Price distortions on the Hungarian raw milk market

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ABSTRACT

The paper attempts to identify the impact of market power in the Hungarian milk chain. Since the conventional conjectural variation approach provides suspicious results the incentives to collude are discussed in an alternative framework. It is argued that the high degree of market transparency, the high frequency of interaction, the low number of large firms which could actually influence market prices, the threat of severe sanctions due to the underutilization of processing capacities as well as opportunistic behavior make collusive behavior more likely than competitive behavior. The empirical evidence for the period 1998 to 2006 supports this view.

Keywords: market power, dairy processing, Hungary.

1 Introduction

In this paper developments on the Hungarian milk market between 1998 and 2006 are analyzed to assess whether the market results are consistent with a functioning market or whether frictions are present that allow some parties to appropriate the rents associated with milk production. Based on a model of tacit collusion, the factor facilitating and hindering collusion are identified. The tacit collusion model is theoretically reasonable, however, it provides no definite answer about the extent of market failures resulting from market power since only qualitative statements are possible. Thus, the conclusions regarding the existence of market power are complemented with results from an earlier study which aimed at estimating the significance of market power in the Hungarian milk market.

We focus on the dairy chain for several reasons. First dairy production is an important source of farm income in Hungary. Second, the Hungarian milk market was subject to policy shocks which induces significant adjustment in milk production and processing. Third, milk processing is relative highly concentrated and dominated by foreign capital. Forth milk prices in Hungary belong to the lowest in the new EU member states, until 2006. Especially the two latter conditions might suggest the existence of considerable market power.

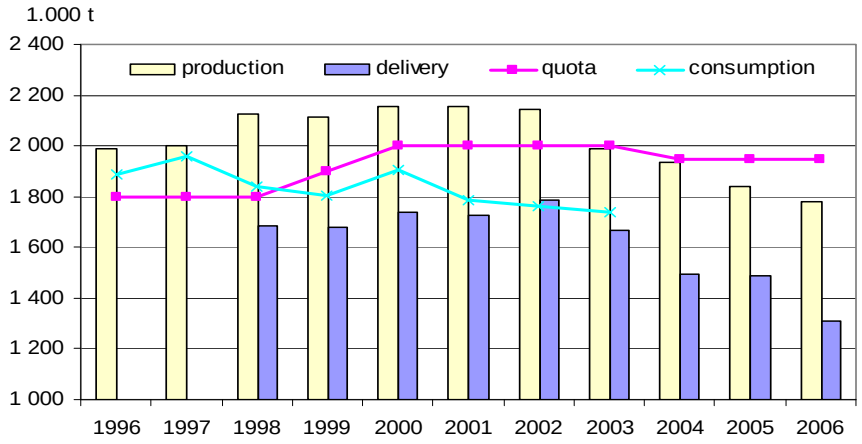
2 Description of the Hungarian Dairy Chain

2.1 Development of milk production and consumption

Before 2004 milk production rose to about 2.1m t. Due to the abolishment of the national price support system in 2004 and the induced decline of milk prices, milk production in Hungary shrank until 2006 by about 15% to 1.8m t. 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 (Figure 1).

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 2006 exports to Italy amounted to already 230,000 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 recent years. However, in the case of high value added products (especially by cheese) some increase could be observed.

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



Source: TEJ TERMÉKTANÁCS, KSH – STATISZTIKAI ÉVKÖNYV, ÁLLATÁLLOMÁNY

2.2 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 number of small producer with 1-9 cows is relative high yet, 90% of the enterprises belongs to this category. Despite of this structure, milk production in Hungary is rather concentrated. Approximately 98% of the raw milk is produced in enterprises with more than 100 cows.

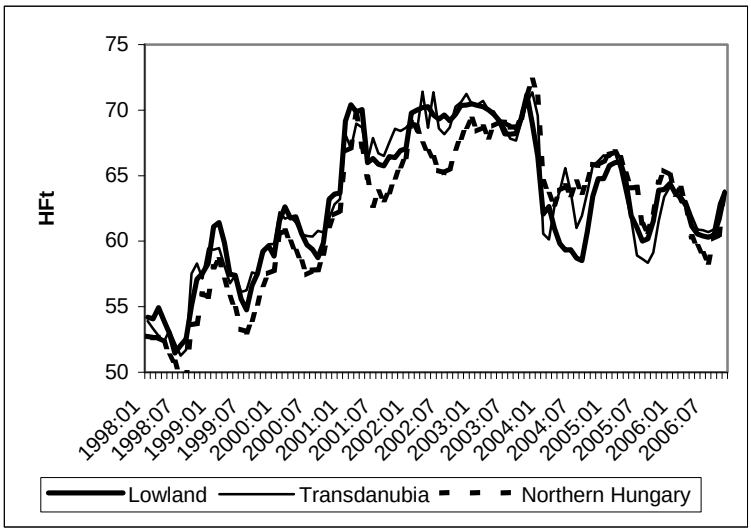
2.3 Processing industry

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.

2.4 Farm gate prices

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. 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. Before 2004 an export subsidy system existed. Processors received export subsidies when they paid the target price for raw milk to the farmers. This system kept the milk prices artificially high. The abolishment of the national price support system in the beginning of 2004 led to decrease of the raw milk price.

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



Source: AKI – PÁIR

3 The significance of market power

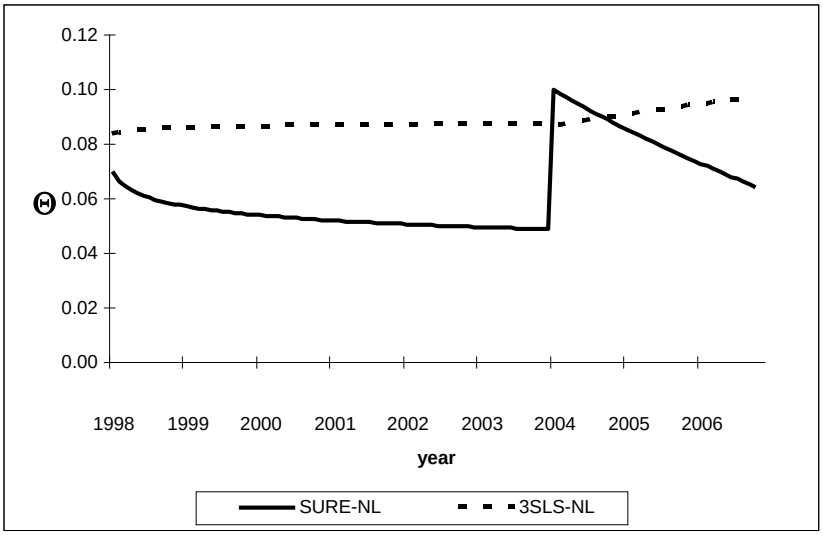
HOCKMANN and VŐNEKI (2009) analysed price formation on the Hungarian raw milk market with a structural market model. These models followed BRESNAHAN (1982 and 1989) and MUTH, WOHLGENANT (1999). In this tradition the identification on market power is embedded into a conjectural variation framework.

HOCKMANN and VŐNEKI (2009) compared two models. Both extent the traditional models by allowing for trend and dummies in the parameter supposed to capture the effects of market power (Θ)[1]. The first model consists of a simultaneous estimation of raw milk supply and demand (3SLS - NL). However, nonlinearities and multicollinearity causes that the estimates behaves poorly from a theoretical point of view. In the second approach the theoretical approach was modified. The result was a recursive model that allows to estimates in the first step raw milk supply and raw milk demand in the second step (SURE - NL). The parameter estimates for this approach were more satisfactory than the second model.

Moreover, the two model produces rather different results regarding the impact of oligopsony power in the Hungarian raw milk market (Figure 3). The estimates provide that the original level of market power was relatively low and, although not statistically significant, decreasing over time. Both estimates indicate that Θ was on average about 0.05 in the period before 2004. The policy change in 2004 increased the exploitation of market power; in fact, Θ doubled in 2004; however, the estimation also provides that there has been a rather fast adjustment to the level existing before 2004. Given that SURE – NL provides more reliable results for the structure of production and processing the authors opted for the second apparoch. From their point of view, the results for the impact of market power in the period under investigation are also more reliable than the results of the SURE – NL model.

[1] A value of Θ =1 denote monopoly power while Θ =0 is a market with perfect competition.

Figure 3: Change of Θ on the Hungarian raw milk market, 1998 to 2006



First, consistent with the increase of prices, market power is declining in the period under investigation. Although not significant, there is indication that the abolishment of export subsidies enables processors to exploit more market power. Before 2004 processors received the export subsidies when they pay the target price to the farmers. Thus the possibilities to extract extra rents by the reduction of raw milk prices where rather limited. Moreover, drop of proces in 2004 suggested that processors where able to improve their market position. However, in sum, the estimates suggest that the degree of market power ($\Theta < .1$) is rather low, and thus may not a serious problem in the Hungarian milk chain.

This result is surprising given the high concentration of dairy processing and the relatively low milk prices in Hungary. Even farmers are confronted by a relatively small number of processors the latter might 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 prices for the raw materials. Given this interpretation, the fact that the evidence for market power is relatively poor is a coherent estimation result. However, in this view it is difficult to explain the drop of raw milk prices after 2004.

Moreover, considering the under utilized capacities in the processing industry, the presumption that processors optimize with regard to quantities is little satisfactory. Given a static framework, KREPS and SHEIKMAN (1983) show that in a homogeneous good industry with capacity constraints, firms behave as they would do in a Cournot setting. In addition, it was shown that the conjectural variation approach only provides consistent results when the Cournot outcome is reached (DAUGHETY 1985). Given that

about 100 processors existed and not all compete with each other the estimated results for Θ by the conjectural variation approach might be consistent with a Cournot outcome.

Without capacity constraints firms will end up in a Bertrand equilibrium characterized by severe competition (TIROLE 1988). In a Bertrand game, firms do not set quantities but process. Following the procedure outlined in section 3.1 and taking into account that raw milk process are horizontally differentiated provides an optimal condition having the same structure as (9). However, the interpretation of the condition is rather different, because Θ captures the impact of product differentiation instead of market power. Moreover, given that raw milk prices differ regionally (Figure 2) and that capacities are underutilized the correct interpretation of Θ may not be market power but the degree of product differentiation.

So far, market power is derived in a conjectural variation approach. Correspondingly, the parameter can only be interpreted consistently within this framework. Because it is incorporated in a static setting, it presumes that at each date firms behave as if they have met for the first time, i.e. there is no memory in the decision making process. Especially when firms repeatedly meet this is a very crucial assumption, especially for food processors and farmers since transaction are conducted continuously. Moreover, CORTS (1999) shows that the conjectural variation approach underestimates the amount of market power systematically compared to a dynamic model allowing for the possibility of tacit collusion when permanent shifts in the exogenous variables occur.

4 Tacit Collusion

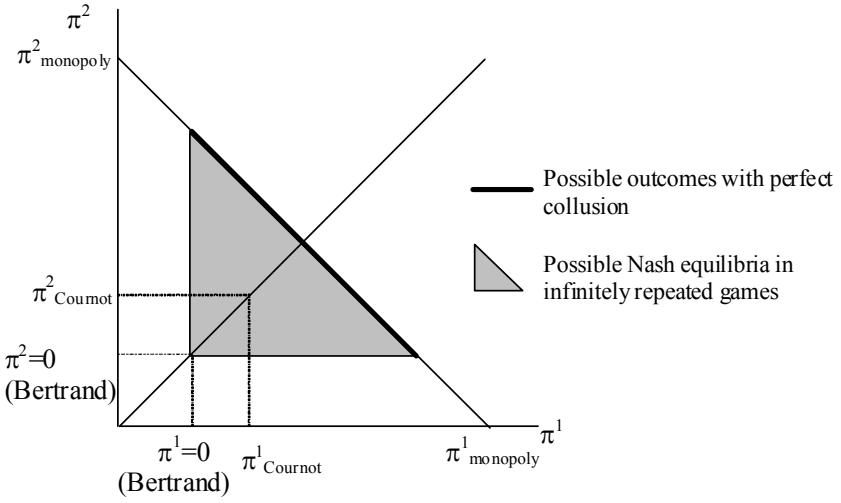
The arguments discussed in the preceding section provide that it might be misleading to regard Θ as an indicator of market power. Moreover, the theoretical consistency of Θ is rather poor. In the following a different approach will be presented. Contrary to section 3.1 no functional relationship between an indicator and market poser will be derived, but the various factors facilitating and hampering collusion in the Hungarian dairy industry will be discussed.

4.1 Firm behaviour in a dynamic setting: Repeated games

While theory provides unambiguous results regarding firm behaviour in a static setting (Cournot equilibrium for full capacity utilisation, Bertrand equilibrium for underutilised capacities), firms behaviour in a dynamic framework is far from unambiguous. Game theoretic results exists for finitely and infinitely repeated games. In the first case backward induction suggests that firms behave as in a shoot simultaneous game. The solution becomes more complex, when the game is repeated indefinitely.

According to the Folk theorem, every outcome that is better than the worst Nash equilibrium can be reached by an equilibrium strategy (Figure 4). This implies that there exists a plenty of equilibrium solutions and no definite answer regarding the behaviour of the firm in the industry is possible (FUDENBERG and TIROLE 1990). It may be argued that the assumption of an indefinitely repeated game is artificial, however, however, this requirement may be weakened by the assumption that the probability of continuation from one stage to the next is strictly positive.

Figure 4: Equilibrium solution in a duopoly under different behavioural assumptions



4.2 Factor hindering and facilitating collusion

Having defined the principle solution set for a situation with dynamic interactions, it remains to discuss the determinants that may hinder and facilitate solution. Possible influences on collusion will be discussed with an illustrative model. We assume a homogeneous good industry with n firms. Furthermore, demand growth with rate g[2].

When firms coordinate their pricing behaviour, prices will be larger than marginal cost ($p > c$) and industry profits π^C will be realized which are divided by a predefined key that consists of the profits shares received by the individual firms (s_i)[3]. A firm deviating from this (implicit) agreement sets a price slightly lower than p and receives profits $\varepsilon_i \pi^C$ in the deviating period and $\delta_i \pi^C$ thereafter, with $\varepsilon_i > \delta_i$. In addition we assume that $\varepsilon_i > s_i > \delta_i$ since otherwise there would be no incentive to deviate (the first inequality) and no incentive to cooperate (the second inequality).

The parameters ε_I and δ_I reflect the production capacities of the firms. The larger ε_I, i. e. the lower are the capacity constrained of the deviating firm, the easier the firm can serve the whole market. Contrary, higher δ_I indicate high capacity constrains of the competitors. The discount factor is given by ρ. The frequency of which transactions occur is given by α. The higher α, the higher the frequency, i.e. $\alpha = 1$ corresponds to an annual transaction while $\alpha = 365$ indicates daily transactions.

Next, we will apply the following strategy. Firms agree to cooperate in the first stage. As long as there is no deviation from the agreed process, cooperation will continue. However, if one firm deviates, the agreement will break down and firms start to apply competitive pricing. Formally, this strategy is sustainable, when the following condition holds:

$$(1) \qquad s_i \pi^C \sum_{j=0}^{\infty} \left[(1+g)\rho\right]^{\frac{j}{\alpha}} > \varepsilon_i \pi^C + \delta_i \pi^C \sum_{j=1}^{\infty} \left[(1+g)\rho\right]^{\frac{j}{\alpha}},$$

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[2] We follow the procedure usually found in the literature, where collusion is discussed with regard to output markets. However, a corresponding interpretation for input or procurement markets is straightforward.

[3] The s_i can be thought of the initial market shares or shares on production capacities of the firms.

Thus, collusion is a viable strategy when firms put more weights on future than on present profits. Moreover, (1) can be transformed to present a threshold at which collusion is sustainable:

$$(2) \qquad \rho^* > \frac{(\varepsilon_i - s_i)^{\alpha}}{(1+g)(\varepsilon_i - \delta_i)^{\alpha}},$$

Generally, collusion is easier to sustain, when the threshold is lower, because than even an impatient firm with a low discount factor regards collusion as a beneficial strategy. Condition (2) provides that the threshold is increasing in ε_i and δ_i, but decreasing in s_i, g and α.

4.3 The potential for Collusion in the Hungarian Dairy industry

4.3.1 General considerations

Milk supply is characterized by steady production. This provides that the *frequency* of transactions (α) is high which in turn makes collusion more likely. Moreover, it can be assumed that *market transparency* is also relatively high. Processors can detect possible deviation from an agreement relatively easy from the change of deliveries or the negotiation with farmers. In addition, price information systems are available that provide information about the recent price developments without serious delays. These suggest that deviation may be detected immediately, and the competitors can react quickly. Thus the high degree of market transparency reduces the incentives to deviate from a collusive agreement.

A further characteristic of milk production is the perishableness of the raw material. Milk cannot be stored for a longer time without being processed. This puts farmers in a poor bargaining position because the possibilities to adjust milk production immediately to the changing market condition are rather limited. From this it follows that processors possess distinct possibilities to gain from *opportunistic behaviour*, i.e., to extract large parts of the producer rents associated with milk production. However, Figure 1 shows that milk production and milk deliveries decreased since 2002. On the one hand, this may indicate structural change in agriculture since it can be expected that especially small farmers who do not deliver to dairy companies would abandon milk production. However, since milk deliveries declined almost parallel to milk production an additional effect is present. It consists in the development of alternative marketing channels for raw milk.

This development has severe consequences for collusive behaviour. Condition (2) provides that *market growth* facilitates the collusive behaviour, because deviation would lead to higher foregone future profits. However, since production as well as deliveries of raw milk in Hungary are decreasing, and given that capacities of the processors are fixed to a large extent, the costs of capacity underutilisation would increase. This suggests that the incentives to switch to competitive behaviour on the raw milk market were increasing over time.

In Chapter 2 the *high concentration* ratio in the dairy processing industry was mentioned. Moreover, this also suggests a wide range of firm sizes in that industries. The incentives for large and small firms to deviate from collusion and also the consequences of deviation will vary by farm size. In condition (2) these forces find their expression in s_i, ε_i and δ_i. *Small firms* will have little s_i and ε_i. On the one hand, the first reduces while the second increases the incentives to collude. However, it can be expected that due to capacity constraints ε_i is not much larger than s_i. Corresponding to condition (2) the threshold will be relatively low, i.e. together the two parameters facilitates collusion. In addition, if a small firm deviates the larger competitors may react with severe competition. This would result in an increase in the procurement price, which in turn – because of the low economies of scale in small firms

– suggests a rather low δ_i. or even market exit ($\delta_i = 0$). Summarizing these arguments provides that small firms may have little incentives to deviate from a collusive agreement. On the other hand, even if the firms deviate, the sanctions may be less severe than those when a large firm of large firms deviates. Since small firms usually have low capacities, their additional demand when deviating will be low possibly without a noticeable impact on market prices. This argument holds as long as not too many small companies try to deceive. In *large firms* were collusion may lead to high unused capacities, ε_i can be expected to be significant larger than s_i which implies a high threshold. However, these low incentives to collude can be compensated by the threat of intense competition on the raw milk market (low δ_i) which in turn requires that large firms possess sufficient underutilised capacities to make the threat reliable. Exactly this is observed in the Hungarian dairy industry.

This discussion of the various determinants of collusion provides that there is no unambiguous answer to the question whether the situation in the Hungarian dairy industry facilitates or hinders collusion. However, in our view, the points in favour of collusion (high degree of market transparency, high frequency of interaction, a low number of large firms which actually could influence market prices, threat of severe sanctions due to low capacity utilisation, opportunistic behaviour) make collusive behaviour more likely than competitive behaviour. The empirical evidence suggests this view. In Figure 2 it is shown that prices have dropped significantly after 2003 with the change of public support of dairy product exports and have remained at that level until the end of 2006. More recently, process started to increase again. This developments will be the subject of the next subchapter.

4.3.2 Public policy and the development of new marketing channels

It was already described in Chapter 2 that the Hungarian government abandoned export subsidies in 2004. These subsidies were provided to dairy processors only when they prove that they pay a least a target price of raw milk. Since especially the large dairy processors were export oriented, it can be expected that the additional benefits from exports overcompensated the benefits arising from a possible exploitation of market power. In this interpretation the export subsidies can be regarded a an institutional restriction that hinders collusion on the raw milk markets.

The abolishment of the subsidies provides more weight to the determinants discussed in Chapter 5.1. Moreover, the difference between the former market price and the subsidy assists in finding a focal point for a price upon which the processors could agree. Further pressure on prices results from the fact that without subsidies the demand for Hungarian export declined which put additional pressure on the domestic market.

In recent years there is an increasing export of raw milk, especially to Italy. In 2005 the share of raw milk exported was about 5% of sales but it strongly increased and it is estimated that in 2007 it will reach about 10% of milk sold by farmers. It can be expected that this development induces pressure on the stability of a collusive agreement, in particular, because of the regional pattern of raw milk exports which come especially from the Western parts of Hungary. The loss of raw materials resulted in an increase in capacity utilisation and thus led to asymmetric capacity utilisation among dairies. However, since asymmetries in capacity utilisation hinder collusion it might have been expected that the factors favouring collusion might become less important. However, part of the exported raw milk was substituted by raw milk imported from Romania. Interestingly, the price of the imported raw milk was higher than the average price for domestically imported milk providing additional evidence that milk production still suffers from the negative impacts of collusion. Consequently, raw milk prices in Hungary are still on a rather low level and there is no sign for a recovery of prices to their old level or even to the

average price level in Poland, Slovakia and the Czech Republic, which joined the EU together with Hungary.

5 Discussion

The analysis was motivated 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, the analysis was restricted to 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 on the raw milk market.

The conjectural variation approach provides that oligopsony power is significant but at a rather low level. However, although consistent with industry structure in dairy processing and marketing alternatives of farmers, the results have to be questioned from theoretical and empirical points of view. First the low degree of market power might not be consistent with the drop of prices observed after the abolishment of export subsidies. In addition, given the underutilized capacities, Bertrand behaviour is more likely than Cournot suggesting that the estimated indicator does not measure market power but the degree of product differentiation. Moreover, a static framework may not be appropriate at all to identify market power.

Because of these shortcomings, we discussed an alternative approach, i. e., tacit collusion discussed factor affecting the co-ordination of behaviour among Hungarian milk processors. This discussion of the various determinants of collusion provides that there is no unambiguous answer to the question whether the situation in the Hungarian dairy industry facilitates or hinders collusion. However, we argue that the high degree of market transparency, the high frequency of interaction, the a low number of large firms which actually could influence market prices, the threat of severe sanctions and opportunistic behaviour make collusive behaviour more likely than competitive behaviour. The empirical evidence suggests this view since prices in Hungary are on a rather low level compared to its neighbouring countries. In addition, we show that the export subsidies provided to processors when they pay farmers the target price for raw milk, might be regarded as an institutional restriction that prevents processors from the exploitation of market power. Beyond, the drop of processes after the abolishment of the subsidies in the end of 2003 provide empirical evidence that the dairy processors in Hungary managed to form an agreement which allows them to extract large parts of the producer rents.

References

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.

Daughety, A. (1985): Reconsidering Cournot: the Cournot equilibrium is consistent, *RAND Journal of Economics* 16, 368-379.

Fudenberg, D., Tirole, J. (1992): Game Theory. Cambridge and London.

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, 227-241.

Hockmann, H., Vőneki, É. (2009): Collusion in the Hungrian Market for Raw Milk. Outlook on Agriculture 38, 39-47.

Kreps, D., Sheikman, J. (1983): Quantity Commitment and Bertrand Competition Yield Cournot Outcomes. *Bell Journal of Economics* 14, 3265-337.

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.

Tirole, J. (1988): The Theory of Industrial Organisation. Cambridge and London.