Assessing Market Functioning: The Case of the Hungarian Milk Chain

HEINRICH HOCKMANN

Leibniz-Institute of Agricultural Development in Central and Eastern Europe (IAMO), Halle (Saale), Germany

ÉVA VŐNEKI

Agricultural Economics Research Institute, Zsil u. 3-5, 1093 Budapest, Hungary

Paper prepared for presentation at the 104th (joint) EAAE-IAAE Seminar Agricultural Economics and Transition:

„What was expected, what we observed,

the lessons learned."

Corvinus University of Budapest (CUB)

Budapest, Hungary. September 6-8, 2007

Abstract

The paper discusses the impact of market power in the Hungarian milk chain. In a first step a vector error correction model is estimates to assess whether a domestic market for raw milk exists. Since the answer was positive we proceed by developing a structural market model of the Hungarian market for raw milk that is able to identify a possible affect of market power on resource allocation. A nonlinear 3SLS approach was applied to estimate the supply and the demand for raw milk. The results provide that despite the high concentration of in dairy processing the indications for market poser are rather limited. The “Bertrand like” equilibrium can be attributed to the low degree of capacity utilization in dairy processing and the marketing alternative of farmers.

Keywords: market power, market integration, dairy, Hungary.

1 Introduction

The transition process in Eastern Europe was characterized by three basic elements: privatization, liberalization, and restructuring. The main intention behind the reforms was the substitution of the centrally planned economies by market coordination. Decentralized coordination was expected to implement incentive compatible decision mechanisms which in turn should allow the allocation of resource to their most beneficial uses. In addition, the improved remuneration of resources should foster economic growth and the increase of per capita income. A favourable transformation process required a basic transformation of the institutional environment within the countries. In most of the transition countries, especially those in Central Europe, these reforms have been implemented and enforced. Because of this the transition process is considered to be finished and the countries are officially classified as market economies.

However, changing the institutional environment can be regarded as a development on the "razors edge". The main reason is that the institutional innovations are not exogenous but endogenous. They are the results of long-lasting bargaining processes in which interest groups attempt to influence the institutional environment in favour of the parties they represent. As a consequence of the impact of pressure groups structures may be established that induce market failures and thus hamper the free allocation of resources according to market signals. Possible consequences are the establishing of market power through technological and institutional barriers of entry that enable interest groups to extract extraordinary rents at the costs of the transaction partners. This in turn suggests that the analysis of market results can be used to assess the success of the transition process.

Several studies have been conducted in this respect, especially in agricultural economics. Most of these use price transmission analysis to assess whether horizontal and vertical market integration exists (with regard to Central Europe see BOJNEC 2002, BAKUCS, FERTŐ 2005, BAKUCS et al. 2006, and PETER 2003). While symmetric price transmission can be attributed to functioning markets, the conclusion that asymmetric integration is an indication of market failure is misleading since asymmetries can also be due to lagged price responses, demand changes, technological change, outsourcing of functions and cost changes (MEYER, von CRAMON – TAUBADEL 2004). Consequently, no definite conclusions regarding market failures are possible.

The objective of this paper is to assess market functioning by evaluating the significance of market power directly using a structural market model. Within this framework not only price but in addition quantity data will be used to assess resource allocation on markets. We will apply the approach to the development on the Hungarian milk market between 1998 and 2006 and discuss whether the institutional setting led to conditions that are consistent with a functioning market or whether frictions are present that allow some parties to appropriate the rents associated with milk production. We focus on the dairy chain for several reasons. First dairy production is an important source of farm income. Second, the Hungarian milk market was subject to policy shocks which induces significant adjustment in milk production and processing. Third, milk processing is highly concentrated and dominated by foreign capital. Forth milk prices in Hungary belong to the lowest in the new EU member states. Especially the two latter conditions might suggest the existence of considerable market power.

The paper is organized in six chapters. Following the introduction stylized fact regarding the Hungarian dairy chain are presented. The descriptions are intended to provide a first indication of the possibility of market power. Chapter 3 discusses whether the transition process in Hungary succeeded in the development of a domestic market for raw milk. This analysis provides not only first results regarding market functioning, but also motivates the deduction of the structural market model in chapter 4. In the fourth part the structural market model is derived. Chapter 5 deals with the econometric implementation of the model and the discussion of estimation results. Chapter 6 summarizes our findings and discusses their implication for policy interventions.

2 DESCRIPTION OF THE HUNGARIAN DAIRY CHAIN

2.1 Market regulations of milk and milk products[1]

The transition to a market economy and, later, the compliance with the *acquis communautaire* necessitated the adoption of new intervention methods and a legislative basis for them. In the 1990s, Hungary enacted a policy towards improving raw milk quality in so far as price support was only given to raw milk which met minimum EU quality standards. As a result, in 2003, about 95 % of all supplies to dairies met the EU-standards.

The creation of the agricultural market regime in 1993 aimed to alleviate extreme fluctuations in supply and prices of commodities and to establish a minimum guarantee for primary production. It was an indirect subsidy for the producer, but provided to processors (after 1999 for Extra quality milk only) if they paid at least the centrally-fixed target price to the farmers. The indirect subsidies were complemented by export subsidies which were needed to stabilize the domestic market. One severe problem was setting the target price for raw milk unreasonably high, especially in 1998-99 and in 2002-03. The government started to create the milk price without respect to the market situation, which caused a huge surplus and finally led to losses and uncertainty for market players. Moreover, since the form of subsidization was incompatible with the EU market organization for milk and milk products the system was abolished in the beginning of 2004.

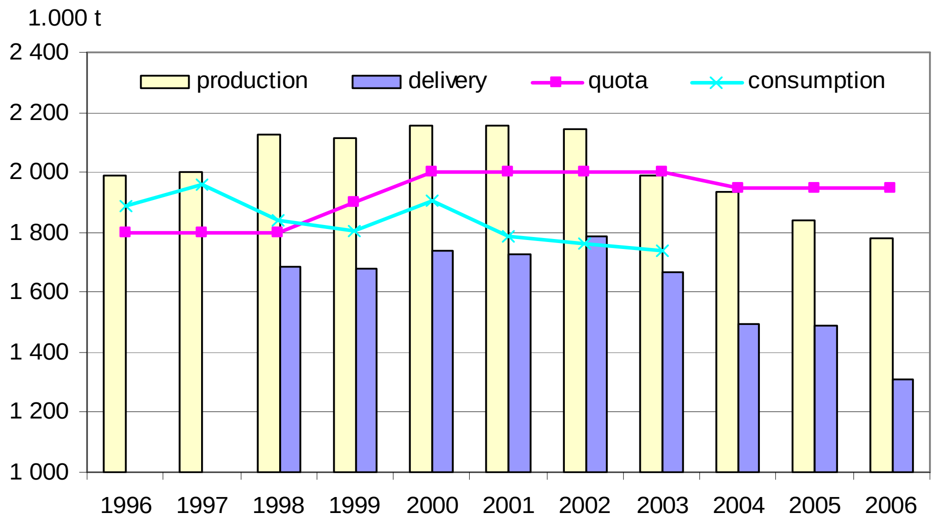
A guaranteed milk price was introduced in 1996, but its extremely low level has prevented it from being effective; no intervention purchases have been, and, no institution has been designated to carry out intervention purchases. Furthermore, there have also been intervention prices (lower and upper) in force since 2000. When the market price reaches the level of either of these two, government interventions should follow in order to keep the market price within the price band – but this was never specified.

After continuing pressure from producer organizations a raw milk quota system was also introduced in 1996. Producers expected the quota to secure a safe marketing outlet for their milk. Thus the objective of introducing the quota was not to fight surpluses but to create

[1] A description of milk market policy in Hungary can be found in HOCKMANN, VŐNEKI (2004).

orderly marketing. Quota applications by producers had to be based on actual supplies in the previous year, but the system allowed producers to pad their reference quantities to provide room for expansion. During EU accession negotiations, Hungary requested a national quota of 2.8 million tons of milk. However, the quotas were fixed by the Commission based on delivered production figures and direct sales between 1997 and 1999. The final national production quota amounts to 1,947,280 t of raw milk (1,782,650 t for deliveries and 164,630 t for direct sale). The EU also agreed on a “milk quota reserve” of 42,780 t that will be given to Hungary in 2006 to compensate for the expected increase in retail demand for milk that should result from a decrease in on-farm consumption. The national quota for deliveries approved by the EU could not be fulfilled in each year (Figure 1). Therefore, the quota has not been restrictive, supply capacities and demand constraints limited output growth instead.

Figure 1 Production and consumption of raw milk, Hungary, 1996/7-2005/06



Source: TEJ TERMÉKTANÁCS, KSH – STATISZTIKAI ÉVKÖNYV, ÁLLATÁLLOMÁNY

2.2 Development of milk production and consumption

The constant decrease of the milk producer prices due to the abolishment of the national price support system in 2004 led despite rising milk yields to smaller milk production in Hungary. Only 79-83% of total production was delivered to dairy companies. This shows the great importance of direct marketing and internal consumption on farms. Moreover, the share of raw milk delivered to domestic dairy companies decreased after 2004. In 2005, 1,49 million t of raw milk was delivered to the dairy industry, by 2% less than in 2004. It is estimated that in 2006, deliveries will further decrease by approximately 12% to around 1,31 million t.

The main reason for the reduction is the dynamic increase of raw milk export to Italy. Export quantities have increased from 43,000 t in 2004 to 108.00 t in 2005. In the first half of 2006 exports to Italy amounted to already 110,000 t. At the same time, import of raw milk has also increased, mainly from Slovakia, however to a less extend. However, imported raw milk still has a marginal share on total milk processing. The consumed volume of dairy products hasn’t chanced significantly in the last years. However, in the case of high value added products (especially by cheese) some increase could be observed.

2.3 Structure of milk production

Since the accession, Hungarian cow stock is decreasing continuously. Between 2003 and 2006, the number of cows has reduced by 9%, from 359.000 to 326.000. Approximately

250.000 cows were hold in enterprises with an agricultural area larger than 50 ha. The main part of the stock (223.000 animals) was hold by legal entities and less than a third of the total stock (102.000 animals) were at private firms. The decrease since 2003 was at private firms with 13% more strongly. This concentration was essentially caused by the price development for raw milk due to the abolishment of the national supports. However, the number of small producer with 1-9 cows is relative high yet, 90% of the enterprises belongs to this category. Despite of this, compared to the other member states, milk production in Hungary is concentrated. Approximately 98% of the raw milk is produced in enterprises with more than 100 cows.

2.4 Processing industry

Between 1997 and 2004, the number of milk processors in Hungary has decreased from 104 to 93. In 2004 the ten largest enterprises bought up approximately 70% of the raw milk. At present, the largest enterprise (Sole-Mizo) has a market share of 26%, followed by Friesland with 24%. While in the second half of the nineties and also at the beginning of this century the Hungarian dairy industry was dominated by foreign enterprises, this has changed slightly in recent years. The largest enterprise was bought by a Hungarian investor and also Parmalat with approximately 20% market share was taken over in the spring of 2006 by 140-150 milk producers. The big influence of foreign companies on the Hungarian raw milk market together with the extremely high concentration suggest that farmers are in a poor bargaining position and processors might be able to exploit significant market power.

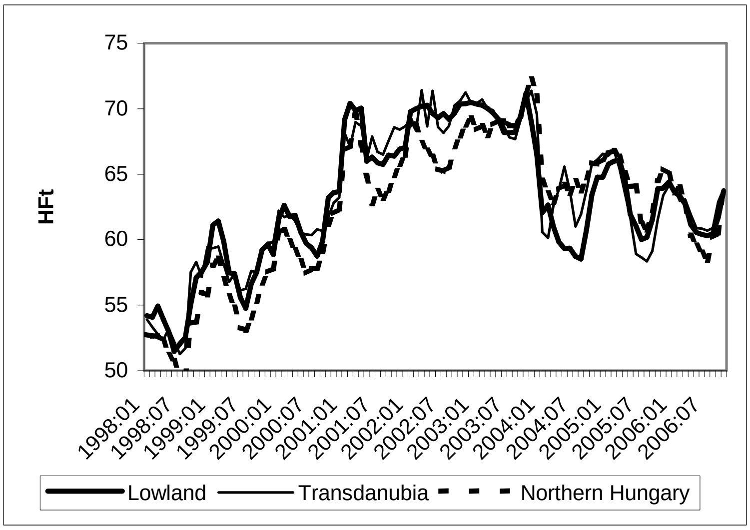
Despite of low milk prices, Hungarian dairy enterprises are not competitive neither on the foreign nor on the domestic market. Due to increasing imports since accession, Hungary has become a net importer of dairy products. In 2005, export value amounted to 118 millions USD, while import value has reached 191 millions USD. Especially, the increasing proportion of imported cheap dairy products with partially insufficient quality from the neighbour countries had a negative affect on the dairy industry. Increasing import volumes were registered particularly in the categories of consumer milk and cheese. Besides the dynamic increase of raw milk deliveries to Italy, overseas sells of fruit yogurt increase, while the export of other dairy products decreased. The increase with regard to fruit yogurt can be explained with the strategy of the foreign dairy companies active in Hungary, which supply different Eastern European markets from Hungary.

3 HORIZONTAL INTEGRATION OF THE RAW MILK MARKET

Between 1995 and 2003 the target price was adjusted annually at increasing levels. During this period, the average market price for raw milk followed the target price without significant regional differences between Lowlands, Transdanubia and Northern Hungary (Figure 2). Until 2004, Hungarian milk producers received a high milk price compared with other new member states such as Poland, the Czech Republic or Slovakia. Since the accession, the situation has changed in principle. The abolishment of the national price support system in the beginning of 2004 led to decrease of the raw milk price. With 24-26 Ct/kg in 2005, Hungarian milk prices were by 5% lower than in 2004. In 2006, the decrease was 8%. As a result, Hungarian milk prices have reached the lowest level in the region in 2006. In addition, the break in 2994 has also an impact regarding price leadership. Before 2004 prices in the Lowlands were the highest. This situation changed in 2004 insofar as the prices in the Lowlands regions are now below those in Transdanubia and Northern Hungary. Moreover, all series show a significant seasonal pattern with high prices during the winter month and low prices during summer.

An analysis of market power on the national level is only meaningful, when the regional markets for raw milk are integrated. In this paper we will not provide detailed information on the results of the various estimations. Instead we will concentrate on those findings which are relevant for conclusion regarding horizontal market integration.

Figure 2 Regional market prices of raw milk in Hungary, 1998-2006



Source: AKI – PÁIR

Because of the break in the time series, we conducted the corresponding analysis for the two periods before and after the abolishment of the price support system. In a first step the seasonal patterns were removed from the series. The adjusted series were checked whether they possess unit roots. The correct identification of unit roots is pivotal for the formulation of the error correction model. Since none of the various tests for unit roots is superior under all circumstances, different test statistics were analysed. The Augmented Dickey Fuller (FULLER 1996) and the nonparametric test developed by BREITUNG (2002) were applied. In the first period (1998-2003) a constant and a trend variable were considered to account for the increase of prices while in the second period the trend variable was omitted. The results provide strong statistical evidence for the existence of unit roots in the series.[2].

The thereon following co-integration analysis was based on an error correction model:

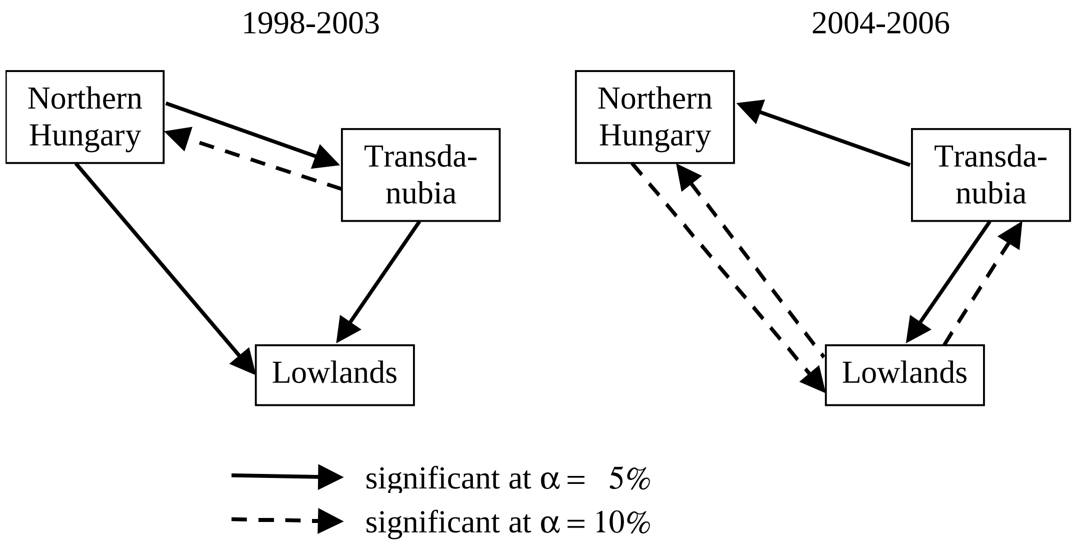
(1) $$\Delta \mathbf{w}_t = \boldsymbol{\alpha} + \Pi \mathbf{w}_{t-1} + \sum_{i=1}^{\rho-1} \boldsymbol{\Gamma}_i \Delta \mathbf{w}_{t-i} + \mathbf{u}_t$$

Pairwise comparisons of the price developments in the three regions were conducted. This procedure was chosen to be able to account for a possible change in price leaderships after 2003. Estimations were conducted using the JOHANSON (1992) procedure. Both, the λ_{trace} as well as the λ_{max} test suggest the existence of a co-integrated relationship in all six cases. The optimal lag length (ρ) was selected using the Hannan –Quinn and the Akaike criterions and was 1 and 2, depending on the individual pairs of prices. The co-integrating relationship is represented by $\Pi \mathbf{w}_{t-1}$, with **w** the raw milk price. With co-integration and two variables the rank of **Π** is one, and the vector can be separated in two vectors **α** and **β**, with **Π** = **α β'** and each with rank one. $\boldsymbol{\beta}' \mathbf{w}_{t-1}$ represents the long run relationship in the model. The loading

[2] Both procedures provide that the hypothesis of the existence of a unit root with constant and trend could not be rejected at a 5% level of significance.

matrix α reflect the velocity of with which, after a shock, the system converges to the long-term equilibrium (LÜTKEPOHL 2004). Moreover the statistical properties of α can be used to decide whether a variable is exogenous in the system, and thus, to determine the causal relationships among the prices. In the following we will concentrate on these results only (Figure 3).

Figure 3 Relationships among regional raw milk prices in Hungary



Source: own estimation

In the first period, raw milk prices were mainly determined by Northern Hungary. After the abolishment of the price support system, the situation changed significantly, since Transdanubia has taken price leadership. However, the co-integration analyses suggest that arbitrage between the regions cannot be rejected, and moreover, that a national market for raw milk exists which in turn justifies an analysis of market power on the national level.

4 MARKET POWER: A STRUCTURAL MARKET MODEL

We follow the methodology developed by BRESNAHAN (1982) and MUTH, WOHLGENANT (1999) to test for oligopsony market power of the milk processing industry. The profit of a representative processor is given by:

(2) $$\pi_i = R(\mathbf{p}, x_i, \mathbf{z}_i) - w_X \cdot x_i - \mathbf{w}_\mathbf{Z}'\mathbf{z}_i$$

where **p** is a vector of dairy product prices, R(**p**, x_i, $\mathbf{z_i}$) represents the revenue function depending in addition on raw milk demand (x_i) and other inputs ($\mathbf{z_i}$). The symbol w is used for the corresponding factor prices. The raw milk supply function is:

(3) $$x = g(w_x, \mathbf{s})$$

Here, **s** is a vector of supply shifters and x is the total supply of raw milk. However, for analysing optimal demand of the processor it is more convenient to use the inverse supply function:

(3') $$w_x = g^{-1}(x, \mathbf{s})$$

Given (2) and (3) the first order condition for profit maximisation is:

(3) $$\frac{\partial R(\mathbf{p}, x_i, \mathbf{z})}{\partial x_i} - w_X - \frac{\partial g^{-1}(x, \mathbf{s})}{\partial x}\frac{\partial x}{\partial x_i} x_i = 0,$$

where $\partial x/\partial x_i$ represents the increase of total farm supply induced by an increase of processor *i*'s milk demand. The first order condition can be aggregated over all n processors. After defining

$$\frac{1}{n}\sum_{i=1}^{n}\frac{\partial R(\mathbf{p},x_i,\mathbf{z}_i)}{\partial x_i}=\frac{\partial R(\mathbf{p},x,\mathbf{z})}{\partial x}$$

(4) can be written as:

$$W_X\left(1+\frac{\Theta}{\varepsilon}\right)=p\frac{\partial R(\mathbf{p},x,\mathbf{z})}{\partial x}, \qquad (5)$$

where $\varepsilon_x=\frac{\partial x}{\partial g^{-1}(x,\mathbf{s})}\frac{g^{-1}(x,\mathbf{s})}{x}=\frac{\partial x}{\partial w_x}\frac{w_x}{x}$ denotes the price elasticity of raw milk supply and $\Theta=\frac{1}{n}\sum_{i=1}^{n}\frac{\partial x}{\partial x_i}\frac{x_i}{x}$ is the average input conjectural elasticity and captures the degree of market power (BRESNAHAN 1989). The parameter range is $0<\Theta<1$. $\Theta=0$ corresponds to perfect competition, while $\Theta=1$ characterizes a monopsonistic market.

5 EMPIRICAL RESULTS

5.1 Empirical implementation

Raw milk supply was approximated by a translog functional specification in order to be able to identify relationships among the variables without imposing ex ante restrictions on economic relevant parameter (CHAMBERS 1988):

$$\ln x=\alpha_0+\alpha_x\ln w_x+\frac{1}{2}\alpha_{xx}(\ln w_x)^2+\alpha_s'\ln\mathbf{s}+\frac{1}{2}\ln\mathbf{s}'\mathbf{A}_{ss}\ln\mathbf{s}+\ln\mathbf{s}'\mathbf{A}_{sw}\ln w_x, \qquad (6)$$

where α and **A** are parameters to be estimated. The elasticity of raw milk supply is:

$$\varepsilon=\frac{\partial\ln x}{\partial\ln w_x}=\alpha_x+\alpha_{xx}\ln w_x+\ln\mathbf{s}'\mathbf{A}_{sw}. \qquad (7)$$

The marginal product $\partial R(\mathbf{p},x,\mathbf{z})/\partial x$ in (5) was derived from a translog approximation of the processors' revenue function:

$$\begin{aligned}\ln R(\mathbf{p},x,\mathbf{z})=\ &ß_0+ß_x\ln x+\frac{1}{2}b_{xx}(\ln x)^2+\mathbf{ß}_z'\ln\mathbf{z}+\frac{1}{2}\ln\mathbf{z}'\mathbf{B}_{zz}\ln\mathbf{z}+\ln\mathbf{z}'\mathbf{B}_{zx}\ln x\\ &+\mathbf{ß}_\mathbf{p}'\ln\mathbf{p}+\frac{1}{2}\ln\mathbf{p}'\mathbf{B}_\mathbf{pp}\ln\mathbf{p}+\ln\mathbf{p}'\mathbf{B}_{\mathbf{p}x}\ln x.\\ &+\frac{1}{2}\ln\mathbf{p}'\mathbf{B}_\mathbf{pz}\ln\mathbf{z}\end{aligned} \qquad (8)$$

The parameters to be estimated are **ß** and **B**. It follows:

$$\frac{\partial R(\mathbf{p},x,\mathbf{z})}{\partial x}=\frac{\partial\ln R(\mathbf{p},x,\mathbf{z})}{\partial\ln x}\frac{R(\mathbf{p},x,\mathbf{z})}{x}=\left(ß_x+b_{xx}\ln x+\ln\mathbf{z}'\mathbf{B}_\mathbf{zx}+\ln\mathbf{p}'\mathbf{B}_{\mathbf{p}x}\right)\frac{R(\mathbf{p},x,\mathbf{z})}{x} \qquad (9)$$

Substituting (7) and (8) in (5) provides:

$$(10) \quad W_X = \frac{\left(ß_x + b_{xx}\ln x + \ln \mathbf{z}'\mathbf{B}_{\mathbf{z}x} + \ln \mathbf{p}'\mathbf{B}_{\mathbf{p}x}\right)\frac{R(\mathbf{p},x,\mathbf{z})}{x}}{1 + \frac{\Theta}{\alpha_x + \alpha_{xx}\ln w_x + \ln \mathbf{s}'\mathbf{A}_{\mathbf{s}w}}}.$$

Equations (6), (8) and (10) constitute a simultaneous nonlinear equation model. In order to allow for cross equation co-variation of the error terms a nonlinear three stage estimation procedure (NL3SLS) would be appropriate (GREENE 2003). Estimating a NL3SLS requires a set of instrumental variables. We used the full set of variables as instruments. Unfortunately, we were not able to derive consistent estimate of the system that possess desirables statistical properties (Table 2). The Durbin Watson statistics suggested the existence of autocorrelation, however, because of convergence problems, we were not able to account for this problem. Alternatively, we estimated a reduced system composed of the supply function (6) and derived demand (10) (Table 3). In order to save on the number of parameters we imposed theoretically consistent homogeneity restrictions on the revenue function and the supply function[3]. The individual restrictions are not presented here but are given in the annotations of corresponding tables.

5.2 Estimation results

The data set consists of 106 observations (from January 1998 to October 2006). Table 1 provides information about the variables used in the estimation. The endogenous variables (market results) are the price of raw milk and the amount of raw milk processing. Since both variables show significant seasonal patterns, the original data were adjusted using the x11 procedure (ESTIMA 2004).

The supply shifters (**s**) consist of the prices for feeding stuff, and labour input and the number of cows. The two latter variables were subject to several kinds of adjustments. Labour input in milk production was calculated in three steps. First, total agricultural labour input was weighted by the share of milk in total agricultural output. Second, since only about 80% of the Hungarian raw milk production is processed by the dairy companies, the adjusted labour input was weighted a second time. In the third step the annual data were transformed into monthly time series. The number of cows was adjusted using the second and third step. In addition, a time trend was included to account for the impact of technological change on milk supply. Land was not considered in the analysis. Data on grassland were available, however since a large part of it is fallow and we have no detailed information on this, land would not be a scarce factor and thus, would not affect raw milk supply.

---

[3] The revenue function is supposed to be linear homogenous of degree 1 in prices, the degree of homogeneity in prices of the supply function (CHAMBERS 1988).

Table 1 Variable description

	Variable	Description	Mean	Standard deviation
Market results	price	Price of raw milk, Ft/kg, deflated by CPI, seasonally adjusted	44.92	5.64
	milk	Amount of processed raw milk, in 1000 t, seasonally adjusted	133.66	21.81
Supply function (**s**)	feed	Price of animal feed, Ft/kg, deflated by CPI	31.96	2.05
	labour	Labour input in milk production, 1000 persons, adjusted by the ratio of processed and produced milk and the share of milk on total production	12.23	7.18
	cows	Number of cows, in 1000 head, adjusted by the ratio of processed and produced milk	308.23	43.60
	time	Trend variable	53.50	30.60
Revenue function (**p** ,**z**)	butter	Price of butter, 1000 Ft/kg, deflated by CPI	0.59	0.04
	cheese	Price of cheese, 1000 Ft/kg, deflated by CPI	0.61	0.08
	labour	Labour input in processing, in 1000 persons	9.55	1.22
	break	Dummy variable to account for the abolishment of export subsidies in 2004		
Revenue		Revenue of the dairy industry, billion Ft, deflated by CPI	11.78	1.74

Source: own estimation

The shifters of the derived demand function (**z**) include a trend variable, the prices of butter and cheese, labour input in processing. Labour input has to be transformed into a monthly series, the same hold for the industry's revenue. A dummy variable was included in the revenue function to account for the changes in milk policy in 2004. In addition, prices and values were deflated by the Consumer Price Index.

In order to ease the interpretation of the estimation results, all variables were weighted by their geometric mean. Because of this transformation, the estimates of α_x, $\boldsymbol{\alpha}_s$, $ß_x$ and $\boldsymbol{ß}_z$ represent elasticities and value shares. The following paragraphs discuss the results. Instead of an in-depth discussion of the parameter estimates we will highlight some important aspects.

Table 2 provides the estimation results of the full system (6), (8) and (10). Since all parameter in (10) are already in (6) and (8), these are presented. The DW-statistics suggests the existence of autocorrelation among the residuals. As a consequence, the estimates cannot considered to be efficient, thus, the significance of the t-values have to be interpreted with care. Acceptable values for the R^2 were obtained for the revenue function only. Moreover, only some of the parameter have the expected sign. The value share of butter is positive ($ß_{butter} > 0$), however, its supply elasticity is positive ($ß_{butter*butter} + ß_{butter} - (ß_{butter})^2 < 0$). Beyond, the high value share of butter suggests that the value share for cheese is negative. An increase of milk processing affects revenues positively, and, as expected, at a decreasing rate ($ß_{milk*milk} + ß_{milk} - (ß_{milk})^2 < 0$). The supply of raw milk increased with higher prices ($\alpha_{milk} > 0$). Moreover, milk supply is relatively inelastic. This is consistent with the implicit assumption that only short run supply reactions are captured. This results from using quantities of cows and labour instead of their prices as arguments in the supply function. Counterintuitive to production economic milk supply decreased with the number of cows ($\alpha_{cows} < 0$).

Table 2 Estimation results of the full system

Revenue function[1]		Supply function[2]	
Coefficient	Estimate	Coefficient	Estimate
$ß_{break}$	0.08707*		
$ß_{time}$	0.00877***	α_{time}	-0.00336***
$ß_{time*time}$	0.54602	$\alpha_{time*time}$	0.00001**
$ß_{butter}$	1.1853***	α_{milk}	0.23002*
$ß_{labour}$	2.0676**	α_{labour}	0.02946
$ß_{milk}$	0.99190***	α_{cows}	-0.51675**
$ß_{butter*time}$	0.02128	$\alpha_{milk*time}$	0.03444***
$ß_{labour*time}$	0.13027	$\alpha_{labour*time}$	-0.00833**
$ß_{milk*time}$	-0.00325	$\alpha_{cows*time}$	0.07735**
$ß_{butter*butter}$	-0.73769	$\alpha_{milk*milk}$	-0.66982
$ß_{labour*labour}$	12.865	$\alpha_{labour*labour}$	0.04079*
$ß_{milk*milk}$	-0.39939***	$\alpha_{cows*cows}$	6.8910**
$ß_{butter*labour}$	3.6630	$\alpha_{milk*labour}$	-0.70730**
$ß_{butter*milk}$	0.34076	$\alpha_{milk*cows}$	6.4706**
$ß_{labour*milk}$	-0.16349	$\alpha_{labour*cows}$	-0.85544
Market Power		0.003180	
Durbin Watson	0.9358		1.1723
R^2	0.9028		0.4271

1) The homogeneity restrictions of the revenue function are $ß_{butter} + ß_{cheese} = 1$, $ß_{butter*time} - ß_{cheese*time} = 0$, $ß_{butter*butter} - ß_{cheese*cheese} = 0$, $ß_{butter*butter} – ß_{butter*cheese} = 0$, $ß_{butter*labour} – ß_{cheese*labour} = 0$, and $ß_{butter*milk} – ß_{cheese*milk} = 0$

2) The homogeneity restrictions of the supply function are $\alpha_{milk} + \alpha_{feed} = 0$, $\alpha_{milk*time} + \alpha_{feed*time} = 0$, $\alpha_{milk*milk} = \alpha_{feed*feed}$, $\alpha_{milk*milk} - \alpha_{milk*deed} = 0$, $\alpha_{milk*labour} + \alpha_{feed*labour} = 0$, and $\alpha_{milk*cows} = \alpha_{feed*cows}$.

*, **, *** denote significant at the 10%, 5%, and 1% level, respectively

Note: The R^2 and the DW estimated for the derived demand equation were 0.3608 and 1.1225 respectively

Source: own estimation

The estimated parameter of market power is rather small and not significant. However, given the estimation problems of the parameters of the supply and the revenue function the conclusions that market friction which lead to a shift of agricultural rents to processors lacks power. In sum, this short discussion of the results provides that the estimation of the full system does not only provide inefficient but also biased results regarding the production technologies in agriculture and in processing.

The results derived for the reduced system are provided in Table 3. Although still not satisfactory, the R^2 are higher than in Table 2. Moreover, The DW coefficients take values for which it is impossible to decide whether autocorrelation is present or not. This suggests that the results of the reduced system are more reliable that those of the full system. This impression is confirmed by the significance of the individual parameter estimates. In addition, the economic relevant parameters, values share and elasticities, have the correct signs. The parameter value of market power is larger than in the full system, and beyond, significant at the 5% level. However, the value is still small, suggesting that market power is not a severe problem on the Hungarian milk market.

Table 3 Estimation results of the reduced system

Derived demand function[1)]		Supply function[1)]	
Coefficient	Estimate	Coefficient	Estimate
$ß_{milk}$	1.0043***	α_{time}	0.001056*
$ß_{milk*time}$	0.00099	$\alpha_{time*time}$	0.00022**
$ß_{butter*milk}$	0.36275**	α_{milk}	0.03665*
$ß_{labour*milk}$	0.56791*	α_{labour}	0.14960*
$ß_{milk*milk}$	-0.35130***	α_{cows}	0.10675
		$\alpha_{milk*time}$	-0.00514***
		$\alpha_{labour*time}$	-0.00395
		$\alpha_{cows*time}$	0.01218***
		$\alpha_{milk*milk}$	0.49869***
		$\alpha_{labour*labour}$	0.04645**
		$\alpha_{cows*cows}$	13.66400***
		$\alpha_{milk*labour}$	-0.69928***
		$\alpha_{milk*cows}$	-5.39250***
		$\alpha_{labour*cows}$	0.73207
Market Power	0.00154**		
Durbin Watson	2.1063		1.3668
R^2	0.5562		0.4862

1) For the homogeneity restriction see the annotations to Table 2.

*, **, *** denote significant at the 10%, 5%, and 1% level, respectively

Source: own estimation

When there is no indication of market power, the questions remains how the decrease of raw milk prices in Hungary could be explained after the abolishment of the price support system in 2004. The observed reaction can only be explained with a specific structure of the supply and demand elasticities on the raw milk market. Generally, the market side that reacts more inelastic is able to appropriate the larger part of subsidies (WÖHLKEN 1984). Correspondingly, the reduction of the subsidies hits the inelastic partner on the market. Thus, the strong price decrease in 2004 has a consistent interpretation as market reaction in the case when raw milk supply is inelastic and demand reacts elastically. However, this is exactly revealed by the estimates of the reduced system. Raw milk supply elasticity is about 0.036. On the other hand, demand reacts relatively elastic. Since all variables were adjusted by their geometric mean the demand elasticity is given by the inverse of $ß_{milk*milk} + ß_{milk} – (ß_{milk})^2$. Since $ß_{milk}$ is about one, the price elasticity of raw milk demand is around – 3.

5.3 Market power and the interpretation of Θ

The estimates suggest that market power is not a severe problem in the Hungarian dairy market. This results is surprising given the high concentration of dairy processing and the relatively low milk prices in Hungary. However, even farmers are confronted by a relatively small number of processors the latter appears not to be able to benefits from their favourable industry structure. One reason is the overcapacities in the dairy industry which led to intense competition among processors on the raw milk market. The problem of overcapacities is aggravated by the fact that farmers posses different opportunities to market their produce. They can sell to Hungarian processors, export raw milk, or market their produce directly to consumers. These choices might put, on the average, Hungarian milk producers, in a relatively favourable market position which hamper the exploitation of market power by the dairy industry. In addition, the low prices for raw milk cannot be regarded as a consequence of market power but instead of the failure of the processing industry to engage in product differentiation and to position itself successively on the market for premium goods which allow higher value added and, in turn, would increase the process for the raw materials. Given this interpretation, the fact that the evidence for market power is relatively poor is a coherent estimation result.

We derived market power is derived in a conjectural variation approach. Correspondingly, the parameter can only be interpreted consistently within this framework. Alternatively to the conduct performance approach used in this paper, the existence of market power may be analysed in a collusion framework. Using a dynamic oligopoly model with collusion CORTS (1999) shows that within such a setting the conjectural variation approach systematically underestimates the impact of market power on market allocation when supply shocks are not permanent.

With regard to milk production this may be a relevant problem since raw milk supply shows a seasonal pattern opposite cyclical changes of raw milk price. Thus, because supply changes are temporary underestimation may be a severe problem. However, a definite answer could only be given when the likelihood and possibilities for collusive behaviour in the dairy industry would be analysed in more detail. An alternative approach would be to examine the price – cost margins in the dairy industry directly. However, because of the lack of data, these approaches could not be pursued in this paper.

6 DISCUSSION

We motivated our analysis by the questions whether the economic and institutional reforms in Hungary provided an environment in the agri-food chain in which market allocation can develop its full benefits. In order to be able to do a detailed analysis, we restricted our analysis to the milk production and processing, one of the pivotal sectors in Hungarian agriculture. We answered the question by developing a formal model that allows conclusion regarding the functioning of market by the investigation of market results, i. e. prices and quantities exchanged.

In a first step we analysed the existence of a domestic market for raw milk by cointegration analyses. The results provide that a joint Hungarian market exists. However, the patterns of price leadership changed with the abolishment of the price support system in 2004. Given an integrated market we moved further and developed in a conjectural variation framework a structural market model allowing the identification of the significance of market power. Due to estimation problems we were not able to consider the full system, but have to rely our interpretation of a reduced system which included market demand and supply only, but not the revenue function of the processing industry. The estimation results provide that oligopsony power is significant but at a very low level. This led us conclude, that factor allocation and income distribution on the milk market might not be biased by market power. In addition, we were able to explain the large reduction of raw milk prices after the abolishment of the price support system by the structure of demand and supply elasticities. The absence of market power on the milk market is also confirmed by the fact that farmers posses alternative choices to market their produce as there are purchases to domestic producers, export of raw milk, and direct sales of the produce. In addition, our results demonstrates that the simple look at indicators of market structure like concentration ratios may lead to misleading results because of the lacking one-to-one relationship between these indicators and the behaviour of firms on the market.

REFERENCES

BAKUCS, L. Z., FERTÖ, I (2005): Marketing Margins and Price Transmission on the Hungarian Pork Meat Market. Agribusiness 21: 273-286.

BAKUCS, l. Z. FERTÖ, I., HOCKMANN, H., PEREKHOSHUK, O. (2006): Farm to Retail Price Transmission on the Pork Market: A German - Hungarian comparison. In: Curtiss, J., Balmann, A., Dautzenberg, K., Happe, K. (eds.): Agriculture in the Face of Changing Markets. Studies on the Agricultural and Food Sector in Central and Eastern Europe, Vol. 33. pp 414-429

BOJNEC, S. (2002): Price Transmission and Marketing Margins in the Slovenian Beef and Pork Markets During Transition. Paper presented at the X. Congress of European Association of Agricultural Economists, 28-31 August, Zaragoza, Spain.

BREITUNG, J. (2002): Nonparametric Tests for Unit Roots and Cointegration. Journal of Econometrics 108: 343-364.

BRESNAHAN, T. F. (1982): The oligopoly solution concept is identified. Economics Letters 10: 87-92.

BRESNAHAN, T. F. (1989): Empirical Studies of Industries with Market Power. In: R. Schmalensee, Willig R. D. (eds.): Handbook of Industrial Economics, 2, Amsterdam. 1011-1057.

CHAMBERS R. G. (1988): Applied Production Economics. A Dual Approach. Cambridge.

CORTS, K. S. (1999): Conduct Parameter and the Measurement of Market Power. Journal of Econometrics 88: 227-250.

ESTIMA (2004): Rats, Version 6. Reference Manual. Evenston.

FULLER, W.A. (1996): Introduction to Statistical Time Series. (2nd Ed.). New York

GREENE W. H. (2003): Econometric Analyses. 5th ed. New Jersey.

HOCKMANN, H., VŐNEKI, É. (2004): German and Hungarian milk chains: expectations and first experiences of accession and market reform. In: Popp, J., Kamarásné Hegedűs, N. (eds.): Application of the Common Agricultural Policy in the Enlarged European Union. Budapest. S. 227-241.

JOHANSON, S. (1992): Determination of the Ccointegration Rank in the Presence of a Linear Trend. Oxdord Bulletin of Economics and Statistics 54: 383-397.

LÜTKEPOHL, H. (2004): Vector Autoregressive and Error Correction Models. In: Lütkephohl, H., Krätzig, M. (eds): Applied Time Series Econometrics. Cambridge. 86-158.

MEYER, L., VON CRAMON-TAUBADEL, S. (2004): Asymmetric Price Transmission: A Survey. Journal of Agricultural Economics 55: 581-611

MUTH, M. K., WOHLGENANT M. K. (1999): Measuring the Degree of Oligopsony Power in the Beef Packing Industry in the Absence of Marketing Input Quantity Data. Journal of Agricultural and Resource Economics 24: 299-312.

PETER, G. (2003): Marktintegration und Preisrisikoreduzierung durch den ungarischen Warenterminmarkt für Getreide. Göttingen

WÖHLKEN, E. (1984): Einführung in die landwirtschaftliche Marktlehre. 2. überarbeitete auflage. Stuttgart.