994, providing a reference point to compare our findings for SIS 2003. For this purpose, we use the Hacettepe University Basket (named after the home institution of the researchers who developed the food basket) which is deemed to be a nutritious and balanced diet taken from a nutrition book (Baysal, 1995). The Hacettepe University

Basket is much richer in total and animal calories than the representative baskets obtained from sampled households (Joint Report, 2005: 5-6). Table A2.1 in Appendix shows the composition (second column) and the least cost of the monthly balanced and nutritious food basket for a four-person household (two adults and two children). The observed differences between food basket costs are solely due to the difference in median prices facing different sub-groups of the population[40]. The self-provisioning rural households' food basket is the cheapest, primarily due to the differences in the cost of dairy products: the same monthly basket of dairy products costs 34.7 TL for urban households and 26.5 for self-provisioning rural households.

The least-cost food budgets from Table A2.1 are not directly comparable with the food basket in Table 3.1 because i) the Hacettepe food budget is constructed for a two-adult, two-child household, whereas the welfare method food basket is calculated for one adult equivalent; and ii) the non-welfare food poverty line is intended to measure whether actual food spending is enough to meet the least cost of a balanced and nutritious food basket, so it has no provision for non-food basic needs. We follow Sengul and Tuncer (2005) and compare the least-cost food basket[41] to actual food budget of sample households to determine the food poverty rate, ignoring spending on non-food items. Sengul & Tuncer (2005) report the headcount food poverty rate for all Turkey as 46.8

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[40] The categories in Hacettepe food basket is too broad compare to the SIS 2003 food consumption data and we are still required to decide on the exact proportion of narrowly defined food groups. For example the food basket calls for consumption of six kg of meat products monthly but does not specify how much of six kg should sourced from chicken, fish, lamb or beef. We resorted to use the observed share of actual consumption of second quintile of all sample to determine these sub-group shares to ensure that all of the baskets are exactly equal and only difference is due to prices.

[41] We us median prices instead of mean prices paid by second quintile households in order to reach the least-cost food basket since median prices are somewhat lower than mean prices.

percent, for urban areas 48.3 percent and for rural areas 44.2 percent (they did not distinguish within rural households) while employing 1994 Household Budget Survey data from SIS (SIS, 1994). These estimates are very close to ours, which suggests that food poverty calculated with the non-welfare method has changed little from 1994 to 2003. The minimal change is expected. The Joint Report (2005) calculates a 28.3 percent headcount poverty rate for 1994 data set, based on the welfare methodology developed for 2002 and beyond (after some slight adjustments due to the more limited nature of available data in the 1994 survey). Thus, the poverty rate calculated with the basic needs approach declined only slightly from 28.3 to 28.1 percent between 1994 and 2003.

Table 3.3 presents the food poverty rates in Turkey for 2003 for self-provisioning rural households and other rural households according to the non-welfare method[42]. Again comparing these to the poverty measures that are obtained when rural households are not differentiated, we find that the conventional approach overstates poverty for self-provisioning rural households and understates poverty for other rural households. Irrespective of how the non-welfare rural poverty line is constructed, it is evident that food insecurity by this measure is much more prevalent and deep for other rural households[43].

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[42] For the interested reader, we present the food poverty using the food baskets from Table 1 in Table A2. The poverty profile is broadly similar to Hacettepe food basket's presented in Table 3.

[43] Joint Report (2005) concludes that rural diet is lower quality because on average rural households eats more bread than urban households. We now know that the real picture is more complicated and lower quality of diet is especially common among other rural households.

Table 3.3: Non-welfare food poverty

	Urban and rural poverty line			Urban, self-provisioning, and other rural poverty lines		
	Headcount Rate(P0)	**Poverty Gap(P1)**	**Squared Poverty Gap(P2)**	**Headcount Rate(P0)**	**Poverty Gap(P1)**	**Squared Poverty Gap(P2)**
Urban	0.46	0.14	0.06	0.46	0.14	0.07
Rural	0.43	0.14	0.06	0.43	0.14	0.07
Rural self-provisioning	0.37	0.11	0.04	0.34	0.10	0.04
Rural other	0.48	0.17	0.08	0.51	0.18	0.09
Total	0.45	0.14	0.06	0.45	0.14	0.07

Furthermore, when we differentiate among rural households, we discover that the severity of food poverty is less among self-provisioning rural households even compared to urban households. This finding is not entirely surprising because the Hacettepe Basket is rich in animal calories, vegetables,[44] and fruits compared to the actual consumption of the sampled households, and self-provisioning is concentrated in dairy products, leafy greens and some cereals. In other words, self-provisioning is concentrated in the more expensive calories that Hacettepe nutritionists recommend to consume.

3.2.4 Discussion of Results

The last row of Table 3.1 shows that self-provisioning rural households have lower per capita monthly spending levels than other rural households and urban households. Also, Figure 3.1 shows that self-provisioning rural households' median monthly spending is less than other rural households' spending. Furthermore, household heads of self-provisioning rural households on average are older (50.2 versus 47.4 for other rural and 45.8 for urban) and less educated (4.7 years, 6.4 years and 7.5 years,

[44] For example Table 3.1 shows that urban households consume roughly 0.39 kg per day of vegetables (or roughly 21.3 kg per adult equivalent per month) whereas Hacettepe basket includes 34 kg of vegetables.

respectively) than both other groups. Moreover, as we show in the next section, self-provisioning is associated with poverty: the higher the budget share of self-provisioned food, the more likely the household is to be under poverty line. Despite these disadvantages, the incidence, depth and severity of poverty among self-provisioning rural households is not higher than that of other rural households according to basic needs approach. Moreover, all measures of food poverty with the non-welfare method are lower for self-provisioning rural households compared to both other rural households and the urban households. We can conclude that even if the self-provisioning of food is no cure for poverty in its many dimensions, at least self-provisioning can be a substantial remedy in attaining adequate calories, including the relatively expensive calories from dairy products.

The poverty line in the non-welfare approach is based on a food basket that is rich in expensive calories. Comparing these results to the basic needs approach, we can conclude that food self-provisioning in Turkey is not simply a strategy employed by the poorest households to scrape by. On the contrary, as will become clearer in the analysis of vulnerability to income poverty and undernutrition in the next section, the depth and severity of poverty are worst among the other rural households who cannot self-provision for food. In other words, households who can self-provision for food because they have control over requisite factors of production like land, labor and access to grazing commons (in the case of dairy consumption) can escape the deepest rungs of poverty.

Since the rural poverty line constructed according to whether rural households self-provision or not is the proper approach in theory and yields significantly different results in practice, we will use these poverty lines in the subsequent vulnerability analysis.

3.3 Vulnerability to Poverty

Section 3.3 is devoted to studying vulnerability to poverty in Turkey, again using the SIS 2003 data set. We follow Haughton & Khandker (2009) and adopt the outcome-based definition of vulnerability to poverty: “the propensity to suffer a significant welfare shock, bringing the household below a socially defined minimum level,” (p. 234) which is adapted from Alwang, Siegel, & Jorgensen (2001). We study two dimensions of vulnerability to poverty: vulnerability to income poverty and undernutrition. We use the poverty line calculated with the basic needs approach as the absolute measure of well-being for vulnerability to income poverty, and the poverty line calculated with the non-welfare approach to analyze vulnerability to undernutrition.

Vulnerability to poverty is rarely studied empirically, because of methodological difficulties that will become clearer as we proceed. Vulnerability to poverty is ideally studied using panel data sets that allow researchers to identify households who move into and out of poverty (or remain permanently poor). Panel data sets would allow us to observe changes in income and nutrition from one period to next, to model the impact of specific shocks. Unfortunately, the 2003 Household Budget Survey (like most household expenditure surveys) is only a cross-section data set. Despite the resulting methodological problems, we make a first attempt to calculate vulnerability to poverty in Turkey.

In his framework for analyzing vulnerability to poverty, Dercon (2001: 17) points out that households have control over labor (human capital), land (physical capital), family networks (social capital), and common and public goods (like surrounding grazing areas) that they can employ or sell to derive income and increase or sustain their well-being. Households are faced with numerous risks to the realization of well-being: death and illness can limit employment and returns to labor; the harvest can decline due to climatic shocks; governments can decide to reduce public provision of certain services like health, etc. Nevertheless, households are not totally powerless against vulnerabilities and they try to reduce exposure to risks and/or mitigate risks. Food self-provisioning is one of the risk-reduction strategies.

Following our findings in Section 3.2, we present the results of our vulnerability analysis not only for the sample as a whole but also for urban, self-provisioning rural and other rural sub-groups. This allows us to observe whether the control over productive farm assets (land, labor, and surrounding grazing areas) that self-provisioning households enjoy makes a difference vis-à-vis vulnerability to income poverty and undernutrition. By supplying some of the food needs within a household, self-provisioning reduces the exposure to price risk in food markets. It may also be an avenue for creating income from otherwise dormant productive factors like common grazing lands, whose exploitation is governed by informal institutional arrangements.

3.3.1 Empirical Model

We choose consumption per capita for income poverty and monthly spending on food for undernutrition[45] as the outcome-based definition of vulnerability. We adopt the absolute poverty lines calculated in Section 3.2 as the ‘socially defined minimum levels.’ We follow the empirical model developed by Chaudhuri, Jalan, & Suryahadi (2002) to

[45] Vulnerability can be studied for different dimensions like income, undernutrition, health or education.

study vulnerability to poverty when only cross-section data for one year is available, assuming that there will not be any significant change in the following year in any of the household characteristics. The vulnerability to experience negative shocks probably increases as the time horizon lengthens beyond a year, so studying vulnerability only for the following year probably will give us a conservative estimate of real vulnerability[46].

Formally, the problem can be stated as follows: if the household's current consumption is $c_{h,t}$ and if the poverty line is *z*, then a household is classified as poor if $c_{h,t} \leq z$ and vulnerability to poverty in the next year can be defined as:

$$v_{h,t} = \Pr(c_{h,t+1} \leq z) \tag{3.5}$$

where $c_{h,t+1}$ is the expected consumption level of household in the next period, which is unobservable with a cross-section data set. In order to determine $c_{h,t+1}$, ideally we should have information about the assets the household could sell for consumption smoothing and the risks-associated probabilities that each household faces during the next year, like potential droughts, illnesses etc. And we also need information about the support systems that each household can rely on in case of a negative welfare shock. In other words, the ideal model would be:

$$c_{h,t} = c(X_h, \beta_t, \alpha_h, e_{ht}) \tag{3.6}$$

where X_h are observable household characteristics like education or assets owned; β_t are common shocks like financial instability; α_h are unobserved, time-invariant household

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[46] Pritchett, Suryahadi, & Sumarto (2000) study the vulnerability for next few years. Dercon (2005) estimates that during 1994-7 in Ethiopia 78 percent of rural households have experienced at least once harvest failure, 40 percent labor problems (illness, death), 39 percent oxen problems (death, illness) (p. 9).

characteristics like family networks; and $e_{h,t}$ is the error term that is supposed to account for idiosyncratic shocks that can affect one household but not necessarily other ones, for example, a non-communicable illness afflicting household member.

Obviously these are insurmountable data requirements especially from a cross-section data set. Chaudhuri et al., (2002) simplify the data requirements by the following methodology: if we know the expected level of per capita consumption in the next period, $E(c_{t+1})$ the variance of expected per capita consumption in the next period, σ^2 and the poverty line, *z*, and if we assume that the expected consumption per capita follows a known distribution (such as the normal distribution) then we can estimate vulnerability to poverty for the next period. For example, if the expected value of per capita consumption for a household for the next period is 272 TL, variance is 2500, the poverty line is 207, and if we assume that welfare shocks are normally distributed, then the probability of being poor is 9.6 percent[47].

$$\begin{aligned} &\ln c_{h,t} = X_h * b + e_h \\ &where \quad e_h \sim N(0, X_h \theta) \end{aligned} \tag{3.7}$$

Equation 3.7 is a simplified version of Equation 3.6 given the data availability from a single cross-section data set. We have to assume away the macro level shocks, and we cannot control for unobservable household characteristics like family networks that a household can rely upon in times of need.

The dependent variable in the simplified model (Equation 3.7) is the natural logarithm of adult equivalent per capita monthly consumption (or adult equivalent per

[47] In excel by typing =normdist(207, 272, 50, 1) one can obtain 9.6 percent for the normal cumulative distribution.

capita monthly food spending)[48]. The variance of the error term is not constant but assumed to depend on household characteristics; hence in the second step, we regress squared values of e_h on the same independent variables from step one to obtain the estimates for $\hat{\theta}$, so that we can estimate the idiosyncratic variance ($\sigma^2 = X_h \hat{\theta}$) for each household.

Once we obtain these variables we can estimate the vulnerability to poverty for each household ($\hat{v}_h$) with Equation 3.8, where Φ is the cumulative density function of the standard normal distribution:

$$\hat{v}_h = \Pr(\ln c_h < \ln z \mid X_h) = \Phi\left(\frac{\ln z - X_h \hat{b}}{\sqrt{X_h \hat{\theta}}}\right) \tag{3.8}$$

Pritchett et al., (2000) point out that the dependent variable, consumption, is measured with substantial error in household surveys. As a result of measurement error, they argue that the movement into and out of poverty is overstated and as a related matter the estimated variance, σ^2, is overstated too. Consequently, they revise their estimates of variance downward by 30 percent. We share their concern as to the impact of measurement errors on the estimated variance. They estimate measurement error with the following method: they estimate a bivariate Engel Curve where the dependent variable is food share in total expenditures and the explanatory variable is the natural logarithm of

[48] Taking the natural logarithm of per capita consumption unfortunately did not ensure the normality of dependent variable in our sample. Nevertheless, we proceed with normality assumption in this draft. Alternatively, Kamanou & Morduch, (2004) and Kühl (2003) rely on actually observed distribution of errors of the consumption equation using bootstrapping.

expenditure per capita. They estimate the bivariate relationship first with OLS and then with instrumental variable (IV) approaches. Then they define the measurement error as one minus the ratio of coefficient estimates of OLS to IV: $1-\left(\beta_{OLS}/\beta_{IV}\right)$. We estimate β_{OLS} as -0.0905 and β_{IV} as -0.1374 where we use variables in Table 3.4, column three as instruments. Following Pritchett et al., (2000) measurement error in our sample is 35 percent. Hence, we revise our estimates of variance downward by 35 percent before utilizing them in Equation 3.8[49].

3.3.2 Data

We start our empirical analysis by estimating the probit model where the dependent variables are dummy variables denoting being poor or non-poor. Such probit models are customary in the poverty literature where their purpose is not to explain cause-and-effect relationship for poverty but to determine which of the easily observed characteristics of households (like location of residence, household size, education level, occupational categories and so on) associate most strongly with being poor. The goal is to form guidelines to use in subsequent anti-poverty campaigns for effective targeting of limited resources. The choice of explanatory variables heavily depends on common sense and data availability.

In choosing which independent variables to include to Equation 3.7, we start with the multivariate analysis in the Joint Report (2005: 40). The variables in common in the Joint Report and our study include: the number of children in the household; age,

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[49] The results are broadly similar even without the correction of variance due to measurement error. Correcting the variance for measurement error only led roughly 1-2 percent shift from highly vulnerable category to low vulnerable category.

education level, and gender of household head; whether the household resides in a rural or urban area; dummy variables for the occupational category (employer, self-employed, salaried, day laborer) of employed member of household (we consider not only household head but all members of household); and whether any member of the household is covered by the social security system that gives access to free health care and eventual retirement benefits. Because we employ a much larger data set compared to the Joint Report (2005), that allows us to draw conclusions not only at the national level but at the regional level, we add dummy variables for regions (Istanbul is the omitted region). Also, the 2003 household budget survey has information on assets, so we include the natural logarithm of land value to the model, to control somewhat for assets on which households can rely to smooth consumption in case of a negative shock.

Following our findings in the previous chapter and sections, we include the budget share of self-provisioned food as a proxy to account for one of the mitigating strategies that the poor and vulnerable can use to reduce food insecurity. We also add the natural logarithm of average size of grazing areas in every region, as a very rough proxy for commons from which rural households may extract resources.

Table 3.4 presents the results of this exercise. The estimated coefficients in the first two columns show the change in probability of being poor when the independent variable changes infinitesimally for continuous variables and by one for dummy variables (i.e. these are not ordinary coefficient estimates from the probit model but marginal effects). For example, having a female household head increases the chance of being poor by 5.7 percent, and every additional year (age variable) decreases the probability of being poor by 0.47 percent. The dependent variable in the first column is whether the household is poor or not according to basic needs approach. The second column is a similar analysis, in which the dependent variable is whether the household is poor or non-poor according to the non-welfare approach. Most explanatory variables have the same sign and significance both in the welfare and non-welfare approaches. The major exceptions are adult equivalent of household size and the dummy variable for female household heads (positive in the welfare approach and negative in non-welfare approach).

In an effort to investigate whether access to common resources have any effect on poverty, we employ average size of grazing areas in a region as a proxy for availability of environmental commons. This turns out statistically significant only at 10 percent in the probit model for non-welfare approach. Recall that in Chapter 2 Section 2.6.2, the average size of grazing area in a region is a significant and positive variable when we investigate dairy consumption. However, access to common grazing lands is associated with more poverty. One potential reason for counter-intuitive result in this model is the high level of aggregation in this variable; we obtain it not from SIS 2003 but construct it using the General Agricultural Survey of 2001 (SIS 2001) and impute it to regions. Hence we do not have a great deal of variation at the household level in this variable. The estimated coefficient on the budget share of self-provisioned food is positive and statistically significant: it is associated with a higher probability of poverty. This finding reinforces our conclusion from Section 3.2 that self-provisioning of food is a strategy used by rural poor – when it is available – to escape the deepest rungs of poverty (i.e., depth and severity of poverty is less prevalent among self-provisioning poor) but that it is not a cure to income poverty.

Table 3.4: Probit estimates of being poor and OLS estimations of determinants of expenditure per capita and food consumption per capita

	Probit	Probit	OLS	OLS
Dependent Variable (1 poor; 0 non-poor):	welfare poor	Non-welfare poor	log expenditure pc	log food spending pc
any member of hh, health insurance dv	-0.1568***	-0.0741***	0.2740***	-0.0062
hh size, adult equivalent	0.0139***	-0.1888***	-0.0522***	-0.0157***
dummy variable for female hh head	0.0577***	-0.0464***	-0.1258***	0.0668***
age of hh head	-0.0051***	-0.0075***	0.0109***	0.0056***
Dummy variable for urban location	-0.0129	0.0108	0.1503***	-0.0205*
number of children in the hh	0.0574***	0.0375***	-0.0855***	-0.0068
hh head, literate dummy variable	-0.0504***	-0.0466*	0.1338***	0.0624***
hh head, primary dummy variable	-0.1738***	-0.1204***	0.3464***	0.0780***
hh head, secondary dummy variable	-0.1724***	-0.1763***	0.5267***	0.0968***
hh head, high school dummy variable	-0.2160***	-0.2440***	0.7146***	0.1205***
hh head, higher education dummy variable	-0.2300***	-0.3511***	1.1639***	0.1623***
any member of hh, salaried dummy variable	-0.1155***	-0.0632***	0.1610***	0.0003
any member of hh, wage dummy variable	0.0046	-0.0085	-0.0452**	-0.0073
any member of hh, employer dv	-0.1482***	-0.1520***	0.6148***	-0.018
any member of hh, self-employed dv	-0.0605***	-0.0470***	0.1722***	-0.0008
any member of hh, unpaid dummy variable	-0.0523***	-0.0635***	0.0463**	0.0654***
any member of hh, physical dummy variable	0.1308***	0.0933***	-0.1332***	-0.0538***
East Marmara dummy variable	0.1803***	0.1993***	-0.3249***	-0.1057***
Aegean dummy variable	0.2291***	0.2047***	-0.3290***	-0.1157***
West Marmara dummy variable	0.1672***	0.1304***	-0.2918***	-0.0655***
Central dummy variable	0.1823***	0.1274***	-0.3065***	-0.0631***
Mediterranean dummy variable	0.2418***	0.1577***	-0.3326***	-0.0690***
Central East dummy variable	0.2724***	0.0825***	-0.4786***	0.0430*
Western Black sea dummy variable	0.3532***	0.1892***	-0.5211***	-0.0430**
Eastern Black sea dummy variable	0.2156***	0.1286***	-0.3927***	-0.0254
North East dummy variable	0.2640***	0.1173***	-0.4953***	0.0305
North Central dummy variable	0.2371***	0.0899***	-0.4726***	0.0085
South East dummy variable	0.4193***	0.0902***	-0.5551***	0.0696***
logarithm of land value	-0.0077***	-0.0111***	0.0153***	0.0067***
logarithm of average grazing areas	0.0217**	0.0234*	0.009	-0.0249**
budget percentage of self-provisioning	0.1540***	0.2315***	-0.4133***	-0.2327***
logarithm of monthly expenditure				0.3081***
Constant			4.5173***	2.0995***
Observations	25747	25747	25745	25745
R-squared			0.47	0.29

Robust z statistics; * significant at 10%; ** significant at 5%; *** significant at 1%; dv= dummy variable

The third and fourth columns of Table 3.4 are the estimation results of Equation 3.7. We present and discuss the estimation of Equation 3.7 side-by-side with the probit estimations, even though they serve different purposes, because it is interesting to note the change in the statistical significance of certain variables once the dependent variable changes from discrete to continuous. The independent variables are observed household characteristics[50]. Some of the variables which are highly influential (for example, the health insurance dummy and the number of children) in the non-welfare probit model turn out to be insignificant when the dependent variable is continuous.

The share of self-provisioning in the household food budget has negative signs both in columns three and four. In column three, where the dependent variable is the natural logarithm of total spending per capita, the negative sign means that the larger the share of food from self-provisioning, the lower the total per capita monthly spending. The more time household members devote to self-provisioning, the less time they work off-farm earning higher wages. We think that this interpretation is plausible, but the causal order may be reversed: when household members cannot find gainful employment off-farm, they devote their energy to grow their food for own consumption. In the fourth column, the dependent variable is the per capita monthly food budget. Here the negative coefficient on the self-provisioned food budget share is likely due to the fact that when converting in-kind consumption into monetary values, SIS officials impute regional wholesale prices; hence if a larger share of household food consumption is obtained in-kind, a larger share is priced at relatively low prices. Hence the total spending on food will be lower when a larger share is sourced within household. As we show in Table 3.3, when the self-provisioning rural households are evaluated with a poverty line that takes

[50] The only extra variable we include to column four in addition to column two is the natural logarithm of per capita monthly spending. We included monthly per capita spending as a control variable in order to get a better estimate for other variables.

into account that self-provisioned food items have substantially lower prices, the self-provisioning rural households' food consumption poverty is substantially less than that of any other sub-group in our sample despite the lower total spending on food.

3.3.3 Vulnerability according to Basic Needs Approach

After we obtain coefficient estimates for Equation 3.7, as reported in column three in Table 3.4, we perform the additional steps described in Section 3.3.1 to obtain vulnerability to poverty, $\hat{v}_h$, as shown in Equation 3.8. Table 3.5 summarizes the results. We label the households whose probability of being poor is more than 50 percent as highly vulnerable; households whose probability of being poor is less than 26 percent (which correspond to the overall poverty rate from Table 3.2) as not vulnerable, and households whose probability of being poor is between 26 percent and 50 percent as moderately vulnerable. These lines are arbitrary; as even households labeled as not vulnerable have a positive chance of falling into poverty during the next period. On the other hand, the labels help us to see if vulnerability is concentrated among any sub-groups of population.

Unsurprisingly, the poor are more likely to be poor in the next period (in the whole sample, 0.12 out of 0.26). Likewise, seven out of ten (or 0.55 out of 0.74) of the current non-poor are unlikely to swing into poverty in the next period. In urban areas, only 15 percent of households are highly vulnerable to income poverty, compared to roughly 20 to 25 percent of rural households. When we compare self-provisioning rural households with other rural households we find that other rural households are slightly more probable to be highly vulnerable to income poverty in the next period.

Table 3.5: Vulnerability to Income Poverty in Turkey, 2003

		Whole sample		
	Criterion	Poor	non-poor	poor and non-poor
not vulnerable	v_h<=.26	0.06	0.55	0.61
low vulnerable	0.5>= v_h >.26	0.07	0.14	0.22
highly vulnerable	v_h >0.5	0.12	0.05	0.18
All groups		0.26	0.74	1.00
		Urban		
	Criterion	Poor	non-poor	Poor and non-poor
not vulnerable	v_h <=.26	0.05	0.61	0.66
low vulnerable	0.5>= v_h >.26	0.07	0.12	0.19
highly vulnerable	v_h >0.5	0.11	0.04	0.15
Urban		0.22	0.78	1.00
		Rural self-provisioning		
	Criterion	Poor	non-poor	poor and non-poor
not vulnerable	v_h <=.26	0.07	0.43	0.51
low vulnerable	0.5>= v_h >.26	0.10	0.20	0.29
highly vulnerable	v_h >0.5	0.13	0.07	0.20
rural self-provisioning		0.30	0.70	1.00
		Rural other		
	Criterion	Poor	non-poor	poor and non-poor
not vulnerable	v_h <=.26	0.06	0.44	0.51
low vulnerable	0.5>= v_h >.26	0.08	0.16	0.24
highly vulnerable	v_h >0.5	0.18	0.07	0.25
rural other		0.32	0.68	1.00

3.3.4 Vulnerability according to the non-welfare method

We perform a similar analysis for vulnerability when the poverty line is calculated with the non-welfare method, that is, when the poverty line is defined by the least-cost budget for the balanced and nutritious food basket[51]. Since the overall food poverty rate, 45 percent, is very close to the cut-off for highly vulnerable (50 percent), we separate the sampled households only according to whether their vulnerability is high (more than 50

[51] We present the vulnerability to nutrition poverty when the reference basket is the basic needs food basket instead of the non-welfare food basket in Table A2.3. The results are broadly similar, both urban and other rural households are more often highly face nutrition vulnerability than self-provisioning rural households.

percent) or not. The results are presented in Table 3.6. 70 percent of current food poor are vulnerable to undernutrition in the next period. Moreover, 25 percent of current food non-poor (0.14 out of 0.55) are highly vulnerable to undernutrition as defined by the non-welfare approach. Among rural households, we find that vulnerability to undernutrition differs greatly between self-provisioning and other rural households. Not only is food poverty is much more prevalent among other rural households, but also that three-fourths of these poor households are highly vulnerable to poverty in the next period. Moreover, roughly 40 percent (0.18 out of 0.48) of currently non-poor among other rural households are highly vulnerable to undernutrition. Overall, 56 percent of all other rural households (poor and non-poor combined) are highly vulnerable to falling below the non-welfare poverty line irrespective of their current classification, compared to 29 percent of self-provisioning rural households. These findings lend support to our hypothesis that control over productive assets allows some rural households not only to escape deepest rungs of food poverty but also to reduce the risk of experiencing undernutrition in the subsequent periods due to idiosyncratic shocks.

Table 3.6: Vulnerability to Non-welfare Food Poverty in Turkey, 2003

		Whole sample		
	criterion	poor	non-poor	poor and non-poor
moderately vulnerable	$0.5 >= v_h$	0.14	0.41	0.55
highly vulnerable	$v_h > 0.5$	0.31	0.14	0.45
All groups		0.45	0.55	1.00
		Urban		
	criterion	poor	non-poor	poor and non-poor
moderately vulnerable	$0.5 >= v_h$	0.13	0.40	0.54
highly vulnerable	$v_h > 0.5$	0.33	0.13	0.46
Urban		0.46	0.54	1.00
		Rural self-provisioning		
	Criterion	poor	non-poor	poor and non-poor
moderately vulnerable	$0.5 >= v_h$	0.16	0.55	0.71
highly vulnerable	$v_h > 0.5$	0.18	0.11	0.29
rural self-provisioning		0.34	0.66	1.00
		Rural other		
	criterion	Poor	non-poor	poor and non-poor
moderately vulnerable	$0.5 >= v_h$	0.14	0.30	0.44
highly vulnerable	$v_h > 0.5$	0.38	0.18	0.56
rural other		0.52	0.48	1.00

3.3.5 Discussion of Results

Alwang et al., (2001) argue that a structural model that allows for simulation of specific shocks is necessary to predict how the household vulnerability is affected by ownership of land, access to common lands, market prices, etc. In order to observe actual response of households to such shocks we need a panel data set that covers long enough periods. We do not have a panel data set for Turkey; even if one were available, panel data sets rarely have sufficient details or sample size to estimate a structural model. In the absence of panel data, in this section we explored vulnerability to poverty using the methodology developed by (Chaudhuri et al., 2002). Our findings are subject to the caveats that result from using a cross-section data set and the inherent difficulty of trying to estimate vulnerability ex-ante. Nevertheless, by separating rural households into self-provisioning and other sub-groups; we are able to shed light on one of the risk-reducing strategies that is available to some rural households. On average the self-provisioning rural households spend less per capita, and are less educated and older. The one asset that self-provisioning rural households have in abundance is land (relative to other rural households). The difference in vulnerability to poverty between self-provisioning and other rural households is striking, both for the current poor and non-poor, especially if we concentrate on food poverty (undernutrition). But even if we concentrate on income poverty, using the poverty line determined according to basic needs approach, high vulnerability is more common among other rural households.

3.4 Concluding Remarks

It is possible to partition the SIS 2003 data set in many different ways in order to test for pockets of poverty. One obvious way is to look for regional poverty measures. For example, South East Turkey has a headcount poverty rate of almost 64 percent with the basic needs approach, two and a half times the national average. Or we can investigate the poverty rates according to age, education, or profession of household head. The ADEPT software released by the World Bank generates these interesting tables effortlessly once the poverty line is calculated. However, our primary goal is not to find a novel way of partitioning data set to discover pockets of poverty. Instead we focus on recalculating the poverty line by taking into account self-provisioning among rural households, on the grounds that self-provisioning households face different prices and therefore consume different food baskets. Since the composition and cost of the food basket is crucial for poverty line calculation, a theoretically correct poverty line in settings where many rural households self-provision should take into account this fact.

We are fortunate to have a data set that allows us to observe self-provisioning. We demonstrate that once self-provisioning is properly accounted in the calculation of poverty line, the poverty profile of rural areas indeed does change.

We then proceed to utilize the distinction between self-provisioning and other rural households to study vulnerability to income poverty and undernutrition. The empirical literature on vulnerability to poverty is plagued by methodological problems, and our analysis is not immune to them. We employ a cross-section data set that does not allow us to test hypotheses derived from a structural model. Only a panel data set which covers periods long enough to include macro shocks, like a major drought or financial crisis, would allow formal hypothesis testing from a structural model. Nevertheless, we are able to present quantitative evidence on some long-standing issues in the literature on vulnerability to poverty. The existing studies on poverty in Turkey employ either the basic needs approach or the non-welfare approach. The basic needs approach takes into account non-food expenses in addition to food, and the food basket in non-welfare approach is rich in relatively expensive calories from animal products. We take advantage of this existing literature and use the poverty line from basic needs approach as the measure of income poverty, and the poverty line from the non-welfare approach as the measure of undernutrition.

We show that households may have different levels of vulnerability to these different dimensions of poverty. We show that self-provisioning households are roughly as vulnerable to income poverty as other rural households, but they are much less vulnerable to undernutrition. Our evidence is in accord with the long-held view that some strategies that households adapt to mitigate certain risks – in our case self-provisioning mitigates the market price risk for food – can themselves be a source of income poverty.

Policymakers attuned to the modern agriculture of developed countries are sometimes puzzled by the lack of specialization and seeming failure to realize gains by trade where peasant farmers produce a great variety of food for home consumption in developing countries. Development economists recognize that this lack of specialization is the result of incomplete markets in product and factor markets, including lack of financial services, insurance, and social security from state. In the previous chapter, we established that food self-provisioning by majority of rural households is statistically significant in a demand system regression analysis. In this chapter, we investigated the welfare implications. We recalculated poverty lines with grounding in economic theory that takes into account the realities of developing countries. We used these newly constructed poverty lines to present evidence that food self-provisioning is a viable strategy to mitigate vulnerability to undernutrition.

This finding has important implications for agricultural policies. Since the early 2000s, Turkey's Ministry of Agriculture and Rural Affairs has been pushing for modernization in the livestock sector, especially in dairy farming, to phase out traditional small-scale production in the name of increasing domestic supply to reduce prices and benefit consumers at large (OIK, 2006). We show that, contrary to perceived wisdom in policy making circles in Turkey, some of the households who are most vulnerable to income poverty in rural Turkey are able to avoid nutrition poverty by consuming home produce. Policies that discourage self-provisioning may have significant adverse impacts on the well-being of these households – impacts that are hidden view by conventional poverty measures that fail to account for price differences between self-provisioning and other rural households.

CHAPTER 4

OLIGOPOLY AND PRICE TRANSMISSION IN TURKEY'S FLUID MILK MARKET

4.1 Introduction

Two complaints are commonly heard in Turkey regarding milk markets, one among milk farmers and other among milk processors. On the one hand, milk farmers in Turkey point out that farm-gate milk price in Turkey is relatively low compared to the EU while the retail price of fluid milk remains among the highest (Section 4.2). The Cattle Breeders Central Association (CBCA) complains that milk processors collude in order not to bid against each other in quarterly auctions where milk prices are set (Güngör, 2006). Their biggest complaints are low and volatile milk prices. Producing milk suitable for delivery to milk processors with modern technology requires hefty investment in milking machines, cold storage and high yielding cow breeds. In order to assess one's ability to recoup the costly investment, one needs to foresee more than the immediate quarter.

Currently there is no national policy in Turkey that protects milk farmers from price fluctuations, whether this is the result of ordinary market forces or is engineered by oligopolistic buyers. On the other hand, milk processors in Turkey complain about the low quality of milk produced in Turkey (i.e. very high bacteria count). They point out that, unlike many EU member countries, the milk farmers in Turkey are very small sized, where 60 percent of households engaged in livestock farming own 1-4 animals (Uzmay,

2007) and this small size increases milk collection costs[52]. More importantly, this hampers the milk farmers' ability to modernize their operations.

Several sources estimate that only 30 to 35 percent of total milk production is processed by modern enterprises (FAO, 2007; Voorbergen, 2004). The rest of the output is of such low quality that they would not qualify for support under the current EU Common Agricultural Policy regulations[53]. Seasonal fluctuations in supply are pointed out as evidence of the traditional nature of milk production in Turkey which relies substantially on grazing. As a result, milk processing firms complain that they cannot find enough suitable quality milk to process and are forced to operate below full capacity.

In this paper we try to sort out these competing claims and propose an alternative scenario that weaves together all the seemingly competing facts. We observe that the cumulative effect of price transmission from farm-gate to retailers is indeed asymmetric. However, the asymmetry is the opposite of what we would expect from the empirical literature on price transmission in agricultural markets[54]. Over time, the vertical distance between farm-gate and wholesale milk prices is shrinking in Turkey. Following

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[52] FAO (2007) report on Turkish dairy sector reports "Turkish dairy industrialists estimate that poor quality milk makes them incur additional costs of between 10-15 percent of the milk price" (p. 69).

[53] The retail sector trade journal report on the dairy industry (January 2007) can be reached at: http://www.perakende.org/haber.php?hid=1197885349

[54] Peltzman (2000) studies a wide variety of industries for the U.S. where a primary input costs at least 20 percent of output price and concludes that more often than not producers pass thru the reductions in input costs slower than increases and he suspects abuse of oligopoly market power. The abuse of oligopoly power is well documented for the U.S. dairy sector (Capps & Sherwell, 2007; Carman & Sexton, 2005; Chidmi, Lopez, & Cotterill, 2005; Cotterill, 2005; Lass, 2005; Li, 2008). von Cramon-Taubadel (1998) is one of the first papers that deal with a European market while taking into account the unit root characteristics of time-series variables. Meyer & Cramon-Taubadel (2004) is an excellent review of the theoretical basis of asymmetric price transmission, time series econometrics and the empirical studies.

McCorriston, Morgan, & Rayner (2001), we propose that the most proximate explanation of the functioning of the fluid milk production and the processing chain is the one where milk processors enjoy oligopsony power and hence can extract price concessions from the farmers. However, processing firms pass price concessions and more to retailers[55] because they also enjoy increasing returns to scale. Increasing returns to scale allow dairy firms to preserve their net profit rates even though the gross margin between farm-gate milk price (chief input) and Ultra High Temperature milk (major fluid milk output, UHT) is narrowing. We show that the capacity utilization ratio in the modern dairy industry in Turkey rose during the study period (1994-2006), but it still remains low. We suggest that the availability of excess capacity makes it evident that increasing returns to scale is achievable in the short run. We show that UHT milk is gaining market share against the open milk – milk sold by the street traders without treatment – suggesting that there are potentially increasing returns to scale in the medium and the long-run due to the expansion of the market. We also find more direct evidence for increasing returns to scale: there is a structural break in unit root tests for the hourly labor productivity index in the dairy sector (hereafter labor productivity index) coinciding with the entry of two major competitors (Danone and Ülker) into the dairy market in 1997. We also detect a gradual but consistent decline in UHT milk price from 1998 onwards, which coincides with the structural break in labor productivity index. The long-term decline in UHT milk prices is accompanied by no major change in farm-gate milk prices.

[55] We assume that reductions in wholesale milk prices are passed to final consumers. Çelen, Erdoğan, & Taymaz (2005) assert that supermarkets are generally competitive in Turkey.

Finally, we employ Threshold Autoregressive (TAR) tests, Moment Threshold Autoregressive (M-TAR) tests, and an Asymmetric Price Transmission (APT) model to look for evidence of abuse of market power by milk processing firms. The APT model (explained in detail in Section 4.3) cannot prove the abuse of market power by intermediaries, because there are other possible explanations for the differing speed of transmission of input price increases and decreases to output prices. However, if we can detect quicker transmission of input price increases to retailers than input price decreases, then we at least have grounds for suspecting abuse of market power by intermediaries. We do not find much evidence for asymmetry, and the little evidence we get for asymmetry supports the contrary conclusion that milk processing firms in Turkey in the study period transmit input price decreases quicker to retailers than input price increases.

In Section 4.2, we describe the dairy sector in Turkey and justify the choice of fluid milk as the object of analysis. Section 4.3 presents the APT as the model to study the price transmission mechanism in fluid milk market. Section 4.4 presents an analysis of unit root characteristics of variables. Section 4.5.1 presents the cointegration analysis. Because the Johansen's trace test is known to perform poorly in the presence of asymmetric price transmission, in Section 4.5.2 we employ TAR and M-TAR cointegration tests that are developed specifically for cases exhibiting potential asymmetric relationships. Section 4.6 is devoted to the estimation and discussion of the APT model. Section 4.7 recaps the empirical findings and concludes the chapter.

4.2 Dairy Sector in Turkey

In Turkey animal production systems differ depending on the animal product. At one end stands the broiler chicken industry where industrial farms dominate. At the other end stands sheep and goat husbandry which is dominated by scattered traditional producers. Dairy products lie in the intermediate terrain between these extremes, with a mix of large and small scale processors. Dairy products are the source of 50 percent of the total animal protein in the Turkish diet and 60 percent of animal calories[56]. The dairy sector has a very diverse product spread. In Turkey the most consumed (in terms of fluid milk equivalent) dairy product is cheese, followed by yogurt, butter and fluid milk (MARA, 2004; Voorbergen, 2004).

Even though it is not the primarily consumed dairy product, in this paper we focus on fluid milk consumption and, specifically, on UHT milk consumption in Turkey owing to the distinctive features of the UHT market. UHT is the partial sterilization of milk by heating it for a short time, 1-2 seconds, at a very high temperature (exceeding 135 °C, compared to heating at 72 °C for 15 seconds for pasteurization). In all primary dairy products except UHT milk, modern large scale enterprises (i.e., potential oligopolies) compete with ‘mandra’ (traditional, small-scale producers and semi-modern enterprises) and street vendors. As Voorbergen (2004: 12) puts it, “Processors operate in different worlds… At one pole, [stand] the big food conglomerates and foreign companies; at the other pole, [stand] the small-scale mandras”. Studying UHT milk will allow us to focus on the one product where mandras do not participate. UHT milk production requires costly initial investment in UHT machinery. (FAO, 2007) reports that Turkey’s ten largest dairies – five of them with nationwide presence – dominate UHT milk production (p. 69). Hence, by concentrating on the UHT milk market, we can most easily analyze whether big food conglomerates manipulate prices for their benefit.

[56] We calculate these estimates from the State Institute of Statistics (SIS) Household Budget Survey of 2003.

The retail price of fluid milk in Turkey is higher than that in most EU member countries. At the same time, the farm-gate price is among the lowest. In other words, the retail/ farm-gate price ratio is higher in Turkey compared to many EU members. Furthermore the farm-gate-milk-price to milk-feed-price[57] ratio is around 1.1-1.2 in Turkey in recent years. Koç, Bayaner, Tan, Ertürk, & Fuller (2001) estimate that for a profitable farm, the milk price/feed ratio should not be lower than 1.5 and preferably around 2[58].

Table 4.1 shows that the retail-to-farm-gate price ratio has been decreasing in Turkey but is still above the retail-to-farm-gate ratio for the United Kingdom. On the one hand, farmer associations claim that the reason for the high retail/farm-gate ratio is the cartel power of milk processors (Güngör, 2006). On the other hand, dairy processors put the blame of the high retail-to-farm-gate ratio squarely on the dispersed and traditional nature of farmers (see footnotes 51 and 52). In other words, since the farms are small-sized and dispersed, milk collection costs are higher than they would be if the farmers had modern and large milk farms. Also, most of the Turkish farmers do not have refrigerated storage tanks for milk and, hence, once the milk is collected it needs to be treated extensively in order to reduce the bacteria count to acceptable levels.

[57] Modern farms, which primarily rely on milk feed – the special mixture of animal feed for milk production – feed costs can account for 63.7 percent of expenses in Turkey (Koç et al., 2001: 26).

[58] Cow Breeders Association report "Producers face the prices dictated by Industrialists" (Güngör, 2006: 2); Agricultural Engineers Association of Turkey report (TZOB, 2005: 11).

Table 4.1: Comparison of retail and farm-gate prices and ratios in England and Turkey

	2002	2003	2004
UK Retail Milk	0.74 €	0.78 €	0.79 €
Turkey Retail Milk	0.80 €	0.81 €	0.86 €
UK Farm-gate Milk	0.29 €	0.30 €	0.31 €
Turkey Farm-gate Milk	0.22 €	0.24 €	0.27 €
UK Milk Feed	0.25 €	0.26 €	0.28 €
Turkey Milk Feed	0.18 €	0.21 €	0.20 €
UK retail / farm-gate	2.55	2.60	2.55
Turkey retail / farm-gate	3.64	3.37	3.19
UK farm-gate / feed	1.16	1.15	1.11
Turkey farm-gate / feed	1.22	1.14	1.35

Note: The feed conversion ratio, on average, is higher in Turkey, which means that for every kg of feed less milk is obtained in Turkey.
Source: Reproduced from (TZOB, 2005) report, p.10

A third group, the board for the 9th Development Plan for Food Processing Industry, takes a position somewhere in between these two (Ataman, 2006). It acknowledges the parceling of milk supply among milk processors, and affirms that most farmers lack the means necessary to participate in modern markets. As a result, the authors of the report make a case for public institutions to regulate the market, implicitly acknowledging the institutional externalities arising from the quickly perishable nature of the product[59]. There is some evidence of concentration for the Turkish dairy processing industry indicating that it is indeed high. (Top four firms controlled between 50 to 60 percent during 1990s[60]). However, it is prudent to regard these statistics with skepticism. The coverage of the informal sector by State Institute of Statistics (SIS) is at best inadequate. For example, Voorbergen reports that only 19 percent of total raw milk in Turkey is processed by modern firms; 35 percent is processed by medium and small-scale firms; roughly 10 percent is sold by street vendors as open milk; and roughly one third is consumed/ processed on the farm itself (Voorbergen, 2004: 10).

[59] This report relies on expert opinion instead of empirical scrutiny.
[60] Personal communication with SIS staff.

The existence of oligopolies does not necessarily imply the exercise of oligopoly power at the expense of social welfare. Sometimes the benefits of oligopolies outweigh their potential costs. For example, oligopolies may enjoy "super profits" (in comparison to the perfect competition case) yet deliver lower prices to consumers because they can enjoy economies of scale, or they can overcome the double marginalization that exists between companies dealing with each other at arm's length[61]. If barriers to entry are sufficiently low, the threat of entry can force existing monopolies or oligopolies to behave as if they are operating in competitive markets. Hence, in order to determine the welfare effects of oligopolistic market structure, it is not enough to show the market share of larger firms. Indeed, McCorriston et al., (2001) provide a theoretical framework where increasing returns to scale in oligopolistic markets can lead to even greater price transmission than a perfect competition case:

> Specifically, whereas market power will reduce the level of price transmission (relative to perfectly competitive case), if the industry is characterized by increasing returns to scale, the level of price transmission will increase. Under reasonable conditions, the degree of price transmission may be greater than in the constant returns, perfectly competitive case. (p. 146)

An inspection of figures relating to inflation-adjusted prices in Section 4.4.1 suggests that the farm-gate and UHT milk real prices are not moving together in the sense that there is no visible pattern in farm-gate milk real prices while UHT milk real prices are in a gradual long term decline. Formal cointegration analysis of farm-gate and UHT

[61] When final consumer products firms (like food processors or supermarkets) deal with their suppliers at arm's length, the resultant production is less than their profit maximizing optimum production level. Given supermarkets' demand, the profit maximizing optimum for their suppliers is less than consumer products firms' optimum. Double marginalization can be avoided if upstream or downstream activities are vertically integrated.

milk real prices rejects cointegration between these two variables and confirms the visual inspection. In Section 4.4 we show that the sustained increase in labor productivity in the post-1997 period in the dairy sector coincides with the entry of two major producers and with the start of a long-term decline in UHT milk prices. In Section 4.5, we show that when we consider the farm-gate and UHT milk real prices, and labor productivity index together they are indeed cointegrated, which stands as further evidence that dairy sector labor productivity has a significant role in explaining the movements in prices. We regard the upward trend in dairy sector productivity as an indicator of increasing returns to scale and as a clear structural break from the past in the post-1997 period.

Tables 4.2 and 4.3 present additional evidence that point to increasing returns to scale in the dairy industry. Table 4.2 shows that only seven percent of fluid milk consumption in 1994 was from the formal sector (pasteurized and UHT milk). By 2003 the formal sector raised its market share relative to open source milk (street milk) to 18 percent and at the same time per capita fluid milk consumption kept increasing. Almost all of the increase in total consumption can be attributed to the formal sector. Potentially, UHT and pasteurized milk products are becoming normal goods consumed by the middle class rather than luxury products as they evidently were in the mid-1990s. Thus the decline in the wholesale-to-farm-gate price ratio may point towards the evolution of a novel/luxury product into a mass consumer good. At the same time the oligopolistic nature of the dairy industry be accompanied by dairy firms’ efforts to introduce the better quality (more hygienic, healthy and with longer shelf life) products to the consumer basket.

Table 4.2: Source of fluid milk consumed 1994 and 2003

	Rural			Urban			Total		
Years	**Open**	**Packed**	**Pc daily, lt**	**Open**	**Packed**	**Pc daily, lt**	**Open**	**Packed**	**Pc daily, lt**
1994	99 %	1 %	0.085	90%	10 %	0.081	93%	7%	0.082
2003	96 %	4 %	0.113	74 %	26 %	0.086	82 %	18 %	0.094

Our calculations are based on the SIS 1994 and 2003 Household Budget Surveys.

Table 4.3 shows that total fluid milk output and capacity utilization in the formal sector have been increasing[62] in Turkey for the years where data are available. We take Tables 4.2 and 4.3 as evidence for potential increasing returns to scale in both the short- and long-run. The gradual decline in excess capacity also suggests the potential for existence of increasing returns to scale even in the short run. In the long-run the UHT and pasteurized milk are gaining market share, allowing for continuous upgrade and expansion of existing factories. During this process, excess capacity can lead to price wars among dairy processors to gain market share.

Table 4.3: Formal sector capacity, production and utilization

UHT				
Years	**# of units**	**Capacity**	**Production**	**Capacity utilization**
1994	8	242,794	85,789	35%
1996	13	280,383	15,917	6%
1998	15	299,783	221,635	74%
2000	10	415,372	181,821	44%
2002	35	231,728	91,126	39%
Pasteurized				
Years	**# of units**	**Capacity**	**Production**	**Capacity utilization**
1994	42	612,545	106,430	17%
1996	46	542,907	130,837	24%
1998	52	414,722	126,186	30%
2000	37	1,792,497*	142,181	8%
2002	48	286,629	170,645	60%

*: The significant increase from 1998 to 2000 and the subsequent substantial decline are probably due to a classification mistake: the buttermilk capacity has a reverse swing during the same period.
Source: Industry surveys by SIS originally reported by Ministry of Agriculture and Rural Affairs (MARA, 2004).

[62] There is no import of fluid milk to Turkey, so all of the increase in consumption is sourced domestically.

4.3 Asymmetric Price Transmission[63]

A likely avenue leading to higher profits for oligopolistic food processors is the manipulation of prices. As a result, one way of studying the competitiveness of agricultural markets is to study the price transmission from farmers (primary producers) to final consumers. Standard economic models assume that positive and negative price changes in input costs are equally transferred to output prices. However, empirical studies challenge this assumption. Peltzman (2000) – analyzing a wide range of industries – finds that output prices rise concurrently with input price increases (i.e., without lag), but respond with a lag when input prices decline. The differing transmission of input price changes to output prices is called asymmetric price transmission (APT).

The APT model cannot explain the causation for price transmission; instead the model serves the role of detecting the asymmetry in price transmission. According to Meyer and von Cramon-Taubel (2004) two main views that explain the observation of APT are: (i) the abuse of market power, and (ii) adjustment costs (e.g., menu costs[64] in the presence of inflation).

Farmers and consumers - at the beginning and end of the marketing chain, respectively - often suspect the abuse of market power as the explanation for APT. Increases in input prices are passed on to output prices more quickly because such

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[63] This section is largely based on Li (2008) and Meyer & Cramon-Taubadel (2004).

[64] Menu costs refer to transaction costs related to updating of price tags. In an inflationary environment firms will adjust their prices downward less often and in lesser amounts simply because the inflation reduces the real prices over time. Hence using nominal price time-series in the analysis of price transmission will reveal that the prices are sticky downward. In other words, in an inflationary environment the analysis of price transmission can spuriously detect abuse of market power even when the firms are simply avoiding the menu costs with the knowledge that inflation will soon render any price reduction unnecessary.

increases squeeze the gross margin for processing firms (the middlemen). On the other hand, the existence of asymmetry could also be explained by the fact that inflation eats into the retail price of goods; input price declines are not immediately followed by output price declines because the latter result in the re-establishment of the usual gross margin that was eroding under inflationary pressures.

4.3.1 Different Ways of Classifying APT

4.3.1.1 Positive versus Negative APT:

Peltzman (2000) suggests dividing APT into two cases: positive and negative. Positive APT occurs when price increases in input prices translate into output prices immediately, but price decreases do not. Negative APT is the opposite case[65]. Meyer and von Cramon-Taubadel (2004) suggest the following definition:

> We propose that positive APT be defined as a set of reactions according to which any price movement that squeezes the margin (i.e., an increase in p_{in} or a fall in p_{out}) is transmitted more rapidly and/or completely (to p_{out} or p_{in}, respectively) than the equivalent movement that stretches the margin. Conversely, APT is negative when price movements that stretch the margin are transmitted more rapidly and/or completely than movements that squeeze it (p. 586).

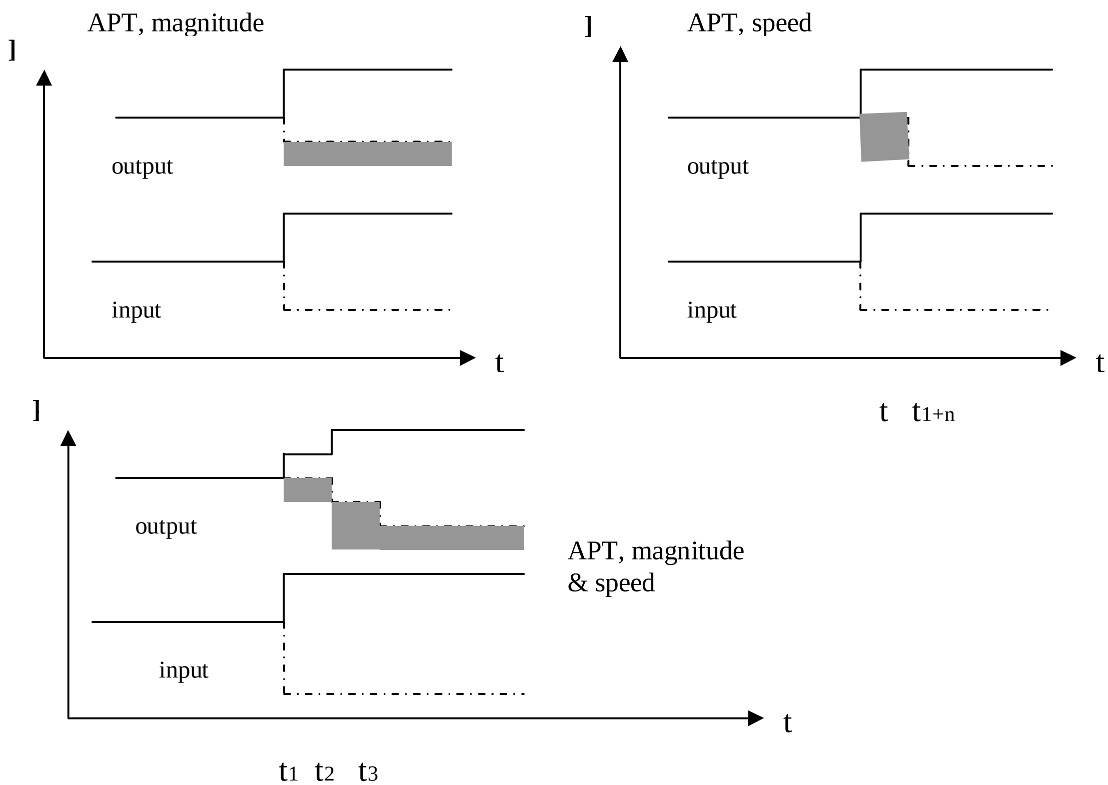
4.3.1.2 Magnitude versus Speed of Adjustment

Another way of looking at APT is to check whether (i) the positive and negative changes in input prices and output prices cancel each other or not (magnitude of adjustment) and (ii) positive and negative changes in input prices are reflected to output prices at the same speed.

[65] In the case of APT, the meanings of “positive” and “negative” can be misleading. In this case positive APT is bad for consumers and negative APT is good for consumers.

The solid lines in Fig. 4.1 represent the price increases (input and output); the dashed lines represent price declines, and shaded areas the welfare effects. In the first graph the input price increases fully and is immediately reflected on the output price, but the input price decline is reflected on the output price immediately but not fully (i.e., the gross margin of middlemen has increased permanently). In the second graph, the decline in the input price is reflected on the output price with a lag (a temporary super profit for middlemen). The third graph is the combination of the first two. The decline in the input price is transmitted to the consumers neither immediately nor to its full extent[66].

Figure 4.1: Different forms of positive APT, reproduced from Meyer and Von Cramon-Taubel (2004)



[66] For ease of explanation assume that the price changes do not lead to a change in quantity consumed. Also, we are not going to discuss spatial APT because we are not going to explore such a situation.

4.3.2 Modeling Asymmetric Price Transmission[67]

Standard symmetric and linear price transmission can be represented by the following equation:

$$p_t^{out} = \alpha + \beta\, p_t^{in} + \mu_t \tag{4.1}$$

where p_t^{out} is the price of output (wholesale milk price in our case), p_t^{in} is the price of primary input (farm-gate milk price in our case), α and β are coefficients to be estimated and μ_t are the error term. The insight of APT model is to split changes in input prices into input price increases, p_t^{in+}, and input price decreases, p_t^{out+}, in order to investigate their effects separately on output (i.e., creating two columns of data from one: when there is an input price increase the corresponding input price decrease cell is zero). Houck, (1977) made the early formulations of the APT model operationally clearer:

$$\Delta p_t^{out} = \alpha + \beta^{+} \Delta p_t^{in+} + \beta^{-} \Delta p_t^{in-} + \gamma_t \tag{4.2}$$

If β^{+} is equal to β^{-} then we can conclude that the magnitude of response to positive and negative input price changes is symmetric. Ward (1982) extended Houck's specification to include lags. Lag lengths of input price increases and decreases are allowed to differ as indicated by K versus L in Equation 4.3, they are designed to account for the speed of adjustment in addition to magnitude of adjustment:

$$\Delta p_t^{out} = \alpha + \sum_{j=1}^{K} (\beta_j^{+} \Delta p_{t-j+1}^{in+}) + \sum_{j=1}^{L} (\beta_j^{-} \Delta p_{t-j+1}^{in-}) + \gamma_t \tag{4.3}$$

For example, if it turns out that K is two and L is three, then we can conclude that input price increases are translated into output prices more speedily. Granger & Newbold

[67] This section relies heavily on Meyer and v. Cramon-Taubadel (2004: 593-96) and von Cramon-Taubadel (1998).

(1974) show that if the dependent and independent variables are randomly and independently generated non-stationary time series variables then ordinary least squares (OLS) will yield a statistically significant relationship in far more cases than expected. Such results are referred to as spurious. Since then, econometricians have developed tests for non-stationarity (including Dickey-Fuller and KPSS tests) and methods for modeling relationships among non-stationary variables e.g., error correction models (ECM). An ECM incorporates the long-term equilibrium relationship among variables in the specification as well as the short-term adjustments to maintain that equilibrium[68]. In an ECM, both the dependent and the independent variables are in first differences. Adjustments to the long-term relationship are accounted by error correction terms (ECT), which are the lagged error terms arising from the long-term relationship.

> The ECT measures the deviations from the long-run equilibrium between p^{in} and p^{out}, so including it in the ECM allows p^{out} not only to respond changes in p^{in} but also to 'correct' any deviations from the long-run equilibrium that may be left over from previous periods. (Meyer and v. Cramon-Taubadel, 2004: 596)

The ECM is a Vector Autoregressive Regression (VAR), which means that lagged values of the differenced dependent variable are also added to the right-hand side of the equation. In the parlance of cointegration analysis, Equation 4.1 symbolizes the long-term relationship. If tests prove that the relationship represented in Equation 4.1 is not spurious[69], then the lagged error terms from Equation 4.1 represent the deviations from long-term equilibrium in period t-1. The coefficient of the ECT is expected to be negative. In other words, the deviations from the long-term relationship are corrected

[68] (Engle & Granger, 1987) have developed the first practical testing strategy for error correction models. (Granger & Lee, 1989) present the first application of non-symmetric error correction models.
[69] The cointegration tests for the milk data from Turkey are presented in Section 4.5.

toward the cointegrated long-term equilibrium. In order to incorporate the ECT into the APT model, the ECTs are split into positive and negative components and added to the Ward specification. In the modified Ward specification, Equation 4.4, if the φ^+ is equal to φ^- then we can conclude that the responses to positive and negative input price changes are symmetric. In other words the speed of adjustment is equal for positive and negative deviations from long-term equilibrium:

$$\Delta p_t^{out} = \alpha + \sum_{i=2}^{K}\left(\beta_i \Delta p_{t-i+1}^{out}\right) + \sum_{j=1}^{L}\left(\beta_j \Delta p_{t-j+1}^{\text{in}}\right) + \varphi^+ ECT_{t-1}^+ + \varphi^- ECT_{t-1}^- + \gamma_t \tag{4.4}$$

As shown in the third and fourth terms on the right-hand side of Equation 4.5, it is also possible to split the input prices into positive and negative components in order to allow the investigation of more complex dynamic relationships.

$$\Delta p_t^{out} = \alpha + \sum_{i=2}^{K}\left(\beta_i \Delta p_{t-i+1}^{out}\right) + \sum_{j=1}^{L}\left(\beta_j^+ \Delta p_{t-j+1}^{\text{in}+}\right) + \sum_{j=1}^{M}\left(\beta_j^- \Delta p_{t-j+1}^{\text{in}-}\right) + \varphi^+ ECT_{t-1}^+ + \varphi^- ECT_{t-1}^- + \gamma_t \tag{4.5}$$

Unfortunately, the cointegration framework of ECM does not allow investigating whether the gross margin of middlemen are permanently increasing because the long-term cointegrated relationship is assumed *a priori*; in these models there is no room for continuous divergence from a long-term relationship (i.e., magnitude of adjustment is assumed away). Enders & Siklos (2001) develop cointegration and threshold adjustment tests that relax the assumption of symmetric adjustment to the long-run equilibrium (for discussion, see Section 4.5.2).

4.4 Data

4.4.1 Exploring the Data Set

The most publicized price gouging cases are the ones concerning the manipulation of retail prices due to the direct link to the pockets of consumers at large. Unfortunately, the retail milk price data released by SIS also include the open sourced milk in addition to packaged milk without differentiating between the two, and hence do not correspond one-to-one to the wholesale product (UHT milk) of the modern dairy industry. Hence we will concentrate on the relationship between farm-gate (input) and UHT wholesale prices (output). Price data for many commodities and products are available monthly starting with January 1994 at SIS's web-site. We use available data up to the end of 2006[70].

We want to control for returns to scale while exploring the relationship between farm-gate and wholesale milk price after McCorriston et al., (2001). Low capacity utilization rates presented in Table 4.3 suggest the potential for increasing returns to scale in the short run. Unfortunately, capacity utilization rate data are only available annually. Hence we use the labor productivity index as a proxy for returns to scale. This index is available as quarterly data on the SIS's web-site for the period 1994-2006. We convert the quarterly index data into monthly data by interpolating..

The nominal farm-gate and wholesale UHT prices are presented in Figure 4.2. The very high level of inflation prior to 2002 (see Table A3.1 in the Appendix) makes it very hard to evaluate price movements visually. To partially ameliorate the inflation

[70] We end the analysis at the end of 2006 because the labor productivity index for dairy sector is available only until the end of 2006. Recently, SIS has released data for indices for labor hours and total dairy production for post 2006 but the base year has changed to 2005 from 1997 and the data frequency for total production is monthly.

problem, we converted nominal prices to logarithms (Figure 4.3). Broadly speaking, the log prices suggest that farm-gate and UHT milk prices move together.

Figure 4.2: Farm-gate and UHT (wholesale) nominal milk prices, TL

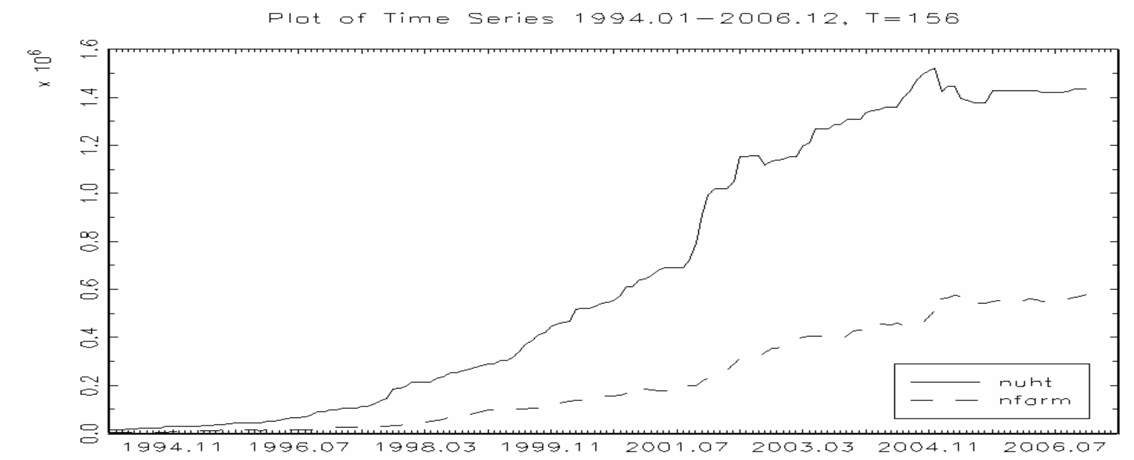
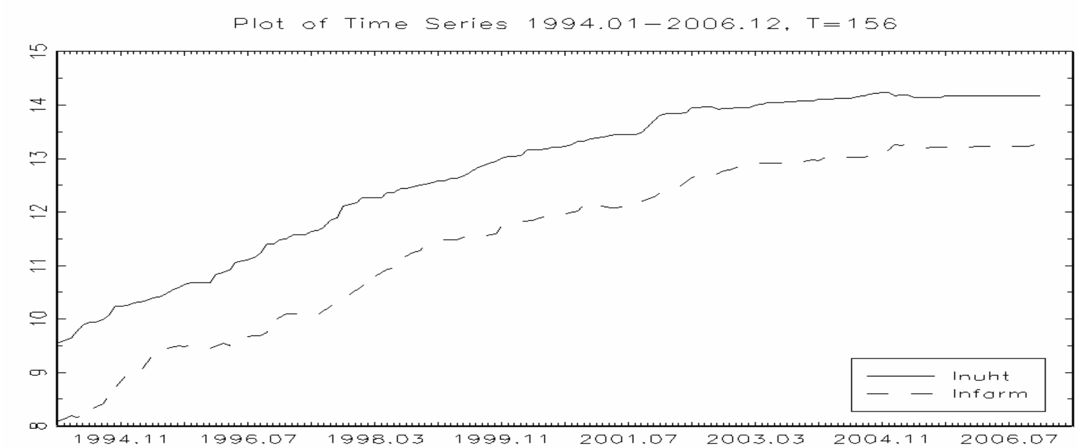
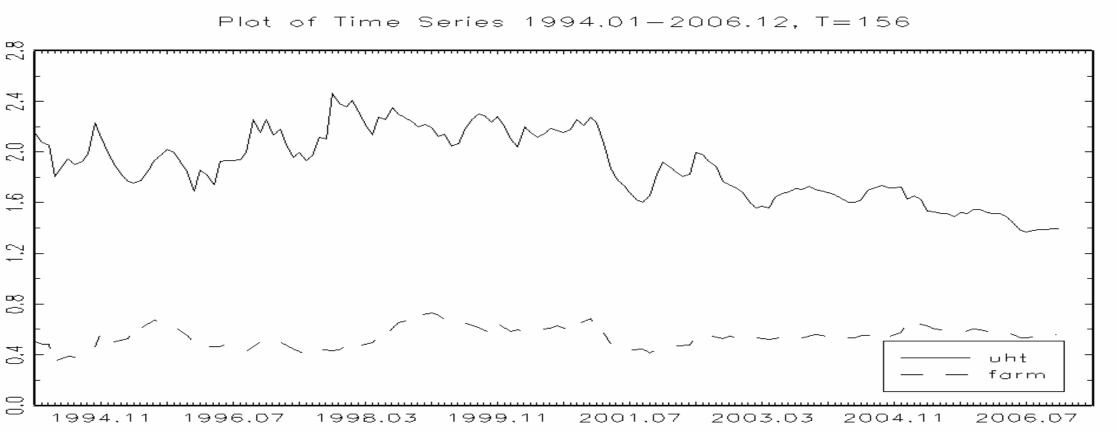


Figure 4.3: Logarithm of farm-gate and UHT (wholesale) nominal milk prices



Alternatively we convert the nominal prices to real prices (using monthly wholesale price index) in Figure 4.4. The gross margin between indexed farm-gate milk price and indexed wholesale UHT price are narrowing in Figure 4.4. In other words, indexed prices suggest that the two series may not be cointegrated since the relationship between the two series is not constant. Due to the discrepancy of the intuitive observations from Figures 4.3 and 4.4, we analyze the relationship between wholesale UHT price and farm-gate price both for nominal and real inflation indexed prices[71].

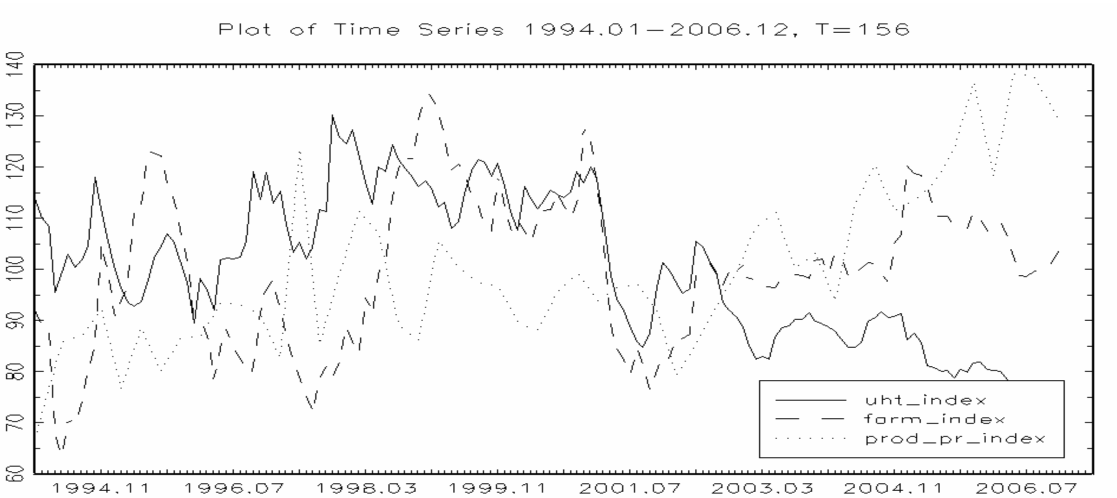
Figure 4.4: Inflation-adjusted farm-gate and UHT (wholesale) milk prices, YTL*



*: YTL = 1,000,000 TL

Figure 4.5 presents the time graph of indices of three indexed variables which illustrates the fluctuating movement of farm-gate prices, the long-term decline in UHT prices and the gradual increase in the productivity index.

Figure 4.5: Indices of inflation-adjusted farm-gate, UHT prices and productivity index



[71]We are presenting only the results for inflation-adjusted prices in the main part of chapter. The analysis for log-nominal prices is presented in the Appendix.

4.4.2 Unit Root Tests

After visual analysis of the time-series data we check for the existence of unit roots. We use JMulti software[72] for unit root tests and for the Johansen co-integration tests. Our testing strategy is to start with an augmented Dickey-Fuller (ADF) model with one lag including the trend variable if a trend is visible in the data. If the final prediction error (FPE)[73] score indicates a lag length different than the default of one lag, we conduct the ADF test with the suggested lag length. In the second step, we use the test developed by Kwiatkowski, Phillips, Schmidt, & Shin (1992). We choose the KPSS test as an alternative to the ADF because it tests opposite null hypothesis. In the ADF test the null hypothesis is the existence of a unit root. In KPSS the null hypothesis is stationarity. While testing for both level stationarity and trend stationarity, we conduct KPSS tests with the same lag length as the ADF test. In the last step, we test for the presence of a unit root with a structural break. Since the data are monthly, we add monthly dummy variables to see if the results change significantly. In the unit root test with a structural break, Saikkonen & Lütkepohl (2002) suggest first estimating Equation 4.6 and subtracting it from the original series. Then the ADF test is performed on the adjusted series.

$$y_t = \alpha_0 + \alpha_1 t + \gamma D_s + e_t \tag{4.6}$$

where $D_s = 0$ if $t < T$
$D_s = 1$ if $t \geq T$ and T is the shift date.

y_t is the time series, t stands for time and D_s is the dummy variable defined as above.

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[72] www.jmulti.de. JMulti is very user friendly and its main advantage is that it allows unit root analysis while testing for structural breaks.

[73] JMulti automatically provides optimal lag length from four alternative information criteria: AIC, FPE, Hannan-Quinn, and Schwarz Criterion. We based our decisions on FPE.

Alternatively, it is possible to experiment with impulse dummy variables (a dummy variable equal to one only when t = T, and zero during the rest of time). Essentially an impulse dummy variable is a jump in a single period but does not point to any structural change in the long-run. We chose to focus on shift dummy variables because structural breaks are more relevant from a policy perspective than one-time outliers. It is also possible to experiment with exponential shift dummy variables. The exponential shift dummy variables allow for a gradual shift to a new level. When we use exponential shift variables instead of ordinary shift variables the conclusions of structural break tests for all three variables are identical.

For the sake of brevity, we present only unit root test results with lag lengths minimizing the FPE score. For the UHT milk real price and labor productivity index, we present unit root tests taking into account the prior information since there are visible trends in the time series (Elder & Kennedy, 2001). Table 4.4 shows that both the ADF and KPSS tests give the same results for the UHT milk real price: the monthly prices are non-stationary. However, the conclusion changes drastically when we conduct the unit root test with structural break test. Prior to formal tests, we thought that February 2001 would be the date for structural break date, due to the severe foreign exchange crisis and sudden jump in inflation in that month. However, the structural break test suggests a break date as October 1997. Figure 4.6 shows the deterministic time trend with a structural break imposed on the inflation-adjusted UHT milk price. The most significant developments prior to or during 1997 are the privatization of SEK (the publicly owned dairy company[74]) and the entrance of new firms into the dairy sector. The privatization of SEK was mostly completed during August-September 1995. The French multinational Danone bought a local company, Tikvesli, and entered the Turkish market in 1997. Moreover, the biggest domestic food company, Ülker, entered the consumer dairy market in 1997 (Voorbergen, 2004)[75]. In other words, the structural break identified in empirical analysis coincides with a significant change in industry structure rather than major macroeconomic events.

Table 4.4 also shows that the ADF and KPSS for farm-gate milk real price and labor productivity index and supports the unit root null hypothesis in every alternative test. Figure 4.7 shows the deterministic time trend with a structural break imposed on the farm-gate milk real price. The structural break date is December 2000 and is just prior to the February 2001 crisis. Unlike the milk processing firms, there is no sector-level drastic change to account for such a break. The sharp drop in real prices during 2001 is the result of the fact that the increases in the nominal milk price did not match increases in the inflation rate.

[74] Modern enterprises, private or owned by the state, have never processed majority of raw milk in Turkey. However, SEK, due to its presence in every region, was widely believed to set the reference price both for farmers (when buying milk from) and for processors (when selling their products).

[75] "Ülker is a diversified Turkish food company with sales of around USD 2.5 billion [2004] that expanded into the dairy business relatively recently. The company already manufactured powdered milk for its own cookie business but moved into the end consumer business with the acquisition of Ak Foods in 1997." (Voorbergen, 2004: 9)

Table 4.4: Unit root tests for UHT and farm-gate milk prices and labor productivity index

Variable	Test	Structural break date	trend variable	Lags	Test score	Conclusion
UHT milk real price	DF		yes	13 lags	-1.5562	FTR Ho of unit root
	KPSS		yes	13 lags	0.2455	Reject Ho of stationarity
	Structural break	1997 M10	yes	3 lags	-4.0588	Reject Ho of unit root
farm-gate milk real price	ADF		no	1 lag	-2.9748	Reject Ho alpha=.05
	ADF		yes	1 lag	-2.7427	FTR Ho of unit root
	KPSS		no	1 lag	0.781	Reject Ho of stationarity
	KPSS		yes	1 lag	0.271	Reject Ho of stationarity
	Structural break	2000 M12	yes	1 lag	-2.6061	FTR Ho of unit root
Productivity index	ADF		yes	22 lags	-1.1158	FTR Ho of unit root
	KPSS		yes	22 lags	0.1407	Reject Ho of stationarity
	Structural break	1997 M10	yes	22 lags	-1.6154	FTR Ho of unit root

Figure 4.6: Inflation-adjusted UHT milk price with shift dummy, break (1997.M10), 3 lags

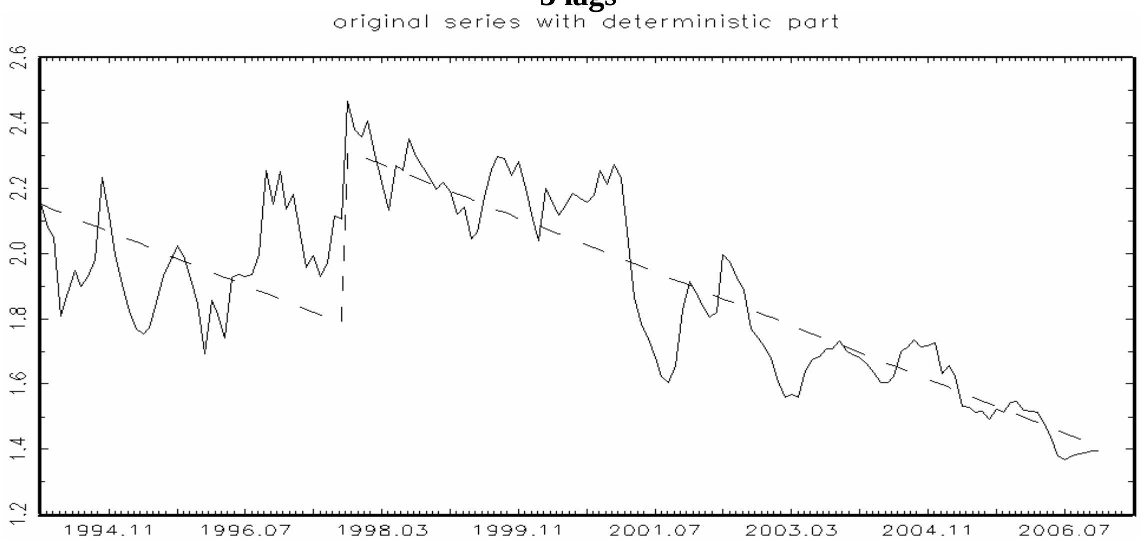
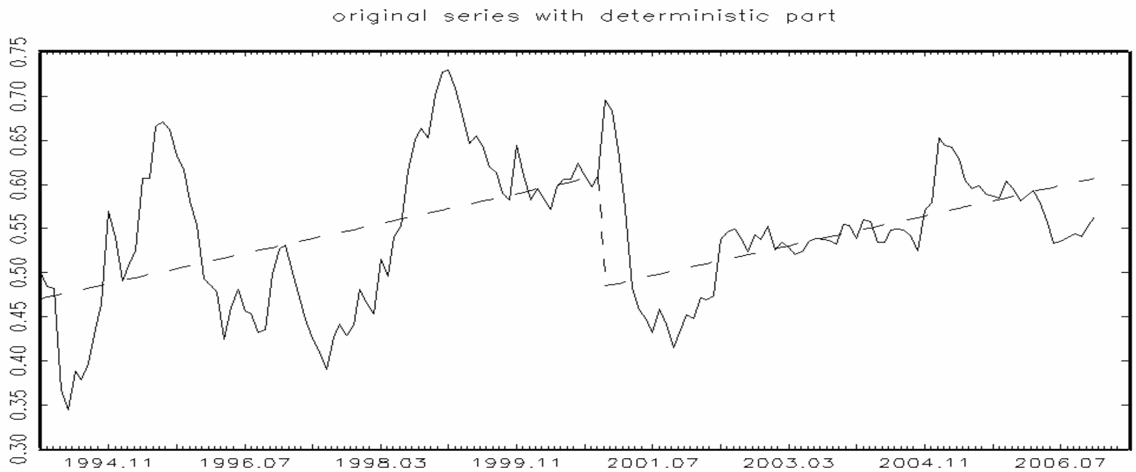


Figure 4.7: Farm-gate real price with shift dummy, break (2000.M12), 1 lag



In the case of the labor productivity index, the suggested break date is May 1997. However, we cannot perform the structural break unit root test occurring during May 1997 with the suggested 22 lags that emerge from initial analysis of lag length because there are not enough prior sample observations. The closest possible date is October 1997 for a structural break with 22 lags. We felt comfortable using October 1997 instead of May 1997 since, as discussed above, major new firms entered the dairy sector during 1997. Figure 4.8 shows the positive deterministic time trend imposed on the actual productivity index data.

Figure 4.8: Labor productivity index with shift dummy, break (1997.M10), 22 lags

4.4.3 Concluding Unit Root Section

ADF and KPSS tests indicate that all three variables exhibit unit root characteristics with appropriate lag lengths (determined according to FPE information criteria). When we include a structural break into the analysis, the result changes only for UHT milk real price; assuming a structural break during October 1997, UHT milk real price is stationary. The suggested structural break dates are intuitively plausible. Both for UHT milk real price and the productivity index the break dates are in 1997 which are plausible given the corresponding new entries by major actors into the Turkish dairy market. The December 2000 structural-break date for inflation-adjusted farm-gate milk price is also plausible considering the immediate severe recession and spike in inflation rate. Adding monthly dummy variables does not change any of these conclusions.

4.5 Cointegration Analysis

4.5.1 Johansen Trace Test and Saikkonen-Lütkepohl Test

In order to perform the cointegration analysis, all variables should have unit root properties. As we show in the previous section we can confidently claim unit roots for all variables in every case except when we introduce a structural break into the unit root analysis of the inflation-adjusted UHT milk price. Despite this caveat, we continue with the cointegration analysis assuming that all variables are unit-root processes. We do not have any *a priori* expectation of the specific form the cointegrating relationship should take; hence we test the cointegration for all the possible variations. We also test for cointegration with the Saikkonen & Lütkepohl (2000) which estimates the deterministic part first, subtracts it from original observations and then applies a Johansen type test to the remaining adjusted series. Unlike Johansen Trace tests, it is not possible to incorporate a structural break into the Saikkonen-Lütkepohl test.

We start by considering the cointegrating relationship between inflation-adjusted farm-gate and UHT milk prices. After visual inspection of Figure 4.4 we do not expect to find a cointegrating relationship between inflation-adjusted farm-gate and UHT milk prices. Unsurprisingly, Johansen trace tests, summarized in Table 4.5, confirm our intuition that these two series are not cointegrated, i.e. the regression relationship between them is spurious. When we introduce two break dates (i.e. shift dummies) for October 1997 and December 2000, there is some evidence for cointegration. Likewise, when we follow Saikkonen and Lütkepohl (2000)'s methodology and subtract the deterministic part from the original observations and test for cointegration in the adjusted observations, there is some evidence of cointegration.

The evidence of cointegration between farm-gate and UHT milk real prices from Table 4.5 is not strong and we have evidence for substantial change in industry structure, so we proceed by including the labor productivity index to the cointegrating relationship. The results in Table 4.5 are more consistent, i.e., less susceptible to specification, to choice of lag length or to the existence or absence of structural break dates. Except for the case of applying the Johansen trace test with no structural break, cointegration is found in every specification. The most consistent finding of cointegration is the specification 'constant and trend'.

Table 4.5: Cointegration tests for farm-gate, UHT milk prices and labor productivity index

Johansen Trace test - Constant			
Variables	**Structural break**	**Lags**	**Conclusion**
Farm-gate and UHT	No	2	0 cointegrating vector
Farm-gate , UHT, productivity index	No	8	0 cointegrating vector
Farm-gate and UHT	1997 M10	2	0 cointegrating vector
Farm-gate , UHT, productivity index	1997 M10	8	1 cointegrating vector 10 %
Farm-gate and UHT	1997 M10; 2000 M12	2	1 cointegrating vector
Farm-gate , UHT, productivity index	1997 M10; 2000 M12	8	1 cointegrating vector
Johansen Trace test - Constant & trend			
Farm-gate and UHT	No	2	0 cointegrating vector
Farm-gate , UHT, productivity index	No	8	0 cointegrating vector
Farm-gate and UHT	1997 M10	2	0 cointegrating vector
Farm-gate , UHT, productivity index	1997 M10	8	1 cointegrating vector
Farm-gate and UHT	1997 M10; 2000 M12	2	1 cointegrating vector
Farm-gate , UHT, productivity index	1997 M10; 2000 M12	8	2 cointegrating vectors
Johansen Trace test - orthogonal trend			
Farm-gate and UHT	No	2	0 cointegrating vector
Farm-gate , UHT, productivity index	No	8	0 cointegrating vector
Farm-gate and UHT	1997 M10	2	0 cointegrating vector
Farm-gate , UHT, productivity index	1997 M10	8	0 cointegrating vector
Farm-gate and UHT	1997 M10; 2000 M12	2	0 cointegrating vector
Farm-gate , UHT, productivity index	1997 M10; 2000 M12	8	1 cointegrating vector
Saikkonen & Lütkepohl test	**Test type**	**Lags**	
Farm-gate and UHT	constant	2	1 cointegrating vector 10 %
Farm-gate , UHT, productivity index	constant	8	1 cointegrating vector
Farm-gate and UHT	constant & trend	2	1 cointegrating vector 10 %
Farm-gate , UHT, productivity index	constant & trend	8	1 cointegrating vector 10 %
Farm-gate and UHT	orthogonal trend	2	1 cointegrating vector 5 %
Farm-gate , UHT, productivity index	orthogonal trend	8	1 cointegrating vector 5 %

*: Breaks are ignored for the 'trend orthogonal' case. For constant and constant-and-trend cases, only breaks in levels are assumed.

4.5.2 Threshold Autoregressive and Moment Threshold Autoregressive Tests[76]

The Johansen trace test is known to function poorly when applied to problems with asymmetric transmission. In order to improve the cointegration test, two alternative tests have been developed: threshold autoregressive (TAR) and moment threshold autoregressive tests (M-TAR) (Enders & Siklos, 2001). In order to perform these

[76] This section closely follows the testing strategy of Li (2008) Chapter 2.

alternative frameworks, we first need to estimate the long-term relationship to obtain the residuals. We include the deterministic components following the results of unit root tests. Following the findings in the previous section, we include the productivity index ($prod_t$), and the trend term (t) on the right-hand side in Equations 4.7a and 4.7b. Furthermore, we add a structural break dummy variable suggested by the findings of Section 4.4 correspondingly (a shift dummy variable from October 1997 onwards for UHT milk and a shift dummy variable for from December 2000 onwards for farm-gate milk real price).

$$uht_t = \alpha_1 + \beta_{u1}t + \beta_{u2}\, farm_t + \beta_{u3}\, prod_t + \beta_{u4} DV9710 + \mu_t \qquad (4.7a)$$

$$farm_t = \alpha_2 + \beta_{f1}t + \beta_{f2} uht_t + \beta_{f3}\, prod_t + \beta_{f4} DV0012 + \theta_t \qquad (4.7b)$$

where $\mu_t = \rho\mu_{t-1} + \varepsilon_t$ and $\theta_t = \eta\theta_{t-1} + \tau_t$ (4.8)

In the threshold autoregressive (TAR) test, the coefficients of the lagged error correction term, μ_t, are allowed to take different values across a threshold (Enders and Siklos (2001)):

$$\begin{aligned} \Delta\mu_t &= I_t\rho_1\mu_{t-1} + (1 - I_t)\rho_2\mu_{t-1} + e_t \\ I_t &= \begin{cases} 1 \;\; if \;\; \mu_{t-1} \ge c \\ 0 \;\; if \;\; \mu_{t-1} < c \end{cases} \end{aligned} \qquad (4.9)$$

If c is equal to zero, μ_{t-1} is simply a negative or a positive deviation from equilibrium. We expect ρ_1 and ρ_2 to be negative so that deviations adjust toward the long-run equilibrium. If the deviation of UHT price from long-run equilibrium is positive (more generally greater than c) in the previous period, then $\rho_1\mu_{t-1}$ will be eliminated in the current period and vice versa. The values of ρ_1 and ρ_2 indicate the relative speed of adjustment. If $\rho_1 > \rho_2$, faster convergence is observed when prices are above the equilibrium[77].

The second alternative framework accommodating asymmetry is the moment threshold autoregressive (M-TAR) test:

$$\Delta\mu_t = I_t \rho_1 \mu_{t-1} + (1 - I_t)\rho_2 \mu_{t-1} + e_t$$
$$I_t = \begin{cases} 1 & if\ \ \Delta\mu_{t-1} \geq c \\ 0 & if\ \ \Delta\mu_{t-1} < c \end{cases} \tag{4.10}$$

In the case of the M-TAR model, economic agents adjust their behaviors according to the trend, or "momentum", of deviations instead of adjusting their behavior according to deviations themselves. In other words, ρ_1 and ρ_2 describe adjustments in response to momentums in different directions. If $\rho_1 \neq \rho_2$, the adjustments are not symmetric and show more "momentum" in one direction than in the other.

Following Enders and Siklos (2001), we perform a grid search to determine the value of the threshold. After sorting all of the estimated μ_t ($\Delta\mu_t$) from Equation 4.7a in ascending order, we consider values between the 15th percentile and 85th percentile as possible threshold values. These values are used to estimate Equation 4.9 (4.10). The value that yields the least residual sum of squares is deemed to be the appropriate threshold value.

In order to ensure cointegration, ρ_1 and ρ_2 should be negative so that the long-term relationship between the variables does not deviate or shrink. The negative coefficients ensure that the short-term deviations are corrected towards long-term

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[77] If $y_t > \hat{y}_t$ than μ_t will be positive. In other words, since $\hat{y}_t$ is the long-run equilibrium, positive μ_t indicates that actual price is above the long-run price.

equilibrium. Enders and Siklos (2001) obtained critical values by recording the *t* statistics for the two null hypotheses $\rho_1 = 0$ and $\rho_2 = 0$ and the *F* statistic for the joint hypothesis $\rho_1 = \rho_2 = 0$. In the *t* tests, the larger of the two *t* statistics is called *t-Max*, and the smaller is called *t-Min*. If series are cointegrated, ρ_1, ρ_2 and the corresponding *t* statistics should be negative (*t-Min* < *t-Max* < 0). The null hypothesis of no cointegration is rejected if *t-Max* is smaller than the critical values. *t-Min* has little power and thus is ignored. In the *F* test, the *F* statistic for the joint hypothesis of $\rho_1 = \rho_2 = 0$ is called Φ to distinguish from the usual *F* distribution. When only one of ρ_1 and ρ_2 is negative, the Φ statistic can be used to reject the null hypothesis of no cointegration. According to Enders and Siklos (2001) the Φ statistic has substantially more power than *t-Max* statistic. Moreover, they report that compared to the Engle-Granger methodology, the TAR test has less power[78] but the M-TAR test has more power.

Table 4.6 shows the test results both for TAR and M-TAR models for Equation 4.7a. For the TAR model, all coefficient estimates have the expected negative signs for both zero and non-zero thresholds. In the case of the TAR model, the threshold is more than zero, indicating that milk processors make adjustments in prices when the actual wholesale prices are above the long-term equilibrium price. Moreover, the absolute value of the coefficient estimate of ρ_1 is larger than that of ρ_2, suggesting faster convergence in response to positive deviations from equilibrium. When the threshold is zero the *t-Max* value for the TAR model is -1.87 (higher than the 10 percent critical value of -1.90) and -

[78] In other words, TAR test rejects the null hypothesis of no cointegration correctly less often than Engle-Granger methodology in Monte Carlo experiments. Enders and Siklos (2001) allude that in the case of the TAR model, the gain from estimating the correctly specified model (asymmetric) is outweighed by the estimation of an additional coefficient – threshold (p. 171).

1.68 for non-zero threshold which is less than 10 percent critical value of -1.61. Hence we fail to reject the no-cointegration hypothesis for the zero threshold model and we find some evidence (only at 10 percent) for cointegration in the case of non-zero threshold. However, when we performed the joint hypothesis with the more powerful Φ test, we reject the null hypothesis of no cointegration at a 5 percent significance level. If we accept the cointegration result of the joint test, then the next step is to test asymmetry. The usual *F-test* is sufficient in this case (see the last two columns of Table 4.6). For the TAR model we fail to reject the symmetry hypothesis in both cases (zero and non-zero thresholds).

For the M-TAR test, coefficient estimates for ρ_1 are negative, but coefficient estimates for ρ_2 are positive (and not statistically significant) both in the zero and non-zero threshold cases. We cannot use *t-Max* because not all coefficient estimates are negative. The sample Φ statistics are 19.49 for zero threshold and 21.89 for non-zero threshold. The Φ statistics are greater than the 1 percent significance value of 8.85, so the null hypothesis of no cointegration can be rejected. Given these strong results for cointegration we test for asymmetry. The *F-test* statistics lead to a strong rejection of the null hypothesis of symmetry. In the case of the M-TAR model the threshold is also more than zero, indicating that milk processors make adjustments in prices when the deviations from long-term equilibrium are above the long-term for 'momentum'. Moreover, the absolute value of the coefficient estimate of ρ_1 is larger than that of ρ_2, suggesting faster convergence in response to positive deviations from equilibrium. Therefore, the farm-to-wholesale price transmission in Turkey is asymmetric, and adjustments are stronger when the previous period deviation is positive. That is, when actual wholesale prices are higher than the equilibrium prices, a more rapid adjustment back toward the equilibrium price occurs. In other words, dairy firms tend to be quicker in lowering prices.

Table 4.6: Results of TAR and M-TAR for inflation indexed UHT milk price

	Threshold	ρ_1^a	t-value	ρ_2^b	t-value	Φ^c	$\rho_1 = \rho_2^d$	p-value
TAR								
c=0		(0.217)	-3.55	(0.133)	-1.87	8.06	0.79	0.38
c ≠ 0	0.131	(0.253)	-3.88	(0.110)	-1.68	8.95	2.4	0.12
M-TAR								
c=0		(0.362)	-6.20	0.044	0.67	19.44	21.49	0.00
c ≠ 0	0.058	(0.445)	-6.62	0.000	0.00	21.89	25.93	0.00

a: Coefficients and t-statistics for the null hypothesis $\rho_1 = 0$.
b: Coefficients and t-statistics for the null hypothesis $\rho_2 = 0$. t-Max critical values:
when c=0: TAR: 1%: -2.55, 5%: -2.11, 10%: -1.90. M-TAR: 1%: -2.57, 5%: -2.14, 10%: -1.91.
when $c \neq 0$: TAR: 1%: -2.35, 5%: -1.85, 10%: -1.61. M-TAR: 1%: -2.37, 5%: -1.90, 10%: -1.65.
c: F statistics for the joint hypothesis $\rho_1 = \rho_2 = 0$.
when c= 0: TAR: 1%: 8.24, 5%: 5.98; 10%: 5.01; M-TAR: 1%: 8.78, 5%: 6.51, 10%: 5.45.
when $c \neq 0$: TAR: 1%: 9.27, 5%: 6.95; 10%: 5.95; M-TAR: 1%: 9.14, 5%: 6.78, 10%: 5.73.
d: F statistics for the joint hypothesis $\rho_1 = \rho_2$ to test for asymmetric price transmission.
The test statistics are taken from Enders and Siklos (2001).

We repeat the TAR and M-TAR cointegration analysis with the inflation-adjusted farm-gate milk prices as the dependent variable. The results, shown in Table 4.7, are significantly different. In the case of TAR, we fail to reject the no co-integration null hypothesis both when the threshold is zero and non-zero. In the case of M-TAR, again we fail to reject the no cointegration hypothesis in the case of zero threshold. In the case of non-zero threshold, we find some evidence for cointegration (but only at a 10 percent significance level). Since both of the coefficient estimates are not negative, we cannot use the *t-Max* statistic. The Φ test score is 5.7, slightly less than the 10 percent critical value of 5.73. If we assume the existence of cointegration, then there is evidence for asymmetry at the 5 percent significance level (see the last row for the last two columns in Table 4.7).

Table 4.7: Results of TAR and M-TAR for inflation indexed farm-gate milk price

	Threshold	ρ_1^a	t-value	ρ_2^b	t-value	Φ^c	$\rho_1 = \rho_2^d$	p-value
TAR								
C=0*		(0.076)	-1.74	(0.091)	-1.92	3.35		
$C \neq 0$**	0.075	(0.063)	-1.34	(0.102)	-2.29	3.51		
M-TAR								
C=0		(0.025)	-0.49	(0.120)	-2.92	4.4		
$C \neq 0$	0.015	0.023	0.39	(0.127)	-3.35	5.7	4.56	0.034

a, b, c, d: Same as Table 4.6.
*: Tests reveal that residuals for the TAR model are not white noise. After augmenting to 6 lags we obtained white noise residuals. At that point the estimated coefficients became negative. We conclude cointegration at the 5 percent level and symmetry.
**: Tests reveal that residuals for the TAR model are not white noise. After augmenting to 6 lags we obtained white noise residuals. At that point the estimated coefficients became negative. We conclude cointegration at the 5 percent level and symmetry.

In the case of the M-TAR model, the threshold is also more than zero, indicating that farmers make adjustments in prices when the deviations from long-term equilibrium are above the long-term 'momentum'. Moreover, the absolute value of the coefficient estimate of ρ_2 is larger than that of ρ_1, suggesting faster convergence in response to negative deviations from equilibrium. Therefore, the wholesale-to-farm price transmission in Turkey is asymmetric, and adjustments are stronger when the previous period deviation is negative. That is, when actual farm-gate prices are lower than the long-term equilibrium prices, a more rapid adjustment back toward the equilibrium price occurs. Nevertheless, evidence is weaker when farm-gate price is the dependent variable.

4.6 Incorporating Error Correction Model to Asymmetric Price Transmission Tests

Enders and Siklos (2001) point out that Engle-Granger and Johansen cointegration tests and all of their variants are misspecified in the presence of asymmetry. Instead they proposed TAR and M-TAR tests. However, the TAR and M-TAR tests entail the estimation of one more coefficient[79] (in the case where threshold is not equal to zero, threshold should be estimated too) which leads to loss of power (especially for the TAR model) vis-à-vis Engle Granger methodology.

Due to the potential loss of power in TAR and M-TAR tests, in this section we estimate the APT model described in section 4.3.2 which is based on the Engle-Granger cointegration test. In the presence of non-stationary variables, Meyer and v. Cramon-Taubadel (2004) suggests the following testing strategy (p. 596):

1) First estimate the long-term relationship and store the residuals (Equation 4.7a).

2) Because the Johansen trace tests indicate that the three random variables are cointegrated when UHT milk real price is the dependent variable, the long-run relationship is not a spurious regression and we can estimate the following error correction model (ECM):

$$\Delta uht_t^{out} = \alpha + \sum_{j=1}^{8}\left(\beta_{1t}\Delta farm_{t-j+1}\right) + \sum_{j=1}^{8}\left(\beta_{2j}\Delta prod_{t-j+1}\right) + \varphi^{+}ECT_{t-1}^{+} + \varphi^{-}ECT_{t-1}^{-} + \gamma_t \quad (4.11)$$

where Δuht_t^{out} is the inflation-adjusted wholesale UHT milk price, $\Delta farm_{t-j+1}$ is the inflation-adjusted farm-gate milk price, $\Delta prod_{t-j+1}$ is the labor productivity index, and ECT_{t-1}^{+} and ECT_{t-1}^{-} are positive and negative error terms from the long term relationship. This specification is slightly different than earlier error correction models in the literature, including the Engle and Granger (1987) representation, and is also different from Equation 4.4 where lagged dependent variables are also included on the right-hand side. In the following analysis, we estimate symmetric and

[79] In the second step of the Engle-Granger test only the coefficient of previous period error is estimated for the cointegration test. In the asymmetric specification the coefficients for both the positive and negative previous period errors should be estimated.

asymmetric ECMs both when lagged dependent variables are absent and when they are included on the right-hand side.

The crucial difference of the APT model with an ordinary ECM is that ECT is split between positive and negative errors in the APT model. To test the asymmetric price transmission an *F-test* can be used to test the null hypothesis of symmetry; i.e., $\varphi^{+} = \varphi^{-}$. In the above version it is possible only to test for the speed of adjustment. This is because by assuming a cointegrating relationship in the long-run (Equation 4.7a), we implicitly assume that the magnitude of the difference between inflation-adjusted UHT milk price and farm-gate milk price is constant when controlling for labor productivity improvements and structural breaks. We have already performed the TAR and M-TAR tests that relax the assumption of symmetric adjustment to the long-run equilibrium so in the APT test we focus on short-run price adjustments.

Table 4.8 presents the long-term relationship where we obtain the error correction terms to include in the error correction models. The ADF tests show that the differenced error correction terms are stationary. Hence OLS is an efficient estimation strategy. In the symmetric case, lagged values of the error correction term are included. In the asymmetric case, we first split the positive and negative ECT and then include them into the asymmetric ECM.

Table 4.8: Long-term relationship for inflation-adjusted UHT milk price

Dependent: uht milk	**L-T relationship**	
time trend	(0.00795)	***
Farm-gate	0.40710	**
Productivity index	0.00005	
str. break DV (1997 M10)	0.46588	***
Constant	5.19804	***
Adj. R-Sq	0.7023	

***: 1%; **: 5%; *: 10%

Table 4.9 shows that the coefficient estimate of contemporary change in farm-gate milk price (Dfarm) is significant in all alternative specifications. We chose the lag length as eight following the results of cointegration tests. Heteroscedasticity is consistently detected in every specification. The t-statistics in Table 4.9 are corrected for heteroscedasticity. We fail to reject the null hypothesis for no autoregressive conditional heteroscedasticity (ARCH) effects and for no serial autocorrelation. Furthermore, the residuals are non-normal. For the first column, 1 Turkish Lira (TL) increase in farm-gate milk price will lead to a 0.619 TL increase in UHT milk price within a month. The coefficients of the productivity index are insignificant in every specification. The error correction terms have the expected negative sign in every specification. However, the error correction term is significant at 10 percent only in the first column. Both in column two and four, the coefficient estimates for ECT^- are larger than ECT^+. In other words when the margin is squeezed, the milk processing firms react quicker. However, the error correction terms in asymmetric specifications are insignificant and are not statistically different from each other. Finally, if the coefficients of ECT and of all of the lagged and differenced farm-gate prices are zero then we conclude that changes in farm-gate prices do not Granger-cause changes in UHT milk price (Enders, 2004: 338). Given the non-zero coefficients for the sixth lag (and the third lag in the Engle-Granger specification), we can claim that farm-gate prices Granger cause UHT prices.

Table 4.9: Error correction models with alternative specifications for UHT

Dependent: uht	Meyer v. Cramon-Taubadel specification				Engle-Granger specification			
	Symmetric		**Asymmetric**		**Symmetric**		**Asymmetric**	
Constant	(0.005)		(0.007)		(0.005)		(0.007)	
Dfarm	0.619	*	0.613	*	0.744	**	0.740	**
Dprod	(0.001)		(0.001)		(0.002)		(0.002)	
ect(-1)	(0.100)	*			(0.064)			
ect_p(-1)			(0.081)				(0.046)	
ect_n(-1)			(0.126)				(0.095)	
Dfarm								
L1.	0.219		0.224		0.207		0.211	
L2.	0.056		0.051		(0.087)		(0.094)	
L3.	(0.306)		(0.303)		(0.434)	*	(0.434)	*
L4.	0.013		0.023		0.060		0.066	
L5.	(0.178)		(0.169)		(0.005)		0.001	
L6.	(0.541)	**	(0.539)	**	(0.401)	*	(0.402)	*
L7.	(0.164)		(0.163)		(0.179)		(0.177)	
L8.	(0.091)		(0.098)		(0.063)		(0.067)	
Dprod								
L1.	0.000		0.000		0.002		0.002	
L2.	0.002		0.002		(0.000)		(0.000)	
L3.	(0.001)		(0.001)		(0.001)		(0.002)	
L4.	(0.003)		(0.003)		(0.001)		(0.001)	
L5.	0.007		0.007		0.005		0.005	
L6.	(0.001)		(0.002)		(0.002)		(0.002)	
L7.	(0.000)		(0.000)		0.001		0.001	
L8.	0.001		0.001		(0.001)		(0.001)	
Duht								
L1.					(0.044)		(0.045)	
L2.					0.028		0.032	
L3.					0.086		0.091	
L4.					(0.035)		(0.030)	
L5.					0.009		0.013	
L6.					(0.295)	***	(0.292)	***
L7.					0.028		0.030	
L8.					0.037		0.038	
Adj. R-Sq	0.1307		0.1245		0.1675		0.1613	
B-P hett:	23.03	***	23.92	***	19.42	***	20.00	***
B-G LM	$0.085 \sim \chi(1)$		$0.135 \sim \chi(1)$		$2.073 \sim \chi(1)$		$2.89 \sim \chi(1)$	*
ARCH(LM)	$0.281 \sim \chi(1)$		$0.395 \sim \chi(1)$		$0.003 \sim \chi(1)$		$0.00 \sim \chi(1)$	
D-W d-stat	2.0198		2.03		1.999		2.002	
Durbin's alternative	$0.073 \sim \chi(1)$		$0.115 \sim \chi(1)$		$1.688 \sim \chi(1)$		$2.347 \sim \chi(1)$	
Normality of residuals	15.48	***	14.72	***	13.33	***	12.57	***
***: 1%; **: 5%; *: 10%			FTR symmetry				FTR symmetry	

To sum up, when we consider only the short run (i.e. speed of adjustment), we fail to detect any statistically significant asymmetry in price transmission. Combining the findings of this section and the previous section where dairy firms were quick to lower their prices, we can conclude that in the process of price transmission from farm-gate to wholesale there is not an immediate concern for policy makers. TAR and M-TAR tests indicate that, if anything, the dairy firms are quicker to pass on the price concessions they extracted from farmers to retailers. And this section indicates that speed of adjustment is symmetric.

4.7 Concluding Remarks

Time series variables are beset by non-stationarity. In Section 4.4, we test for the presence of a unit root in inflation-adjusted farm-gate milk prices, UHT milk prices, and the labor productivity index. In Section 4.5 we test whether these three variables are cointegrated. We find evidence for a structural break during October 1997 for the UHT milk price and labor productivity index and another one during December 2000 for farm-gate milk price. Even after accounting for these structural breaks, we find evidence for a unit root in most specifications and conclude that these variables are non-stationary. Next, we test for cointegration employing the Johansen trace tests and initially conclude that inflation-adjusted farm-gate and UHT milk prices are not cointegrated; i.e., the detected relationship between the two is spurious. In the next step, we add the labor productivity index to inflation-adjusted milk prices and, using the Johansen trace test, conclude that these three variables are indeed cointegrated. However, we suspect an asymmetric price transmission and the Johansen trace test is known to perform poorly in the presence of asymmetry. Hence, we apply TAR and M-TAR procedures to test for cointegration in the case of asymmetry. When the dependent variable is the inflation-adjusted UHT milk price, we find strong evidence for cointegration both with TAR and M-TAR tests.

A cointegrated model assumes a stable long-run relationship by definition. In the case of cointegrated APT, a stable long-run relationship means that we can only test for the speed of APT and not the magnitude of APT. When the dependent variable is the UHT milk price, we detect asymmetric price transmission in the M-TAR (the more powerful test), but not in the TAR. Interestingly, the asymmetry suggested by M-TAR is the opposite of what the literature would have predicted. The estimated threshold is greater than zero, suggesting that UHT milk producers adjust their prices quicker when the difference is above the long-run equilibrium (i.e., when the gross profit margin is stretched). In the M-TAR procedure we test whether agents adjust their behavior according to the trend of deviations instead of adjusting their behavior according to deviations. We find that the absolute value of the ρ_1 (coefficient of deviations that are above the threshold) is larger than ρ_2, meaning that speed of adjustment is faster when the deviations are above the long-run relationship. Despite the fact that we find evidence for asymmetry for a cointegrated relationship among the three variables in Section 4.5.2, we still construct the ECM for APT in Section 4.6 because of loss of power of TAR and M-TAR due to estimating one more coefficient. In the ECM, we again find some evidence for asymmetry but this evidence is not statistically significant.

As explained in Section 4.3, the APT model does not prove the exercise of monopoly power; it just detects the existence (or absence) of asymmetry. Three possible explanations for asymmetry are proposed: oligopolies exerting their muscle to capture some of consumer surplus; the menu-costs argument; and McCorriston et al.'s (2001) argument that oligopolies can enjoy both super-profits and can provide lower prices for downstream consumers because they enjoy increasing returns to scale. In Section 4.8, we have some evidence (yet statistically insignificant) that UHT milk processors react quicker if the gross margin is squeezed. However, the evidence (statistically significant) from Section 4.7 points to the opposite direction. The TAR test points symmetry, And the M-TAR test signals asymmetry but a quicker reaction from UHT milk processors when the gross margin is extended. All in all, the weight of evidence discredits the first two explanations: we do not detect positive APT which would point to oligopolies abusing their market power. On the other hand, we find some evidence (in the M-TAR test) that oligopolies are passing cost reductions to retailers quicker than the cost increases. The combined evidence from the M-TAR test for the UHT milk price and the auxiliary evidence of short- and long-run economies of scale[80] support the McCorriston et al. framework. We conclude, therefore, that for UHT milk in Turkey, there is both evidence of increasing returns to scale and evidence that price reductions are passed to retailers quicker than price increases.

[80] Table 3.2 shows that between 1994 and 2003 the share of packed fluid milk in total consumption has increased from 7 to 18 percent implying that UHT milk processors are gaining market share from open milk. Table 3.3 shows that there is ample capacity to increase the production of UHT and pasteurized milk in the short run.

CHAPTER 5

CONCLUSION

In Chapter 2 we studied food consumption in conjunction with food self-provisioning. We used the budget share of self-provisioning as a proxy to account for the productive capacity of these rural households and show that self-provisioning rural households consume a statistically significantly different food basket than other rural households and urban households. The difference is most pronounced for the dairy and egg, vegetables, and cereals food groups. We explain this difference by the different prices faced by self-provisioning rural households. Unlike other rural and urban households, the self-provisioning rural households are not pure price takers. They base their decision on how much to consume on the shadow prices resulting from being a site of both consumption and production.

When retail and shadow prices differ substantially, rural households that have access to productive factors choose to supply certain food items for themselves. The retail and shadow prices can differ substantially because of incomplete labor and credit markets or excessive margins in marketing chains. A potential consequence of incomplete markets is that participants will be less responsive to signals transmitted through markets. When we explicitly include productive factors into consumption function some of the consequences of incomplete markets are captured as lower elasticities. We compare the food expenditure and own-price elasticities obtained first from the AIDS model implicitly assuming that everybody is a price taker, and second from a model that explicitly incorporates some of the productive factors to estimate elasticities. We show that the standard AIDS model ignoring food self-provisioning overestimates both the food expenditure and own-price elasticities, especially for dairy and egg food group. From a policy perspective, the overestimation of elasticities means that reforms that are expected to work through the markets will be less effective than predicted. For example, a reduction in the price of dairy products that can result from integrating Turkish and EU dairy markets under a customs union may increase the consumption of urban and other rural households who rely on retail markets. However, the consequence of a retail price decline for dairy products is not clear for self-provisioning rural households. If the self-provisioning rural households are not only self-sufficient in dairy products but also net sellers, the decline in price level will also result in lower income and hence will affect total consumption through the income effect. Moreover, if the chief reason for self-provisioning is lack of cash income, then a reduction in retail price may not increase the level of consumption in such households.

In Chapter 3, we build on the findings of Chapter 2 and recalculate the poverty lines for rural Turkey. In order to calculate food consumption, SIS researchers impute the regional wholesale price to self-provisioned food items. But the shadow price that determines the amount of self-provisioned food is theoretically higher than wholesale price. Households preferring to consume these food items in-kind rather than sell them at wholesale price leads to a significantly different food basket. This is evidence that they value these items higher than wholesale price. Also, at the margin cash income should be preferred to in-kind income because of money preference. This being said, accounting for in-kind income is difficult. Imputing retail prices is theoretically wrong too, because the shadow price is lower than the retail price. Moreover, self-provisioning is not uniformly distributed among regions and products but rather concentrated in certain products and more common in some regions. Practically speaking this means that there aren't many observations for retail prices where the self-provisioning is most prevalent. On the other hand, calculating shadow prices with regression techniques would require not only detailed data on consumption (which we have in SIS 2003) but also on productive factors and allocation of these factors between various activities in a mixed farm setting (which we do not have).

Once the self-provisioned food is priced at wholesale prices it raises the possibility that the true expenditure level of these households is undervalued. The undervaluation of expenditures can lead to overstatement of poverty measures and can be consequential to the identification of poor. Furthermore, due to the methodology of poverty line construction, the poverty among other rural households can be underestimated: if we do not differentiate between self-provisioning and other rural households, the representative food basket will be priced by the weighted average of retail and self-provisioned (i.e., wholesale) prices. In other words, other rural households will be assumed to have access to some food items at wholesale prices when they actually do not. Since the poverty line is undervalued for these households, the corresponding poverty measures are underestimated.

With these concerns in mind, we first lump all rural households together, calculate the poverty line as is conventionally done, and calculate the corresponding poverty measures separately for self-provisioning and other rural households. We find that the level, depth and intensity of poverty are statistically significantly higher for self-provisioning rural households compared to other rural households. Then, in order to determine the level of under and overestimation of poverty measures, we calculate separate poverty lines for self-provisioning and other rural households. When pricing the food basket for other rural households we consider only the prices paid by these households which are exclusively retail prices. Likewise, when pricing the food basket for self-provisioning rural households we consider the prices paid by those households which in effect are a weighted average of imputed wholesale prices and retail prices. In the end when we recalculate the poverty measures for rural households we find that initial poverty measures were indeed overestimated for self-provisioning rural households and underestimated for other rural households.

We first perform this study with the basic needs poverty line approach where the reference group which we use to determine the items in the food basket is second quintile households. SIS has been using this methodology since 2002. Before 2002, SIS has been calculating the poverty line starting from a pre-conceived food basket (also called the non-welfare approach). The previous methodology is criticized because the food basket is roughly equivalent to 3000 calories per day per capita and uncharacteristically rich in animal proteins for Turkey. Nevertheless, we repeat the same exercise using the preconceived food basket and reach similar results: poverty measures are overestimated for self-provisioning rural households and underestimated for other rural households when the self-provisioning issue ignored. Actually, the over- and underestimation is even more stark in the non-welfare approach, because the preconceived food basket is rich in animal calories where self-provisioning rural households have a distinct advantage, and because the non-welfare approach ignores the non-food basic needs.

In the second part of Chapter 3, we study vulnerability to income poverty and undernutrition. The study of vulnerability to poverty has garnered increased attention in recent years because first many households who currently are non-poor live with the constant fear and insecurity that any misfortune (be it an individual tragedy such as illness or death to household members or a macro shock affecting all region or the country) can tip them below the poverty line, and this insecurity is detrimental to one's well being. Moreover, it is increasingly recognized that because of vulnerability many households change their behavior in order to reduce their exposure to risky events. In some instances the low-risk, low-return activities can reduce overall income and leave the household poorer. In other words, insurance has a cost. We use the basic needs poverty lines (calculated separately for self-provisioning and other rural households) as a benchmark for vulnerability to income poverty, and the non-welfare poverty lines as a benchmark for vulnerability to undernutrition. We show that 20 to 25 percent of both the self-provisioning and other rural households are highly vulnerable to income poverty, but when we consider the vulnerability to undernutrition the situation is different: overall 29 percent of self-provisioning rural households are highly vulnerable to undernutrition versus 56 percent of other rural households. The share of urban households who are highly vulnerable to undernutrition also is higher than self-provisioning rural households (49 percent).

These empirical findings from Turkey support the predictions of the literature on vulnerability. Rural households who have access to required productive factors can choose to self-provision in order to reduce their exposure to market price risk. These findings are also in line with our initial claim that rural areas in Turkey are still beset by incomplete markets. The volatility in the prices of agricultural goods, the high markups between wholesale and retail prices, and limited access to credit all force the majority of rural households to consider alternative strategies to ensure a steady supply of food even if it means eschewing specialization and integration into markets which result in lower overall income in the long-run.

In Chapter 4, we turn our attention to the fluid milk marketing chain. This topic is hotly debated not only in academia but also in Turkey's popular press and dairy industry circles. The raw milk price in Turkey is lower than the EU average, while some dairy product prices are significantly higher than EU levels (Grethe, 2005). On the one hand, the dairy farmers and the consumers at each end of the marketing chain suspect that the dairy processors and retailers are cornering the market by forming cartels and acting as oligopsonies especially while procuring milk. On the other hand, milk processing firms complain that milk output in Turkey is low quality and because of the dispersion of farmers their collection costs account for 15 – 20 percent of the total cost (as opposed to 3 - 6 percent in EU; FAO, 2007: 57). Moreover, they complain that they cannot find a sufficient quantity of suitable milk. In order to sort out these competing claims, we focus on the interaction between farm-gate milk and wholesale UHT fluid milk prices. Visual inspection of inflation adjusted farm-gate and wholesale UHT milk prices reveals that farm-gate prices are fluctuating around a mean whereas UHT milk prices show a persistent long-term decline starting late in 1997. Formal cointegration analysis confirms the visual inspection and we conclude that these two variables are not cointegrated, contrary to what we might expect based on the literature on developed countries' dairy sectors.

We observe that there were major entries to Turkey's diary processing sector during the study period, and we have auxiliary evidence that formal sector enterprises are gradually gaining market share from an informal sector (The growing size of the formal market distinguishes the Turkish dairy sector from its U.S. and European counterparts). We suspect that the growing market size for the formal sector and new investments can herald increasing returns to scale in the dairy processing, and that this can explain the long-run decline in UHT milk prices. We use the sector's labor productivity index as a proxy measure to account for increasing returns to scale. We find that the start of the long-run decline in inflation-adjusted UHT wholesale prices coincides with the start of a long-run increase in labor productivity. Furthermore, when we conduct formal cointegration tests, we show that the inflation adjusted farm-gate price, wholesale fluid milk price, and labor productivity index are cointegrated in the long-run.

Next we investigate whether dairy processing firms exercise their oligopoly powers to manipulate milk prices to their benefit. Dairy processors can intervene to manipulate the speed or the magnitude of price adjustments (or both) to benefit themselves. Manipulating speed of adjustment happens when dairy processing firms delay passing reductions in farm-gate milk prices to their customers, while more immediately reflecting increases in farm-gate milk prices. Similarly, processing firms can pass only a portion of the decline in farm-gate prices to their customers while reflecting the full cost of price increases. A combination of both strategies is also possible. We employ TAR and M-TAR models to study whether manipulation by dairy processors in the form of asymmetric price transmission is taking place as suspected by farmers and consumer groups. We find evidence of asymmetry, but its direction is contrary to our initial expectations. The dairy processing firms are quicker to pass price reductions in farm-gate prices to their customers than price increases. We repeat the analysis with the APT model, and find no evidence of asymmetry in price transmission from farm-gate to wholesale milk prices. The weight of the empirical evidence thus does not support the initial claim by farmer and consumer groups. Even if the level of dairy product prices in Turkey is higher than the EU levels, the long-term trend in the price of these products processed by major firms is toward narrowing margins. We conclude that the increasing returns to scale and the associated productivity gains enjoyed by these firms allow them to increase their market share collectively against the informal sector and still possibly enjoy hefty profit margins.

Finally, an interesting aspect of Chapter 4 is to shed light on the limits of market forces in carrying the agricultural transformation forward. Despite a dynamic processing sector, the supply response from the dairy farmers has been disappointing both for policymakers and for processing firms themselves. The biggest complaint of these firms is that it is hard to find good quality milk at desirable quantities and prices. As noted before, two-thirds of the raw milk is either processed by households or by informal enterprises. Moreover, the dairy farmers who are the suppliers of big dairy firms are not increasing their output rapidly enough to meet the demands of the formal sector. The larger dairy farmers in Turkey are generally members of marketing cooperatives, and the prices concerning them are set in quarterly local auctions. There is no national-level price making authority for raw-milk in Turkey, so each local cooperative faces regional cartel-like buyers in auctions (Güngör, 2006). The level and volatility of milk prices[81] formed at these auctions apparently does not instill enough confidence in dairy farmers to invest in expensive machinery and to enlarge their herds in order to meet the demand of dairy processors. Hence even if we do not unearth any immediate concern for public policy while investigating interaction of farm-gate and wholesale prices for fluid milk, there might be hidden costs for social welfare in the form of what might be termed as "missing milk".

On the one hand, Chapters 2 and 3 show that "modernization" strategies are misguided in seeking to shift Turkey's dairy sector towards less self-provisioning and more production for the market because self-provisioning plays an important role reducing vulnerability to undernutrition. On the other hand, Chapter 4 suggests that formal dairy processing sector is efficient but its growth is hindered by lack of supply. We believe that the most appropriate policies should try to sustain the advantages of small farms (e.g. self-provisioning) while at the same time allowing for the growth of the formal dairy industry. When profit-maximizing dairy firms try to obtain lowest farm-gate prices in the short-run, this risks undermining the long-run supply of milk. This suggests that, at the minimum, there is room for public policy to ensure that farm-gate prices will be less volatile and high enough to stimulate increased marketed output of adequate quality milk. Previously, prior to its privatization, SEK played this role with its procurement prices. Similarly, in many developed countries, the farm-gate prices are set by dairy boards which try to balance the interests of all parties. The dairy board in Turkey can generate a positive externality by reducing the uncertainty for dairy farmers and

[81] We show that farm-gate milk prices follow a random walk without much discernable trend.

stimulating investment in dairy farms. At the same time, extension services targeted to the small-scale producers (e.g. by improving physical infrastructure and skills of small-scale farmers) can further increase the marketed output without hampering the self-provisioning that makes an important contribution to the nutritional well-being of Turkey's rural population.

APPENDICES

APPENDIX 1

CHAPTER 2 APPENDIX

Table A1.1: Summary Statistics for variables used in LA/AIDS model

Variable	Mean	Stan. dev.	associated parameter
Bread price (TL/kg)	1.32	0.47	γ_{ij}
Cereal price (TL/kg)	1.55	1.24	
Meat price (TL/kg)	6.25	4.46	
Vegetable oil price (TL/kg)	2.66	0.73	
Vegetable price (TL/kg)	1.15	0.41	
Fruit price (TL/kg)	1.38	0.87	
Dairy and egg price (TL/kg)	1.73	0.99	
Sugar, jam and confectionery price (TL/kg)	3.39	2.41	
Tea and coffee price (TL/kg)	7.16	4.32	
Non-alcoholic beverage price (TL/kg)	1.44	0.55	
Other food price (TL/kg)	2.40	2.77	
Food expenditure of household (TL/month)	211.63	126.63	β_i
Total monthly spending (TL/month)[a]	741.31	665.70	
Number of members in the household	4.18	2.04	λ_{i1}
1 if there is children <14 years of age	0.59	0.49	λ_{i2}
1 if the head of the household is male and otherwise	0.90	0.29	λ_{i3}
1 if the head of the household is married and otherwise	0.89	0.31	λ_{i4}
1 if the head of hh is illiterate, literate without diploma or finished elementary school and 0 otherwise [b]	0.63	0.48	
1 if the head of hh finished secondary or high school and 0 otherwise	0.27	0.45	λ_{i52}
1 if the head of hh has university degree and 0 otherwise	0.09	0.29	λ_{i53}
1 if the head of household is <29 years old and 0 otherwise [b]	0.08	0.28	
1 if the age of the head of household is between 30 and 39 and 0 otherwise	0.26	0.44	λ_{i62}
1 if the age of the head of household is between 40 and 49 and 0 otherwise	0.27	0.44	λ_{i63}
1 if the age of the head of household is <50 and 0 otherwise	0.39	0.49	λ_{i64}
1 if the housewife has employed in full-time job and 0 otherwise	0.20	0.40	λ_{i7}
1 if the household is located in an urban area and 0 otherwise	0.71	0.45	λ_{i8}
1 for the lowest income group and 0 otherwise [b]	0.20	0.40	
1 for the lowest-to-middle income group and 0 otherwise	0.20	0.40	λ_{i92}
1 for the middle income group and 0 otherwise	0.20	0.40	λ_{i93}
1 for the middle-to-highest income group and 0 otherwise	0.20	0.40	λ_{i94}
1 for highest income group and 0 otherwise	0.20	0.40	λ_{i95}
1 if survey done in the first quarter of the year and 0 otherwise [b]	0.25	0.43	
1 if survey done in the second quarter of the year and 0 otherwise	0.25	0.43	λ_{i102}
1 if survey done in the third quarter of the year and 0 otherwise	0.25	0.43	λ_{i103}
1 if survey done in the fourth quarter of the year and 0 otherwise	0.25	0.43	λ_{i104}

continued

Table A1.1, continued

Variable	Mean	Stan. dev.	associated parameter
1 if household lives in Marmara region and 0 otherwise	0.14	0.35	λ_{i112}
1 if household lives in Aegean or West Anatolia region and 0 otherwise	0.25	0.44	λ_{i113}
1 if household lives in the Mediterranean region and 0 otherwise	0.13	0.34	λ_{i114}
1 if household lives in Central Anatolia region and 0 otherwise	0.07	0.25	λ_{i115}
1 if household lives in the Black Sea region and 0 otherwise	0.14	0.35	λ_{i116}
1 if household lives in northeastern or central eastern Anatolia and 0 otherwise	0.06	0.25	λ_{i117}
1 if household lives in southeastern Anatolia region and 0 otherwise [b]	0.09	0.28	
PDF for each food group			δ_i
Share of self-provisioning (calculated in terms of monetary value)	0.05	0.15	ρ_i

a: Only included in the first step probit model; b: The dummy variable omitted in the estimation.

Table A1.2: Summary Statistics for the Production Variables

	all sample			Urban			rural		
	# of obs.	Mean	St. Dev	# of obs.	Mean	St. Dev	# of obs.	Mean	St. Dev
F. farm labor (hour/week)	4,044	59	49	441	46	34	3,603	60	50
M. farm labor (hour/week)	4,285	63	47	474	49	36	3,811	64	48
Field (TL)	5,757	31,231	75,407	1,207	32,395	84,042	4,550	30,922	72,952
Health insurance	25,747	46.5%	50%	18,267	52.3%	50%	7,480	32.2%	47%
Average grazing	25,747	61	52	18,267	61	52	7,480	61	54
Poor share	25,747	9.77%	1%	18,267	9.69%	1%	7,480	9.95%	1%

Table A1.3 present the results for likelihood ratio tests. The null hypothesis is whether the alternative models - one with and other without the self-provisioning variables – are statistically significantly different from each other. The first two rows are the test the significance of imposing demand theory restrictions (Equation 2.9). We conclude that these restrictions are statistically significant. The rest of the table presents test results for the nonseparation assumption. All the specifications have the same result: likelihood ratio test statistics reject the separation assumption. Inclusion of self-provisioning variables statistically significantly changes the demand system for SIS 2003 sample.

Table A1.3: Likelihood Ratio Tests for Separability Test

Likelihood Ratio Test	Sample	D.F.	LOGL	Chi2	Critical value (0.05)	Prob >Chi2
Demand system without constraints	all		501,802			
Demand system with constraints & w/o self-provisioning	all	94	489,453	24,698.0	117.63	0.00
Self-provisioning budget share included	all	11	491,585	4,265.5	19.68	0.00
Demand system without self-provisioning	urban		361,814	-		
Self-provisioning budget share included	urban	11	362,037	446.7	19.68	0.00
Demand system without self-provisioning	rural		137,567	-		
Self-provisioning budget share included	rural	11	138,405	1,675.9	19.68	0.00
Demand system with constraints & w/o self-provisioning	all		489,453	-		
Self-provisioning alternative#	all	11	490,888	2,870.4	19.68	0.00
Self-provisioning predicted variable*	all	11	490,790	2,674.4	19.68	0.00

*: We used food budget share of corresponding food groups instead of overall average, please see Table 3 for food groups with non-zero self-provisioning. #: We constructed an alternative budget share of self-provision variable by combining rows 2, 3 and 4 from Table 1. ^: The R-Square of the first stage is 0.48. The result of the first stage is available upon request.

In the model including the self-provisioning budget share, 385 coefficients are estimated. Of these 275 of those relate to demographic variables (Please refer to Table A4). Also, 193 of the demographic coefficients are significant (70 percent) at the 5 percent significance level or less. All of the coefficients for the urban dummy are statistically significant except for fruit budget share. Likewise, all of the coefficients for 5th quintile dummy are significant except for the sugar budget share. Moreover, when we consider the income quintile dummies for food groups, almost all of them have the same sign (even when statistically insignificant). For example, all of the coefficients for quintile dummies are negative for bread (1st quintile is omitted) and positive for meat products. A similar situation is mostly true for education and age dummies: when they are significant, they generally have the same signs. For example, as the educational attainment of household head increases the budget share of meat products, fruits, non-alcoholic beverages and other food products also increases. All regional dummies for cereal and tea and coffee food groups are significant and negative relative to the omitted region (which is the southeast, the poorest region).

Quality:

Drichoutis, et al., (2008) point out that like many other household surveys, the SIS 2003 actually does not include price information and Akbay et al., (2007) calculate the price by dividing expenditures by quantity purchased. However, such a calculated unit price may reflect not only differences in prices but also the differences in quality of the commodity. If the quality effects depend on household characteristics (for example, wealthier households may prefer higher quality products) then some of the regressors may covary. They suggest an instrumental variables approach to adjust for quality differences. In their response to the commentary, Akbay et al., (2008) pose the question: "What is the good corresponding to that price after quality adjustment?" (p. 101). They also point out that existing instrumental variable approaches (using household income and demographics as instruments) are *ad hoc*, and may cause identification problems in the second stage. They end up using calculated unit prices.

As the discussion in the introduction suggests, there is more to price differences than quality, i.e., self-provisioning. Whatever the initial reason, incomplete markets reflect themselves as a significant discrepancy between the cost of self-provisioning for the household and the alternative retail price. The next section discusses self-provisioning for the SIS 2003 survey in detail, and it will be clear to the reader that using this data set for quality adjustment without properly accounting for self-provisioning[82] will lead to the erroneous conclusion that urban consumers consume higher quality produce since they pay higher prices. Hence, we do not adjust for the quality and calculated prices as they did.

[82] Naturally, only quantity information is available for self-provisioned home produce. In order to convert quantity to monetary spending, the prices are imputed by SIS. It turns out that the imputed prices are roughly 70 percent of corresponding rural retail prices.

Table A1.4: Estimated demand parameters of LA/AIDS model including self-provisioning variable

Variables	Bread	Cereal	Meat	Veg. Oils	Vegetables	Fruit	Dairy& Egg	Sugar	Tea& Coff.	Beverage	Other food
Constant	0.3004***	0.1226***	-0.3586***	0.0186***	0.2722***	0.1612***	0.2553***	0.0530***	0.1184***	0.0276***	0.0294***
Bread price	0.0143***										
Cereal price	0.0065***	0.0183***									
Meat price	-0.0093***	-0.0055***	0.0520***								
Vegetable oil price	0.0054***	-0.0026***	-0.0060***	0.0053***							
Vegetable price	-0.0025**	-0.0049***	-0.0099***	0.0089***	0.0344***						
Fruit price	-0.0054***	-0.001	-0.0058***	-0.0002	-0.0116***	0.0173***					
Dairy & egg price	-0.0032***	-0.0061***	-0.0081***	-0.0028***	-0.0064***	-0.0024***	0.0345***				
Sugar price	-0.0052***	-0.0040***	-0.0034***	-0.0061***	-0.0071***	0.0050***	-0.0050***	0.0249***			
Tea & coffee price	0.0016***	-0.0008*	-0.0012**	-0.0005	0.0027***	-0.0006	-0.0005	-0.0055***	0.0039***		
beverage price	-0.0026***	0.0015***	-0.0003	-0.0004	-0.0029***	0.0032***	0.0001	0.0053***	0.0007**	-0.0035***	
Other food	0.0003	-0.0014***	-0.0026***	-0.0009***	-0.0006*	0.0016***	-0.0001	0.0011***	0.0003	-0.0011***	0.0035***
Food expenditure	-0.0542***	0.0085***	0.1145***	0.0114***	-0.0211***	-0.0172***	-0.0286***	0.0067***	-0.0093***	-0.0090***	-0.0017***
Hh size	0.0075***	0.0048***	-0.0124***	0.0004	0.0019***	-0.0026***	-0.0008***	0.0030***	0	-0.0016***	-0.0003**
Child dummy	0.0089***	-0.0046***	-0.0042**	-0.0025**	-0.0080***	-0.0021**	0.0131***	0.0018	-0.0023***	0	0
Male head	0.0197***	-0.0069**	0.0005	-0.0046**	-0.0036	0.0028	-0.0060***	-0.0073***	0.0032**	0.0029**	-0.0006
Married	0.0057*	0	-0.0094***	0.0034	0.0046**	0.0026	0.0009	0.0039*	-0.0063***	-0.0052***	-0.0002
Education 2	-0.0096***	-0.0081***	0.0100***	-0.0062***	0.0001	0.0086***	0.0060***	-0.0077***	-0.0005	0.0058***	0.0015***
Education 3	-0.0339***	-0.0013	0.0158***	-0.0131***	-0.0038**	0.0234***	0.0145***	-0.0075***	-0.0016	0.0063***	0.0012**
Age 2	0.0036	-0.0068***	0.0043	0.0038**	-0.0024	0.0047***	-0.0009	0.0014	-0.0005	-0.0044***	-0.0028***
Age 3	0.0128***	-0.0063***	-0.0005	0.0050***	0.0040**	0.0067***	-0.0070***	-0.0037**	-0.0006	-0.0076***	-0.0027***
Age 4	-0.0031	-0.0064***	0.0019	0.0084***	0.0047***	0.0095***	0.0047**	-0.0036**	-0.0019*	-0.0110***	-0.0032***
Wife employed	-0.0125***	0.0104***	-0.0032	0.0011	-0.0007	-0.0051***	0.0008	0.0087***	0.0005	0.0002	-0.0003
Urban	0.0386***	-0.0305***	0.0103***	-0.0074***	-0.0102***	-0.0019*	0.0180***	-0.0165***	-0.0053***	0.0061***	-0.0013***
Quintile 2	-0.0029	-0.0085***	0.0007	0.0032**	-0.0183***	0.0041***	0.0035**	0.0021	-0.0057***	0.0182***	0.0037***
Quintile 3	-0.0084***	-0.0189***	0.0027	0.001	-0.0178***	0.0130***	0.0085***	0.0031*	-0.0092***	0.0230***	0.0030***
Quintile 4	-0.0167***	-0.0228***	0.0138***	-0.002	-0.0177***	0.0164***	0.0121***	-0.0023	-0.0109***	0.0276***	0.0025**
Quintile 5	-0.0362***	-0.0203***	0.0232***	-0.0054***	-0.0275***	0.0247***	0.0123***	-0.0037*	-0.0085***	0.0379***	0.0037***
Quarter 2	0.0044***	-0.0018	-0.0716***	0.0005	0.0488***	-0.0001	0.0070***	-0.0047***	0.001	0.0157***	0.0007

continued

Table A1.4, continued

Variables	Bread	Cereal	Meat	Veg. Oils	Vegetables	Fruit	Dairy& Egg	Sugar	Tea& Coff.	Beverage	Other food
Quarter 3	0.0030*	-0.0015	-0.0697***	0.0009	0.0646***	-0.0120***	0.0047***	-0.0063***	0.0012*	0.0139***	0.0012**
Quarter 4	0.0007	0.0038**	-0.0417***	-0.0037***	0.0369***	-0.0008	-0.0047***	0.0014	-0.0006	0.0064***	0.0022***
Istanbul	0.0593***	-0.0312***	-0.0237***	-0.0091***	-0.0005	0.0013	0.0123***	-0.0150***	-0.0133***	0.0202***	-0.0004
Marmara	0.0739***	-0.0352***	-0.0117***	-0.0115***	-0.0053***	0.0042**	-0.0025	-0.0078***	-0.0179***	0.0138***	-0.0001
Aegean & West	0.0600***	-0.0325***	-0.0156***	-0.0091***	-0.0029	0.0096***	-0.0043**	-0.0075***	-0.0095***	0.0111***	0.0007
Mediterranean	0.0618***	-0.0349***	-0.0195***	-0.0061***	0.002	0.0021	-0.0061***	-0.0028	-0.0079***	0.0105***	0.0011
Central Anatolia	0.0625***	-0.0450***	-0.0097**	-0.0007	-0.0136***	0.0114***	0.0042*	-0.0028	-0.0142***	0.0046***	0.0034***
Black Sea	0.0708***	-0.0260***	-0.0164***	0.002	-0.0022	0.0024	-0.0082***	-0.0084***	-0.0140***	0.0002	-0.0005
NE & Central East	0.0630***	-0.0094***	0.0124***	-0.0106***	-0.0123***	-0.0022	-0.0021	-0.0096***	-0.0163***	-0.0081***	-0.0049***
PDF	0.0315***	0.0200***	0.1065***	0.0839***	-0.6965***	0.009	0.3141***	0.1208***	-0.0195***	0.0304***	-0.0001
Self-provisioning	-0.2302***	0.1203***	-0.0732***	-0.0595***	-0.0257***	0.0057	0.2766***	-0.0457***	-0.0069***	-0.0090***	-0.0032*
Observations	25,747	25,747	25,747	25,747	25,747	25,747	25,747	25,747	25,747	25,747	25,747

significant at 10%; ** significant at 5%; *** significant at 1%

Table A1.5: Food Expenditure and uncompensated price elasticities for the demand system estimated including the self provisioning variable

Uncompensated own and cross price elasticities

Food Groups	Bread	Cereals	Meat	Veg. oils	Vegetables	Fruits	Dairy & egg	Sugar	Tea & Coffee	Beverages	Other food	Expenditure Elasticities
Bread	-0.86	0.05	-0.18	0.05	0.00	-0.03	0.01	-0.08	0.08	-0.03	0.03	0.67
Cereals	0.07	-0.82	-0.10	-0.05	-0.02	0.01	-0.02	-0.06	0.00	0.06	-0.07	1.09
Meat & meat products	-0.01	-0.07	-0.76	-0.11	-0.04	-0.04	-0.03	-0.05	0.00	0.03	-0.13	1.75
Vegetable oils	0.05	-0.03	-0.08	-0.93	0.06	0.01	-0.01	-0.08	0.00	0.00	-0.04	1.17
Vegetables	0.04	-0.07	-0.19	0.10	-0.78	-0.09	-0.01	-0.10	0.11	-0.04	-0.02	0.88
Fruits	0.00	-0.02	-0.11	-0.02	-0.06	-0.80	0.00	0.05	0.01	0.11	0.10	0.81
Dairy products and egg	0.03	-0.08	-0.17	-0.07	-0.02	0.00	-0.74	-0.07	0.02	0.04	0.01	0.81
Sugar, etc…	-0.01	-0.05	-0.08	-0.10	-0.03	0.07	-0.02	-0.71	-0.12	0.16	0.07	1.08
Tea and Coffee	0.02	-0.01	-0.03	-0.01	0.02	0.00	0.00	-0.07	-0.90	0.03	0.02	0.77
Non-alcoholic beverages	-0.01	0.01	-0.02	-0.01	-0.01	0.04	0.01	0.06	0.02	-1.09	-0.06	0.76
Other food products	0.01	-0.02	-0.03	-0.02	0.00	0.02	0.00	0.01	0.01	-0.03	-0.80	0.90

APPENDIX 2

CHAPTER 3 APPENDIX

Table A2.1: Monthly cost of the Hacettepe Basket for four-person family

Food Groups	Monthly Quantities (kg)	Urban, TL	Rural, TL	Self-provisioning rural, TL	rural other, TL
Meat, eggs, beans					
Meat, poultry, fish, edible offal	6	31.9	31.5	30.7	31.9
Dried bean, lentil, chickpeas	5	5.4	5.4	5.2	5.6
Eggs	80 units	10.4	10.5	10.5	10.5
Dairy products					
Milk, yogurt	28	23.6	17.5	16.1	20.9
Cheese	3	12.3	11.1	9.6	12.5
Vegetables and Fruits					
Vegetables, leafy greens	12	9.7	9.1	8.8	10.2
Potatoes	12	5.1	5.3	5.1	6.0
Onion	4	1.3	1.2	1.2	1.2
Other vegetables	6	4.8	4.8	4.8	4.8
Fresh fruit	16	12.4	12.3	11.7	12.7
Cereals					
Bread	12	13.1	13.3	12.9	13.4
Boiled wheat	2	2.1	2.0	0.8	2.6
Rice	2	2.8	3.0	2.9	3.0
Macaroni, vermicelli	2	2.1	2.1	2.1	2.1
Flour	2	1.7	1.4	1.3	1.6
Oils and Sugar					
Edible oil	2	4.4	4.3	4.2	4.4
Margarine and butter	2	6.4	6.3	6.4	6.4
Olive	2	4.1	4.2	4.3	4.2
Sugar	4	7.0	7.1	7.1	7.1
Jam, honey, syrup	2	10.6	10.0	9.6	10.0
Tea, Spice and nuts					
Tomato paste	2	4.1	4.2	4.3	4.2
Salt	2	1.4	1.3	1.2	1.4
Tea	0.4	2.2	2.2	2.3	2.2
Walnut, hazelnut in shell	0.4	1.3	1.2	1.2	1.3
Monthly Total food budget, TL		180.3	171.5	164.3	180.1
Observed mean food budget for four person household, TL		226	210	213	208

The average exchange rate for 2003 is 1.5 TL for $1 at current prices, and 0.732 TL for $1 at PPP.

Table A2.2: Food Poverty according to welfare method (Table 3.1 food bundle)

	urban-rural poverty line			Urban, self-provisioning and other rural poverty lines		
	Headcount Rate(P0)	**Poverty Gap(P1)**	**Squared Poverty Gap(P2)**	**Headcount Rate(P0)**	**Poverty Gap(P1)**	**Squared Poverty Gap(P2)**
Urban	0.47	0.14	0.06	0.47	0.14	0.06
Rural	0.37	0.10	0.04	0.38	0.11	0.05
rural self-provisioning	0.36	0.10	0.04	0.30	0.08	0.03
rural other	0.37	0.11	0.05	0.45	0.14	0.06
Total	0.43	0.13	0.05	0.44	0.13	0.06

Table A2.3: Vulnerability to undernutrition according to welfare method

		all sample		
	criterion	poor	non-poor	poor and non-poor
moderately vulnerable	$0.5 >= v_h$	0.16	0.44	0.60
highly vulnerable	$v_h > 0.5$	0.28	0.13	0.40
All groups		0.44	0.56	1.00
		Urban		
	criterion	poor	non-poor	poor and non-poor
moderately vulnerable	$0.5 >= v_h$	0.15	0.39	0.54
highly vulnerable	$v_h > 0.5$	0.32	0.14	0.46
Urban		0.47	0.53	1.00
		rural self-provisioning		
	criterion	poor	non-poor	poor and non-poor
moderately vulnerable	$0.5 >= v_h$	0.19	0.63	0.83
highly vulnerable	$v_h > 0.5$	0.10	0.07	0.17
rural self-provisioning		0.30	0.70	1.00
		rural other		
	criterion	poor	non-poor	poor and non-poor
moderately vulnerable	$0.5 >= v_h$	0.18	0.41	0.59
highly vulnerable	$v_h > 0.5$	0.27	0.14	0.41
rural other		0.45	0.55	1.00

APPENDIX 3

CHAPTER 4 APPPENDIX

Table A3.1: Annual inflation rates for selected years and indices

Year	CPI	Wholesale	Agriculture
1994	111.01	117.42	91.5
1995	76.05	65.63	86.7
1996	79.76	84.92	89.9
1997	99.09	90.96	96.5
1998	69.73	54.26	71.9
1999	68.79	62.91	30.0
2000	39.03	32.66	39.8
2001	68.53	88.56	65.5
2002	29.75	30.84	35.2
2003	18.36	13.94	20.0
2004	9.32	13.84	14.1
2005	10.53	4.54	2.6
2006	9.65	11.58	2.7

Unit Root and Cointegration Analyses of Nominal Prices

Here we present the unit root and cointegration analyses for log-nominal prices. The corollary tables for the inflation-adjusted prices are noted in parentheses.

Table A3.2: Log-nominal farm-gate and UHT milk price and log-nominal labor productivity index (Table 4.4)

Variable	test	structural break date	trend variable	lags	test score	conclusion
log-nominal UHT milk price	DF		yes	0 lag	-0.125	FTR Ho of unit root
	KPSS		yes	13 lags	1.8684	Reject Ho of stationarity
	Structural break	1997 M10	yes	3 lags	-0.5971	FTR Ho of unit root
log-nominal farm-gate milk price	DF		yes	0 lag	-0.6168	FTR Ho of unit root
	KPSS		yes	1 lag	1.715	Reject Ho of stationarity
	Structural break	1994 M11	yes	1 lag	-0.8078	FTR Ho of unit root
log-nominal productivity index	ADF		yes	10 lags	-1.5347	FTR Ho of unit root
	KPSS		yes	10 lags	0.2033	Reject Ho at 5%
	Structural break	1997 M3	yes	10 lags	-1.7531	FTR Ho of unit root

Figure A3.1: Log-nominal UHT milk price with shift dummy, break (1997.M10), 1 lag

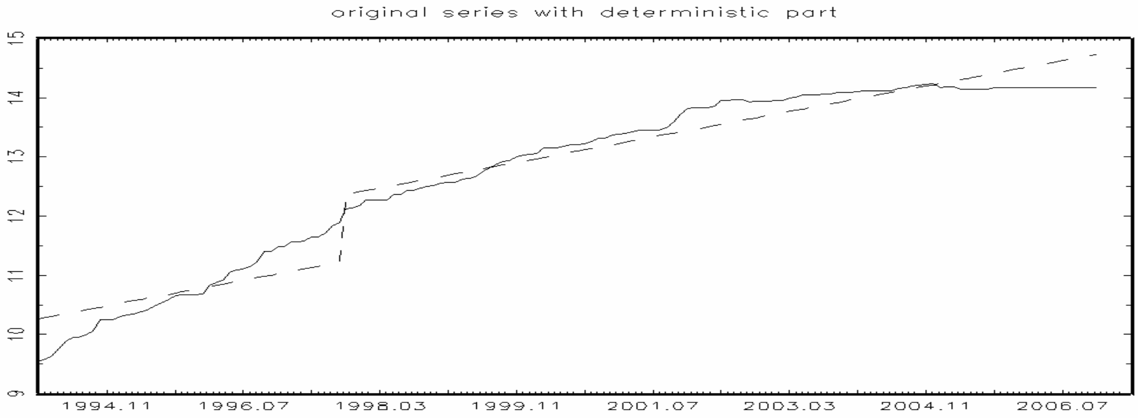


Figure A3.2: Log-nominal Farm-gate milk price with shift dummy, break (1994.M11), 0 lag

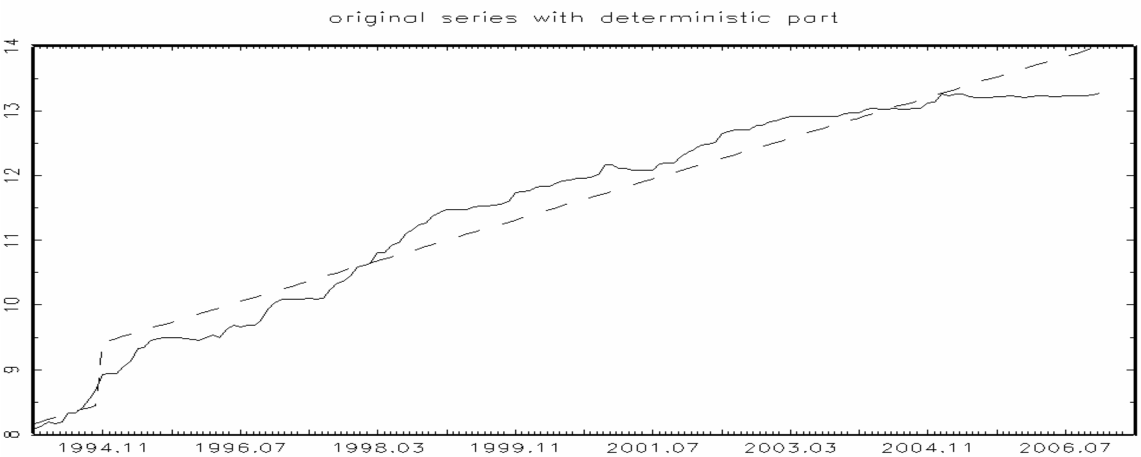
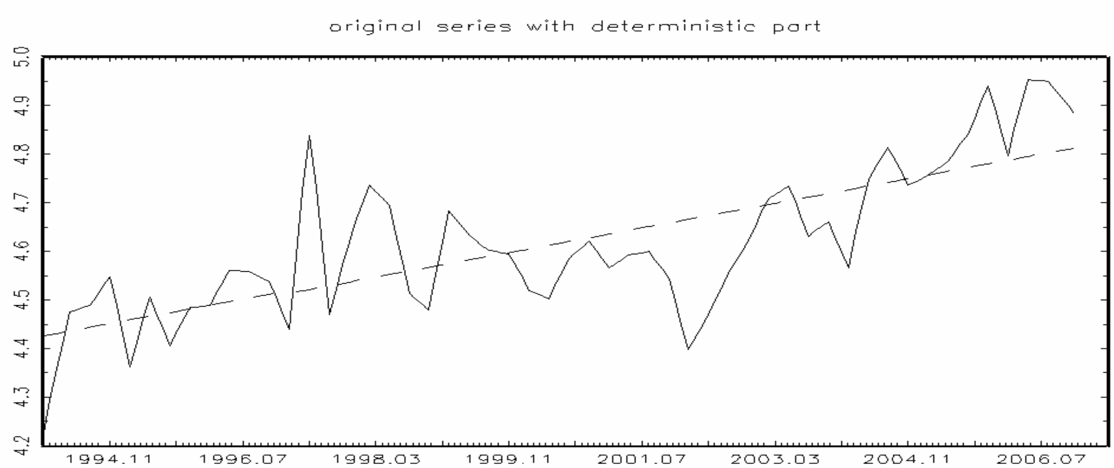


Figure A3.3: Log-nominal Productivity Index with shift dummy (1997.M3), 10 lags



The following TAR and M-TAR analysis considers only the cointegration of log-nominal UHT price and log-nominal farm-gate price following the findings in Table A3.3 which reveal that log-nominal prices are cointegrated (without taking into account the hourly labor productivity index). For simplicity, we consider only one structural break for October 1997. Table A3.4 shows the results for TAR and M-TAR models. For the TAR model, all coefficient estimates have the expected negative signs for zero and non-zero threshold. In the case of the TAR model, the threshold is less than zero, indicating that milk processors make quicker adjustments in prices when the actual wholesale prices are below the long-term equilibrium price. The absolute value of the coefficient estimate of ρ_1 is larger than that of ρ_2, suggesting faster convergence in response to positive deviations from equilibrium. *t-Max* values for the TAR model are -1.28 (zero threshold) and -0.91 (non-zero threshold); i.e. higher than the 10 percent critical values (-1.90 and -1.91). Hence, we fail to reject the no-cointegration hypothesis. Moreover, when we perform the joint hypothesis with the more powerful Φ test, we fail to reject the null hypothesis of no cointegration at every significance level.

For the M-TAR model the coefficient estimate for ρ_1 is negative and the coefficient estimate for ρ_2 is negative when the threshold is zero and positive when the threshold is non-zero (statistically insignificant in both cases). In this case, we cannot use *t-Max* because not all coefficient estimates are negative. The sample Φ^* statistics are 3.87 for zero threshold and 8.61 for non-zero threshold. The Φ^* statistics is greater than the 5 percent significance value of 6.78 for the case of non-zero threshold, so only in this case the null hypothesis of no cointegration can be rejected. Given this results for cointegration, the next step is to test asymmetry. The usual F-test confirms that the coefficients of positive and negative deviations are asymmetric.

Table A3.3: Cointegration tests for farm-gate, UHT milk prices and labor productivity index (Table 4.5)

Johansen Trace test - Constant			
Variables	**structural break**	**lags**	**result**
Farm-gate and UHT	no	1	1 cointegrating vector
Farm-gate , UHT, productivity index	no	8	1 cointegrating vector
Farm-gate and UHT	1997 M10	1	1 cointegrating vector
Farm-gate , UHT, productivity index	1997 M10	5	2 cointegrating vectors
Farm-gate and UHT	1994.M11 1997.M10	1	1 cointegrating vector
Farm-gate , UHT, productivity index	1994.M11 1997.M10	5	2 cointegrating vectors
Johansen Trace test - Constant & trend			
Farm-gate and UHT	no	1	1 cointegrating vector
Farm-gate , UHT, productivity index	no	8	1 cointegrating vector
Farm-gate and UHT	1997 M10	1	1 cointegrating vector
Farm-gate , UHT, productivity index	1997 M10	5	3 cointegrating vectors
Farm-gate and UHT	1994.M11 1997.M10	1	1 cointegrating vector
Farm-gate , UHT, productivity index	1994.M11 1997.M10	5	2 cointegrating vectors
Johansen Trace test - orthogonal trend			
Farm-gate and UHT	no	1	1 cointegrating vector
Farm-gate , UHT, productivity index	no	8	1 cointegrating vector
Farm-gate and UHT	1997 M10	1	1 cointegrating vector
Farm-gate , UHT, productivity index	1997 M10	5	1 cointegrating vector
Farm-gate and UHT	1994.M11 1997.M10	1	1 cointegrating vector
Farm-gate , UHT, productivity index	1994.M11 1997.M10	5	1 cointegrating vector
Saikkonen & Lütkepohl test	**test type**	**lags**	
Farm-gate and UHT	constant	1	1 cointegrating vector
Farm-gate , UHT, productivity index	constant	8	0 cointegrating vector
Farm-gate and UHT	constant & trend	1	1 cointegrating vector at 10 %
Farm-gate , UHT, productivity index	constant & trend	8	0 cointegrating vector
Farm-gate and UHT	orthogonal trend	1	1 cointegrating vector
Farm-gate , UHT, productivity index	orthogonal trend	8	2 cointegrating vectors

When we deal with log-nominal prices, we find evidence for cointegration and asymmetry only in the M-TAR test. In the case of the M-TAR model, the threshold is less than zero, indicating that milk processors make quicker adjustments in prices when the deviations from long-term equilibrium are below the long-term for ‘momentum’. However, the absolute value of the coefficient estimate of ρ_1 is larger than that of ρ_2, suggesting faster convergence in response to positive deviations from equilibrium.

Therefore, the farm-to-wholesale price transmission in Turkey is asymmetric, and adjustments are stronger when μ_{t-1} is greater than the threshold value of -0.032. That is, when actual wholesale prices are higher than the equilibrium prices, a more rapid adjustment back toward the equilibrium price occurs. This conclusion for log nominal prices is similar to inflation-adjusted prices.

Table A3.4: Results of TAR and M-TAR for log-nominal UHT milk price (Table 4.6)

dependent variable	threshold	ρ_1^a	t-value	ρ_2^b	t-value	Φ^c	$\rho_1 = \rho_2^d$	p-value
TAR								
c=0		(0.117)	-2.46	(0.059)	-1.28	3.85		
$C \neq 0$	(0.093)	(0.128)	-2.8	(0.043)	-0.91	4.33		
M-TAR								
c=0		(0.112)	-2.59	(0.052)	-1.01	3.87		
$C \neq 0$	(0.032)	(0.136)	-3.71	0.072	1.08	7.36	7.49	0.007

a: Coefficients and t-statistics for the null hypothesis $\rho_1 = 0$.
b: Coefficients and t-statistics for the null hypothesis $\rho_2 = 0$. t-Max critical values:
when c=0: TAR: 1%: -2.55, 5%: -2.11, 10%: -1.90. M-TAR: 1%: -2.57, 5%: -2.14, 10%: -1.91.
when $c \neq 0$: TAR: 1%: -2.35, 5%: -1.85, 10%: -1.61. M-TAR: 1%: -2.37, 5%: -1.90, 10%: -1.65.
c: F statistics for the joint hypothesis $\rho_1 = \rho_2 = 0$.
when c= 0: TAR: 1%: 8.24, 5%: 5.98; 10%: 5.01; M-TAR: 1%: 8.78, 5%: 6.51, 10%: 5.45.
when $c \neq 0$: TAR: 1%: 9.27, 5%: 6.95; 10%: 5.95; M-TAR: 1%: 9.14, 5%: 6.78, 10%: 5.73.
d: F statistics for the joint hypothesis $\rho_1 = \rho_2$ to test for asymmetric price transmission.

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