Do the EU food processors abuse Oligopsony market power?

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Abstract[1]: *The paper identifies the degree of market imperfections in the input processing market and provides a comparative analysis among the different EU countries and different industries. For detection of the abuse of oligopsonistic/monopsonistic behavior a mark down model using stochastic frontier methodology was derived. The results show that the input food processing market is characterized by some degree of non-competitive behavior in all analysed sectors - slaughtering, fruits and vegetables, dairy and milling. However, the degree of market imperfections differs among the sectors as well as within individual sectors. In particular, the EU slaughtering common market is characterised by considerably greater market imperfections as compared to the dairy and milling sectors. Moreover, significant differences among EU member countries in individual countries were revealed by the estimate in all analysed sectors. In particularly, some companies are characterized by significant oligopsony market power.*

Key words: *oligopsony, market power, food processing industry, SFA*

JEL classification: D22, D43, L13

[1] Acknowledgement: This paper was generated as part of the COMPETE Project, Grant Agreement No. 312029 funded by the European Community under the 7th Framework Programme. The authors gratefully acknowledge for the support.

1. Introduction

In this paper we focus on the analysis of market imperfections in the EU food processing industry. Our aim is to identify the degree of market imperfections in the input food processing market and conduct a comparative analysis among the different EU countries and different industries. That is, based on the derived mark down and using stochastic frontier methodology, we will identify the degree of non-competitive behaviour in the slaughtering, fruits and vegetables, dairy and milling sectors in 24 EU member states (only Croatia, Cyprus, Luxemburg and Malta are missing).

This study extends the research on the analysis of market imperfections. Since 1980 there have been numerous studies based on a New Empirical Industrial Organization theoretical background focused on detecting market power or, in general, market imperfections in the agricultural and food processing market, as the case may be. Most of these studies are based on market-level data. There is evidence of the oligopsonistic market power of food processors (e.g. Schroeter and Azzam, 1990, Morrison Paul, 2000), but there are also studies which failed to find any evidence of oligopsonistic power (e.g. Weliwita and Azzam, 1996, Muth and Wohlgenant, 1999, Perekhozhuk and Grings, 2006) or found only weak oligopsonistic power (Scalco and Brage, 2014). Studies using firm-level data are not so numerous and include, for example, Hockmann and Vöneki (2009), Bakucs et al. (2009), Perekhozhuk et al. (2011) and Acharya et al. (2011).

In this paper, we use firm-level data and address the following research questions: (1) which degree of non-competitive behaviour of the food processors with respect to farmers could be observed? (2) Whether the input processing markets differ significantly among countries, and 3) Whether the EU processing market is becoming increasingly competitive or whether an idiosyncratic development of market power can be observed.

The paper is organized as follows: Chapter 2 introduces the theoretical framework and Chapter 3 presents the estimation strategy. Chapter 4 describes the data set. Chapter 5 presents the results of the mark down model, compares the estimated market imperfections between countries and sectors as well as their development. The concluding remarks are presented in Chapter 6.

2. Theoretical framework

2.1 Mark down pricing: Simple principles

Throughout this paper we assume simple mark down modelling of the form (Dorfman 2014, Wohlgenannt 2001)**:**

$$w = b(s)\frac{\partial R(p,l,r,x)}{\partial x} - a(s) \quad (1)$$

With w the factor price, R is the revenue function which depend on an output prices (p), labour and capital cost (l and r, respectively) and the level of the raw material output (x). a and b are constants but contingent on firm strategies (s). In general the strategy may depend on frequency of transactions, opportunistic behaviour, market growth, firm size, capacities and their utilization, technology and innovation, entry barriers. However, in addition the behaviour of competitors also affects the strategies and thus pricing. A typical example is exploitation of market power through tacit or explicit collusion[2]. These determinants are mutually interdependent and determine a complex system of determinants.

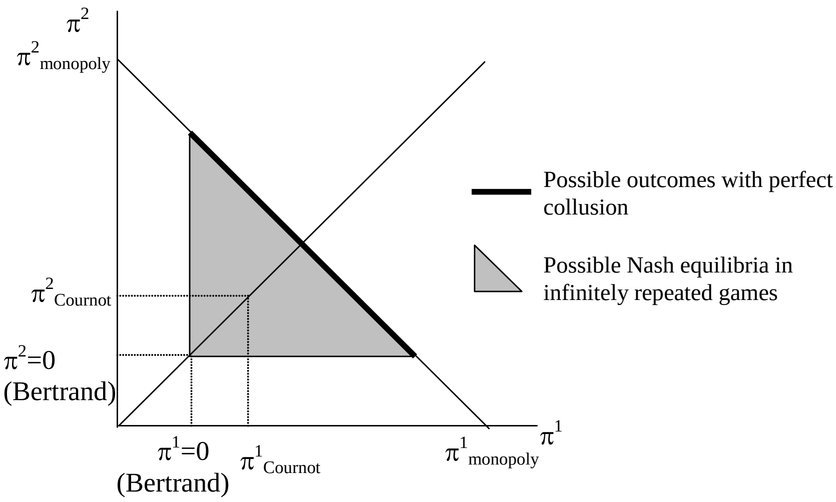
In reality companies would like not only cover their costs but also achieve desired amount of profit. To achieve this profit margin the products should be purchased at a price, that is lower thanmarginal revenue, i.e. a > 0, b < 1 In perfect competition, any profit-maximizing raw material producer faces a market price equal to its marginal revenue (w=MR, e. g. b=1 and a = 0). The existence of a pronounced mark down suggests that the non-competitive behaviour at the markets exists.

2.2 Firm behaviour in a dynamic setting: Repeated games

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

[2] Mark up models are generally used in the analysis of vertical and horizontal price transmission (e.g. Fudenberg, Tirole, 1990)

Figure 1: Equilibrium solution in a duopoly under different behavioural assumptions



Source: Hockmann, Vöneki (2009)

According to the Folk theorem, every outcome that is better than the worst Nash equilibrium can be reached by an equilibrium strategy (Figure 1). This implies that there exist plenty of equilibrium solutions, and no definite answer regarding the behaviour of a firm in the industry is possible (Fudenberg, Tirole, 1990). It may be argued that the assumption of an indefinitely repeated game is artificial; however, this requirement may be weakened by the assumption that the probability of continuation from one stage to the next is strictly positive.

2.3 Factors 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 a 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.[3]

When firms coordinate their pricing behaviour, prices will be larger than marginal costs ($w < MR$ and industry profits π^C will be realized, which are divided by a predefined key that consists of the profit shares received by the individual firms (σ_i).[4] A firm deviating from this (implicit) agreement sets a price slightly lower than p and receives profits $\varepsilon_i\ \pi^C$ in the

[3] 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.

[4] The σ_i can be thought of as the initial market shares or shares of the production capacities of the firms.

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 less the capacity of the deviating firm is constrained, the easier the firm can serve the whole market. By contrast, higher δ_I indicate large capacity constraints of the competitors. The discount factor is given by ρ. The frequency with which transactions occur is given by α. The higher the 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 will begin to apply competitive pricing. Formally, this strategy is sustainable, when the following condition holds:

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

Thus, collusion is a viable strategy when firms put more weight on future than on present profits. Moreover, (12) can be transformed to present a threshold at which collusion is sustainable:

(13) $$\rho^* > \frac{(\varepsilon_i - \sigma_i)^{\alpha}}{(1+g)(\varepsilon_i - \delta_i)^{a}},$$

Generally, collusion is easier to sustain when the threshold is lower, because in that case even an impatient firm with a low discount factor regards collusion as a beneficial strategy. Condition (13) provides that the threshold is increasing in ε_i and δ_i but decreasing in σ_i, g and α.

2.4 The potential for collusion in the food industry

If the *frequency* of transactions (α) is high it makes collusion more likely (Buigues and Rey 2004). Moreover, this situation implies that *market transparency* is also relatively high (Ivaldi et al. 2003). Processors can detect possible deviation from an agreement relatively easily from a change in deliveries or negotiations with farmers. In addition, price information systems are available that provide information about recent price developments without serious delays. These suggest that deviation may be detected immediately, and the competitors can react quickly. Thus a high degree of market transparency reduces the incentives to deviate from a collusive agreement.

A further characteristic of food production is the perishableness of the raw material. Raw material usually cannot be stored for a long time without being processed. This puts farmers in a poor bargaining position, because the opportunities to adjust production immediately to changing market conditions are rather limited. From this it follows that processors possess distinct possibilities of gaining from *opportunistic behaviour*, i.e. of extracting large parts of the producer rents associated with production (Ivaldi et al. 2003).

Moreover, condition (13) provides that *market growth* facilitates collusive behaviour, because deviation would lead to higher foregone future profits. In general, the costs of capacity underutilisation determine a firm's behaviour. An increase in the costs of capacity underutilisation increases the incentives to switch to competitive behaviour over time.

Furthermore, the incentives for large and small firms to deviate from collusion, as well as the consequences of deviation, will vary by firm size (Compte et al., 2002). In condition (13), these forces find their expression in σ_i, ε_i and δ_i. *Small firms* will have little σ_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 σ_i. Corresponding to condition (13), the threshold will be relatively low, i.e. together the two parameters facilitate 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 a market exit ($\delta_i = 0$). Summarizing these arguments suggests that small firms may have few incentives to deviate from a collusive agreement. On the other hand, even if the firms deviate, the sanctions may be less severe than those which occur when a large firm or firms deviate. 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* where collusion may lead to high unused capacities, ε_i can be expected to be significant larger than σ_i, which implies a high threshold. However, these low incentives to collude can be compensated by the threat of intense competition on the raw materials market (low δ_i), which in turn requires that large firms possess sufficient underutilised capacities to make the threat credible.

This discussion of the various determinants of collusion shows that there is no unambiguous answer to the question of whether the situation in the food processing industry facilitates or hinders collusion. However, in our view, the points in favour of collusion (high degree of market transparency, high frequency of interaction, small number of large firms which could actually influence market prices, threat of severe sanctions due to low capacity utilisation, opportunistic behaviour) make collusive behaviour more likely than competitive behaviour.[5]

Generally, the data needed to estimate the mark down are usually very sensitive information and not available because they present specific knowledge that is kept secret. In fact revealing the mark down gives information about the competitive strategies and thus could be used by competitors to adjust their behaviour to gain from an adjustment of their pricing. However economic modelling can be applied to identify the mark down and to gain some insights into the behaviour of the firms.

3. Identification of the mark down

The research questions will be addressed by estimating the derived mark down and employing stochastic frontier methodology. The stochastic frontier approach for detection of the degree of monopoly power was first applied by Kumbhakar et al. (2012). The novelty of our study is the derivation of a mark down model using stochastic frontier methodology for detection of the abuse of oligopsonistic/monopsonistic behaviour. The mark down model is derived using the conjectural variation approach. First, we introduce the firm optimization problem, which is followed by the identification and estimation of the mark down.

3.1 Firm optimization

We follow the methodology developed by Bresnahan (1982 and 1989) and Muth, Wohlgenant (1999) to test for oligopsonistic market power. The profit of a processor (*i*) is given by:

[5] Since the dataset consist of large companies (see chapter 4) in majority of cases we can expect that some large companies may exercise market power.

(1) $\pi_i = R(\mathbf{p}, \cdot x_i, \mathbf{z}_i, t) - w_X \cdot x_i - \mathbf{w_Z}'\mathbf{z}_i$

where **p** is a vector of product prices, R(**p**, x_i, $\mathbf{z_i}$, t) represents the revenue function depending in addition on the agricultural raw materials (x), other inputs (**z**) and a time trend (t) as an indicator of technical change. The symbol w is used for the corresponding factor prices. The supply function of raw materials is:

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

Here, **s** is a vector of supply shifters and x is the total supply of raw material. However, for analysing the optimal demand of the processor it is more convenient to use the inverse supply function $w_x = g^{-1}(x, \mathbf{s})$. Given (1) and (2), 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 in total farm supply induced by an increase in processor *i*'s demand for milk. After rearrangement of (3):

(4) $$w_X \left(1 + \frac{\Theta}{\varepsilon}\right) = \frac{\partial R(\mathbf{p}, x, \mathbf{z}, t)}{\partial x},$$

where $\varepsilon_x = \frac{\partial x}{\partial g^{-1}(x, \mathbf{s})} \frac{g^{-1}(x, \mathbf{s})}{x} = \frac{\partial \ln x}{\partial \ln w_x} < 0$ denotes the price elasticity of the raw material supply and $\Theta = \frac{\partial x}{\partial x_i} \frac{x_i}{x}$ is an elasticity capturing the degree of oligopsonistic market power (Bresnahan, 1989). The parameter range is $0 < \Theta < 1$. $\Theta = 0$ corresponds to perfect competition, while $\Theta = 1$ characterizes a monopsonistic market.[6]

From (4) it follows that:

$$w_x < MRP_x = \frac{\partial R}{\partial x}$$

This relationship can furthermore be expressed as:

6 Since prices of other inputs are assumed to be constant, their optimal level is given when the factor price is equal to the value of marginal revenue: $w_Z = \frac{\partial R(\mathbf{p}, x, \mathbf{z}, t)}{\partial z}$.

(5) $$w_x \frac{x}{R} < MRP_x \frac{x}{R} = \frac{\partial \mathrm{R}}{\partial \mathrm{x}} \frac{x}{R} = \frac{\partial \ln R}{\partial \ln x} = \frac{\partial \ln D^o}{\partial \ln x}$$

Where the last equality comes from the duality of the revenue (R) and output distance (D^o) functions.

3.2 Derivation of the mark down

Inequality in (5) can be transformed into equality by adding a non-negative one-sided term, u:

(6) $$\frac{w_x x}{R} = \frac{\partial \ln D^o}{\partial \ln x} - u\,,\; u \geq 0\,.$$

Assuming that the output distance function has a translog form:

(7) $$\begin{aligned} \ln D^o =\; & ß_0 + ß_t t + \frac{1}{2} ß_{tt} t^2 + ß_x \ln x + ß_{xt} \ln xt + \frac{1}{2} ß_{xx} (\ln x)^2 \\ & + \mathbf{ß}_z ' \ln \mathbf{z} + \mathbf{ß}_{zt} ' \ln \mathbf{z} t + \frac{1}{2} \ln \mathbf{z} ' \mathbf{B}_{zz} \ln \mathbf{z} + \ln \mathbf{z} ' \mathbf{ß}_{zx} \ln x \\ & + \mathbf{ß}_{\mathbf{y}} ' \ln \mathbf{y} + \mathbf{ß}_{\mathbf{y}t} ' \ln \mathbf{y} t + \frac{1}{2} \ln \mathbf{y} ' \mathbf{B}_{\mathbf{yy}} \ln \mathbf{y} + \ln \mathbf{y} ' \mathbf{ß}_{\mathbf{y}x} \ln x \\ & + \ln \mathbf{y} ' \mathbf{B}_{\mathbf{yz}} \ln \mathbf{z} \end{aligned}$$

With the corresponding differential and addition of statistical noise (v), (6) becomes:

(8) $$\frac{w_x x}{R} = ß_x + ß_{xt} t + ß_{xx} \ln x + \mathbf{ß}_{zx} ' \ln \mathbf{z} + \mathbf{ß}_{\mathbf{y}x} ' \ln \mathbf{y} - u + v\,.$$

For one output, (8) reduces to (*homogeneity of degree 1 requires that $\beta_{yx} = 0$*):

(9) $$\frac{w_x x}{R} = ß_x + ß_{xt} t + ß_{xx} \ln x + \mathbf{ß}_{zx} ' \ln \mathbf{z} - u + v\,.$$

Since we define the relative mark down by:

(10) $$\sigma = \frac{MRP_x \text{-w}_{\text{x}}}{\text{MRP}_x}$$

It can be estimated via (*expanding by x/R and using the duality relationship*):

(11) $$\sigma = \frac{u}{\partial \ln D^o / \partial \ln x}$$

That is,

(11´) $$\hat{\sigma} = \frac{\hat{u}}{ß_x + ß_{xt} t + ß_{xx} \ln x + \mathbf{ß}_{zx} ' \ln \mathbf{z}} \ .$$

3.3 Estimation strategy

The derived mark down model (9) will be estimated using the stochastic frontier methodology. Since we respect both the heterogeneity in production structures and possible time-varying mark down component, we employ the Fixed Management model (Alvarez et al. 2003 and 2004). Alvarez et al. (2003 and 2004) specified the Fixed Management model as a special case of the Random Parameters model in the following form:

(12) $$\frac{w_x x}{R} = \beta_x + \beta_{xt} t + \beta_{xx} \ln x_{it} + \boldsymbol{\beta}_{zx}{}' \ln \mathbf{z}_{it} + \beta_m m_i^* + \frac{1}{2} \beta_{mm} m_i^{*2} + \beta_{tm} m_i^* t + \beta_{xm} m_i^* x_{it} + \boldsymbol{\beta}_{zm} m_i^*{}' \ln \mathbf{z}_{it} - u_{it} + v_{it}$$

The mark down component, $u_{it} \geq 0$, captures the deviations from competitive behaviour. $m_i^* \sim \bullet(0,1)$ represents the impact of firm heterogeneity. The symbol $\bullet$ expresses that m_i^* could possess any distribution with zero mean and unit variance.

Firm heterogeneity can be estimated via (Alvarez et al. 2003 and 2004)

(13) $$\hat{E}\left[m_i^* \left| \frac{w_{x,i} x_i}{R_i}, x_i, \mathbf{z}_i, \boldsymbol{\beta} \right.\right] = \frac{\frac{1}{R} \sum_{r=1}^{R} m_{i,r}^* \hat{f}\left(\ln \frac{w_{x,i} x_i}{R_i} \middle| x_{it}, \mathbf{z}_{it}, t, m_{i,r}^*; \boldsymbol{\beta} \right)}{\frac{1}{R} \sum_{r=1}^{R} \hat{f}\left(\ln \frac{w_{x,i} x_i}{R_i} \middle| x_{it}, \mathbf{z}_{it}, t, m_i^*; \boldsymbol{\beta} \right)} .$$

Álvarez et al. (2004) showed that u_{it} can be estimated according to Jondrow at al. (1982) as (14), with simulated m_i^* according to (13).

(14) $$E\left[u_{it} \middle| \varepsilon_{it}, m_i^* \right] = \frac{\sigma\lambda}{(1+\lambda^2)} \left[\frac{\phi\left(-\left(\varepsilon_{it} \middle| m_i^*\right)\lambda / \sigma\right)}{\Phi\left(-\left(\varepsilon_{it} \middle| m_i^*\right)\lambda / \sigma\right)} - \frac{\left(\varepsilon_{it} \middle| m_i^*\right)\lambda}{\sigma} \right],$$

where $\lambda = \frac{\sigma_u}{\sigma_v}$, $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\varepsilon_{it} = v_{it} + u_{it}$.

The Fixed Management model is fitted by maximum simulated likelihood with NLOGIT 5.0.

4. Data

The data we use in the analysis is drawn from the Amadeus database, created and produced by Bureau van Dijk. The database contains financial information for public and private companies across Europe.[7] The database provides detailed information about (standardised) annual accounts, financial ratios, sectoral activities and ownership information.[8]

The panel data set that we use in our analysis contains companies whose main activity is food processing according to the NACE classification (NACE 10 – manufacture of food products – groups from 10.1 to 10.9). It is an unbalanced panel data set which represents the period from 2003 to 2012 and contains 9,885 food processing companies from 24 EU countries. Since not all companies in the database have complete information, we exclude those companies with negative and zero values of the variables of interest. Thus, we were constrained to using an unbalanced panel data set containing 8,110 companies with 52,682 observations covering the period from 2003 to 2012. Moreover, we concentrated on the analysis of four food processing sectors: slaughtering (12,239 observations), fruits and vegetables (5,541 observations), dairy (6,367 observations) and milling (3,271 observations). Table 1 presents the structure of the data set.

The following variables were used in the analysis. Cost share is Material costs divided by Revenue. Material costs are the total costs of materials and energy consumption per company deflated by the index of producer prices in the industry (country level; 2010 = 100). Labour is represented by the total number of employees and Capital is the book value of fixed assets deflated by the index of producer prices in the industry (country level; 2010 = 100). Revenue is represented by operating revenue (Turnover) of the company.

7 The dataset consists of the companies who are obliged to publish a balance sheet and a profit loss account (cooperatives, joint stock companies, etc.). That is, the dataset contains mainly large (and often successful) companies that might be able to exercise market power (see chapter 2). In other words, the sample of companies is biased with respect to the companies that might be able to exploit their bargaining power.

8 More information on the Amadeus database is provided at: http://www.bvdinfo.com.

Moreover, we rejected producers with fewer than three observations (on average) to decrease the problem associated with the entry and exit of producers from the database.

Table 3.1: Structure of the data set

EU member country	Slaughtering	Fruit & Vegetables	Dairy	Milling
Austria	69	31	39	1
Belgium	539	318	276	167
Bulgaria	200	64	83	32
Czech Republic	381	68	282	110
Germany	375	186	414	115
Denmark	41	31	15	38
Estonia	58	10	43	9
Spain	2031	835	570	329
Finland	159	52	84	32
France	1887	462	623	351
United Kingdom	837	546	450	266
Greece	223	468	206	118
Hungary	226	111	79	60
Ireland	72	0	17	19
Italy	2211	1321	1666	868
Lithuania	125	19	99	31
Latvia	58	19	70	18
Netherlands	55	71	64	20
Poland	1189	521	754	207
Portugal	279	97	75	106
Romania	676	126	317	219
Sweden	393	143	27	110
Slovenia	66	18	27	9
Slovakia	89	24	87	36

Source: Amadeus database and our own calculations

5. Results

5.1 Mark down model – parameter estimates

Table 1 provides the parameter estimate of the mark down model for the slaughtering, fruits and vegetables, dairy and milling sectors in 24 EU member states. We estimated models separately for the slaughtering, fruits and vegetables, dairy and milling sectors. All the fitted parameters are highly significant, in the majority of cases even the significance level is at 1 %. This holds for all sectors. Moreover, the high significance of the coefficients on unobservable fixed management suggests that the chosen specification represents the structure of the factor demand functions very well, e. g. that heterogeneity among firms is an important characteristic of the food processing sector.

The fitted parameters show that Capital and Labour have a negative impact on the material cost share. This also holds for the time variable in the slaughtering and dairy sectors. That is, the cost share decreases over time in the slaughtering and dairy sectors and increases in the milling sector. The time variable is not significant in the fruits and vegetables sector. The negative impact of capital and labour inputs on the material cost share and, on the other hand, the positive contribution of the material inputs implies that the larger companies produce with smaller relative value added.

The unobservable heterogeneity component (management) contributes positively to the cost share in slaughtering and dairy and negatively in the fruits and vegetables and milling sectors. Moreover, the positive impact is decelerating, and the negative accelerates over time. The increase in heterogeniety has a different effect in each sector. Slaughtering is characterized by the positive contribution of heterogeniety on the impact of capital, as well as labour on the material cost share. The opposite holds true for the time component and material inputs. The heterogeneity component negatively determines the impact of capital on the material cost share, whereas it positively determines the labour and material impact in fruits and vegetables. In the dairy sector, the increase in the heterogeneity component contributes positively to the impact of capital and labour on the material cost share and negatively to the impact of material. Finally, the milling sector is characterized by a negative contribution of the heterogeneity component to the impact of labour inputs on the material cost share, and a positive contribution on the impact of capital and material.

These estimates correspond to our expectations only partially. The heterogeneity (management) component can be viewed as a measure of the quality of inputs as well as a measure of good practises. That is, higher quality and better practises (management, strategy) can be a source of non-competitive behaviour. Moreover, higher inputs are associated with the larger size of a food processor, and with larger size (or market share in general) we should expect a higher relative mark down – either due to the higher market power or, in terms of game theory, the higher the probability of collusion.

The first assumption is met in the fruits and vegetables and milling sectors. That is, the higher heterogeneity component is a source for higher non-competitive behaviour in these sectors. Moreover, the signs of unobservable heterogeniety on inputs are also only partially in line with the second assumption for a given level of heterogeniety. But if we regress the relative mark down on the input quantities we can find a significant positive relationship. To sum up, the hypothesis about the positive relationship between market power or market imperfections and size cannot be rejected; however, it is significantly determined by the sources of non-competitive behaviour (see the discussion in Chapter 2).

The impact of time on the relative mark down is negative in the slaughtering, fruits and vegetables and dairy sectors and positive in the milling sector. This could be a sign of increasing competitiveness on the EU common market in the slaughtering, fruits and vegetables and dairy sectors.

Finally, the parameter λ is highly significant and is greater than one in the slaughtering, dairy and milling sectors, and approximately one in fruits and vegetables. This means that the variation in the mark down component u_{it} is more pronounced than the variation in the random component v_{it} in slaughtering, dairy and milling. That is, the estimates indicate that differences in non-competitive behaviour among food processors are important characteristics of these sectors.

Table 1: Parameter estimates

Slaughtering							
Means for random parameters				Coefficient on unobservable fixed management			
Variable	Coeff.	SE	P [|z|>Z*]	Variable	Coeff.	SE	P [|z|>Z*]
Const.	0.5317	0.0030	0.0000	Alpha_m	0.5963	0.0033	0.0000
Time	-0.0012	0.0001	0.0000	Time	-0.0003	0.0001	0.0267
Capital	-0.0209	0.0003	0.0000	Capital	0.0043	0.0004	0.0000
Labour	-0.0417	0.0004	0.0000	Labour	0.0395	0.0005	0.0000
Material	0.0791	0.0004	0.0000	Material	-0.0750	0.0004	0.0000
				Alpha_mm	-0.3635	0.0011	0.0000
Sigma	0.0707	0.0002	0.0000	Lambda	2.2733	0.0288	0.0000
Fruits and vegetables							
Means for random parameters				Coefficient on unobservable fixed management			
Variable	Coeff.	SE	P [|z|>Z*]	Variable	Coeff.	SE	P [|z|>Z*]
Const.	0.3520	0.0057	0.0000	Alpha_m	-0.6157	0.0058	0.0000
Time	-0.0002	0.0002	0.4384	Time	-0.0004	0.0002	0.0483
Capital	-0.0211	0.0005	0.0000	Capital	-0.0060	0.0006	0.0000
Labour	-0.0227	0.0006	0.0000	Labour	0.0012	0.0008	0.1173
Material	0.0853	0.0007	0.0000	Material	0.0653	0.0006	0.0000
				Alpha_mm	-0.3737	0.0019	0.0000
Sigma	0.0610	0.0006	0.0000	Lambda	0.9308	0.0387	0.0000

Dairy							
Means for random parameters				Coefficient on unobservable fixed management			
Variable	Coeff.	SE	P [|z|>Z*]	Variable	Coeff.	SE	P [|z|>Z*]
Const.	0.3779	0.0044	0.0000	Alpha_m	0.3264	0.0050	0.0000
Time	-0.0018	0.0002	0.0000	Time	-0.0012	0.0002	0.0000
Capital	-0.0193	0.0004	0.0000	Capital	0.0016	0.0004	0.0000
Labour	-0.0439	0.0005	0.0000	Labour	0.0207	0.0006	0.0000
Material	0.0782	0.0005	0.0000	Material	-0.0293	0.0006	0.0000
				Alpha_mm	-0.0475	0.0010	0.0000
Sigma	0.0702	0.0004	0.0000	Lambda	1.9872	0.0434	0.0000
Milling							
Means for random parameters				Coefficient on unobservable fixed management			
Variable	Coeff.	SE	P [|z|>Z*]	Variable	Coeff.	SE	P [|z|>Z*]
Const.	0.3092	0.0076	0.0000	Alpha_m	-0.1886	0.0074	0.0000
Time	0.0008	0.0002	0.0023	Time	0.0017	0.0003	0.0000
Capital	-0.0232	0.0007	0.0000	Capital	0.0041	0.0007	0.0000
Labour	-0.0498	0.0009	0.0000	Labour	-0.0216	0.0009	0.0000
Material	0.0885	0.0010	0.0000	Material	0.0128	0.0008	0.0000
				Alpha_mm	-0.0290	0.0014	0.0000
Sigma	0.0729	0.0007	0.0000	Lambda	2.0917	0.0720	0.0000

Source: own calculation

5.2 The degree of mark down in EU agri-food sector

Tables A1-A4 (please see APPENDIX) present the results of calculations of relative mark down for four analysed sectors.

The relative mark down is in the interval zero to one. Zero indicates no market imperfections or generally competitive behaviour, as the case may be, i.e. the situation where marginal revenue product equals the price of the material inputs (especially agricultural raw material, which dominates the material inputs in the analysed food processing sectors). Then, the positive value of the relative mark down represents non-competitive behaviour. In particular, an increasing relative mark down is associated with increasing market imperfections or, in general, increasing abuse of market power, i.e. the food processor has a greater degree of oligopsonistic power (e.g. due to the higher bargaining power) to charge mark down ($MRP_x > w_x$) with respect to suppliers (in this case farmers). Another interpretation of the $MRP_x > w_x$ is in terms of game theory, i.e. coordination of the firms' pricing behaviour – collusion. With respect to the different interpretation of the surplus of marginal revenue product over the input price, we will relate the increase in relative mark down to an increase in the degree of non-competitive behaviour, which is more general compared to the increase in oligopsonistic power interpretation.[9]

The estimated overall mean of the relative mark down for the EU slaughtering common market, 0.1578, indicates non-competitive behaviour in the EU slaughtering industry. The distribution of the relative mark down is relatively narrow, with standard deviation of 0.11, and slightly skewed toward smaller values. The first decile indicates that 10 % of producers have a rather low mark down. On the other hand, the last 10 % of producers reach a relative mark down higher than 0.28, indicating a considerably large relative mark down and thus a degree of non-competitive behaviour. The relation between the size of the mark down and the size of the company was not found.

The overall means of the relative mark down differ among the individual member states, and the differences are quite large from 0.05 to 0.27. Countries like the Czech Republic (0.11), Denmark (0.12), Estonia (0.11), United Kingdom (0.10), Greece (0.09), Ireland (0.09), Latvia (0.05), Lithuania (0.06), Poland (0.09), and Slovakia (0.09) have a lower mean compared to the EU average. The farmers in these countries may face a lower degree of non-competitive behaviour in these countries as compared to Austria (0.22), Belgium (0.19), Germany (0.23), Finland (0.27), France (0.21) and Italy (0.18), which are the countries with a mean of relative mark down higher than the EU average.

The distribution of the relative mark down is narrow in all countries and slightly skewed toward small values. That is, despite the small standard deviations, significant differences between the 1st and 9th deciles are pronounced in the majority of EU countries. Large

9 The interpretation in terms of oligopsonistic power can be misleading; see the discussion in Chapters 2.2 and 5.

differences can be found primarily in Austria, Belgium, Bulgaria, Germany, Spain, Finland, France, Hungary, Italy, the Netherlands, Romania and Sweden.

The overall mean of the relative mark down for the EU fruit and vegetables sector is 0.10, indicating small deviations from competitive behaviour. The market imperfections are quite small as compared to the slaughtering sector. The distribution is narrow and skewed toward smaller values. Moreover, the differences between the first and last deciles are not so pronounced as compared to slaughtering.

The market environment in individual member countries differs slightly. The overall mean of the relative mark down is in the interval 0.04 to 0.17. However, country differences are more pronounced if we take into consideration the distribution of the relative mark down. E.g. Belgium, Finland, France, the Netherlands and Romania are characterised by considerable non-competitive behaviour or degree of market power, in the companies included in the last decile.

As opposed to the slaughtering and fruits and vegetables sectors, the overall mean of the relative mark down for the EU dairy market is quite small and together with the narrow distribution and skewness toward small values indicate that the behaviour of dairy processors is almost competitive with respect to farmers. In other words, we found only minor market imperfections. The last decile suggests that there are only a few companies with a considerable degree of non-competitive behaviour.

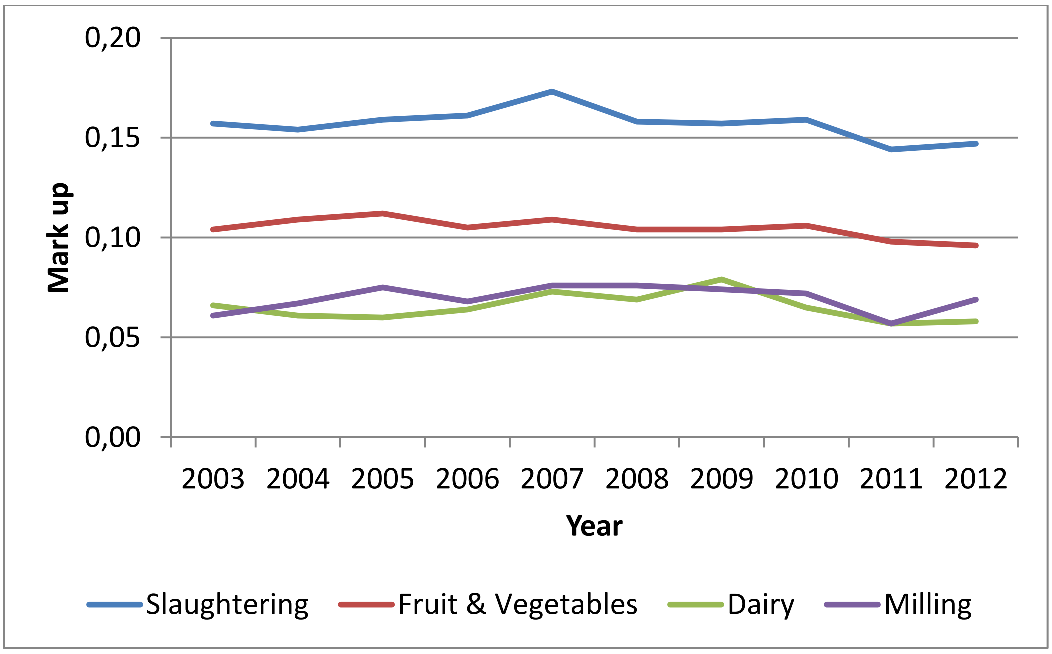
The differences among EU member states are minimal. In the majority of cases the mean of the relative mark down is, , in the interval 0.05 to 0.07. A higher mean can only be found in the Czech Republic (0.081), France (0.075), Portugal (0.078) and Romania (0.105). The first decile in all countries is very close to zero. The last decile in the majority of countries is around 0.10, indicating that the majority of dairy companies have a small degree of non-competitive behaviour. The exception is Bulgaria (0.19), the Czech Republic (0.17) and Romania (0.26) with a higher relative mark down in the last decile.

As in the case of the dairy sector, the estimated relative mark down for the milling sector is small with the mean 0.07. The distribution, which is narrow and skewed toward smaller values, suggests that the market environment is not far from competitive behaviour on the EU common market.

The differences among EU member states are also marginal, as in the case of the dairy sector. The mean of the relative mark down is around 0.06 in the majority of cases. Only Romania has a slightly higher overall mean of the relative mark down, 0.10. The first decile is very close to zero in all countries. The last decile is around 0.11 in the majority of countries, indicating that the majority of dairy companies have a low degree of non-competitive behaviour. Romania is again an exception, with the milling companies in the last decile having a substantial degree of market power. That is, we cannot find severe market imperfections in the milling sector in the majority of EU member countries.

5.3 Development of mark down at the EU level

Figure 2: Development of mark down, 2003-2012



Source: own presentation

The figure 2 provides the development of the relative mark down in the analysed sectors. It's obvious that the mark downs at the EU average are more or less stable in the whole period under investigation for all sectors. Detailed information about the development of mark down in the sectors across EU countries are provided in the APPENDIX (Tables A5-A8). The results suggest that the slaughtering producers did not change significantly the degree of non-competitive behaviour during the analysed period. The fitted trend function shows a weak positive trend for 12 countries. Other 12 members' states show a negative trend. This trend is weak in the majority of cases, except for Estonia. That is, the results suggest that the slaughtering producers did not significantly change the degree of non-competitive behaviour during the analysed period. In other sectors the estimated trend functions suggest a rather constant trend for majority of countries. Only marginal changes can be found. However, some exceptions can be found. In fruits and vegetables, a significant increase in the relative mark down can be observed in Slovenia. On the other hand, Belgium, the Netherlands and Sweden experienced a significant decrease in the relative mark down.

In the dairy sector, the Czech Republic and Slovakia are characterised by a significant increase in the relative mark down, and France and Lithuania by a decrease in the relative mark down. In the milling sector, a significant increase in the relative mark down can be observed in Bulgaria, Estonia and Latvia, and a decrease in the United Kingdom, Ireland and Lithuania.

Moreover, the distribution of the mark downs are skewed to the left indicating that in all countries are allocation of resources is very close to the principle of functioning markets (factor price = value of the marginal product). In each of the countries, there were only a few companies which had a persistent mark down higher than value of the marginal product. Weather this is the results for the exploitation of market power of factor markets or whether more due to other sources which offer the companies a competitive fringe cannot be identified with the data used in our analyses. So, in general, we conclude that the factor markets work considerably well, so no need for policy changes at the EU level are needed.

However, significant differences between the sectors are revealed. The highest mark down can be observed for slaughtering followed by fruit and vegetables. Dairy and milling had the lowest mark downs. There indication that these higher mark down are systemic effects since the higher mark downs for slaughtering are present in each country. Though, more detailed country specific investigations are needed to determine the condition of factor allocation and the market functioning in the slaughtering sector.

6. Conclusions

The estimated mark down model revealed some degree of non-competitive behaviour in the input food processing market for all analysed sectors, i.e. slaughtering, fruits and vegetables, dairy and milling. Since the relative mark down is in the interval zero to one (zero indicating no market imperfections or in general competitive behaviour, as the case may be, and a positive value of the relative mark down representing non-competitive behaviour), the estimated overall means show quite small market imperfections on the EU input food processing markets. This especially holds true for the dairy and milling sectors. That is, the EU slaughtering common market is characterised by significantly greater market imperfections as compared to the dairy and milling sectors, in particular.

The degree of market imperfections differed among the sectors. Whereas the overall mean of the relative mark down for the EU slaughtering common market is 0.1578, for fruits and vegetables it is 0.1054, for dairy 0.0663 and for milling 0.0697. The distribution of the relative mark down is relatively narrow in all sectors, and skewed toward smaller values. Significant differences between the first and last decile were revealed in slaughtering, indicating low market imperfections for the first 10 % of producers, but a considerable degree of non-competitive behaviour for the last 10 % of slaughtering producers. The differences among the producers in fruits and vegetables, and especially in the dairy and milling sectors, are not so pronounced. Moreover, we have not found the relation between the size of the mark down and the size of the company.

Within the sectors there are there are significant differences among EU member countries. Especially in slaughtering, the mean of the relative mark down ranges from 0.05 to 0.27. Bulgaria, the Czech Republic, Denmark, Estonia, the United Kingdom, Greece, Ireland, Latvia, Lithuania, Poland, Portugal, Romania, Slovenia and Slovakia are characterised by lower market imperfections as compared to the EU average. On the other hand, Austria, Belgium, Germany, Finland, France and Italy are characterised by higher market imperfections as compared to the EU average.

Belgium, Finland, France, the Netherlands and Romania are countries with a relatively high degree of market imperfections in fruit and vegetables sector

The differences among EU member states are minimal in the dairy and milling sectors. In dairy, the mean of the relative mark down is in the interval 0.05 to 0.07 in the majority of cases. The mean of the relative mark down in the milling sector is around 0.06 in the majority of cases; only Romania is an exception, with a mean of the relative mark down of 0.10.

Finally, the development of the relative mark down between 2003 and 2012 is characterised by a rather stochastic trend. This holds for the majority of countries in all analysed sectors.

In sum, we did not find any sector or country with large and significantly market imperfections. The most analysed markets are functioning well however slaughtering was an exception, where the estimated mark down was relatively high in comparison to the other sectors. The deviation of the results for perfect competition deserves more detailed analysis, so that definitive conclusions about market functioning in this sector could be drawn and corresponding policy recommendations could be derived.

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APPENDIX

Table A1: Relative mark down - Slaughtering

Country	Statistical characteristics of relative mark down								
	Mean	**Std. Dev**	**Min.**	**Max.**	**Decile**		**Quartile**		**Cases**
					1st	**9th**	**1st**	**3rd**	
Total	0.157	0.106	0.006	0.978	0.048	0.287	0.084	0.202	11715
Austria	0.220	0.058	0.067	0.343	0.142	0.288	0.180	0.254	57
Belgium	0.196	0.092	0.025	0.656	0.092	0.317	0.141	0.240	503
Bulgaria	0.135	0.140	0.006	0.892	0.023	0.305	0.046	0.165	174
Czech Republic	0.112	0.067	0.016	0.552	0.043	0.177	0.073	0.134	377
Germany	0.232	0.098	0.017	0.977	0.142	0.326	0.166	0.288	344
Denmark	0.115	0.067	0.020	0.369	0.035	0.187	0.061	0.140	40
Estonia	0.108	0.054	0.012	0.229	0.036	0.181	0.070	0.155	58
Spain	0.155	0.104	0.007	0.960	0.061	0.270	0.096	0.188	1956
Finland	0.272	0.151	0.019	0.844	0.104	0.407	0.171	0.341	158
France	0.210	0.098	0.021	0.978	0.112	0.317	0.155	0.244	1735
United Kingdom	0.099	0.046	0.012	0.290	0.047	0.162	0.065	0.130	834
Greece	0.085	0.054	0.008	0.275	0.025	0.160	0.050	0.111	215
Hungary	0.160	0.124	0.015	0.734	0.060	0.279	0.093	0.182	191
Italy	0.186	0.095	0.022	0.962	0.083	0.312	0.121	0.238	2143
Ireland	0.090	0.043	0.017	0.209	0.036	0.138	0.061	0.122	68
Latvia	0.054	0.036	0.008	0.197	0.015	0.100	0.026	0.073	58
Lithuania	0.056	0.044	0.009	0.236	0.013	0.110	0.019	0.083	123
Netherlands	0.148	0.087	0.023	0.306	0.041	0.260	0.055	0.229	47
Poland	0.093	0.079	0.007	0.669	0.028	0.153	0.049	0.112	1171
Portugal	0.134	0.096	0.021	0.966	0.067	0.191	0.088	0.158	268
Romania	0.138	0.157	0.006	0.906	0.018	0.391	0.029	0.197	652
Sweden	0.163	0.079	0.015	0.4298	0.064	0.266	0.114	0.200	392
Slovenia	0.132	0.039	0.045	0.217	0.078	0.178	0.105	0.158	64
Slovakia	0.091	0.066	0.010	0.491	0.041	0.137	0.053	0.1140	87

Source: own calculation

Table A2: Relative mark down – Milling

Country	Statistical characteristics of relative mark down								
	Mean	Std. Dev	Min.	Max.	Decile		Quartile		Cases
					1st	9th	1st	3rd	
Total	0.069	0.051	0.008	0.689	0.030	0.118	0.041	0.081	3224
Austria	NA	NA	NA	NA	NA	NA	NA	NA	NA
Belgium	0.065	0.030	0.016	0.202	0.034	0.099	0.042	0.079	166
Bulgaria	0.084	0.057	0.018	0.222	0.030	0.190	0.044	0.106	26
Czech Republic	0.084	0.054	0.010	0.249	0.025	0.167	0.045	0.115	110
Germany	0.071	0.028	0.015	0.220	0.041	0.101	0.054	0.087	110
Denmark	0.070	0.061	0.012	0.260	0.027	0.126	0.040	0.067	38
Estonia	0.056	0.022	0.028	0.084	0.031	0.083	0.034	0.081	9
Spain	0.061	0.033	0.012	0.308	0.030	0.094	0.041	0.069	329
Finland	0.077	0.034	0.034	0.158	0.046	0.138	0.053	0.092	31
France	0.079	0.044	0.018	0.265	0.038	0.125	0.050	0.095	349
United Kingdom	0.062	0.047	0.012	0.287	0.027	0.096	0.036	0.067	265
Greece	0.062	0.034	0.012	0.178	0.026	0.110	0.036	0.081	117
Hungary	0.068	0.035	0.019	0.199	0.032	0.101	0.044	0.075	59
Italy	0.062	0.033	0.008	0.350	0.032	0.098	0.041	0.075	859
Ireland	0.065	0.031	0.034	0.142	0.035	0.105	0.038	0.085	17
Latvia	0.056	0.025	0.018	0.114	0.027	0.096	0.039	0.067	18
Lithuania	0.067	0.046	0.014	0.238	0.021	0.119	0.036	0.081	31
Netherlands	0.082	0.0746	0.016	0.344	0.018	0.108	0.040	0.084	20
Poland	0.067	0.048	0.008	0.381	0.030	0.124	0.038	0.077	207
Portugal	0.065	0.039	0.013	0.228	0.030	0.110	0.040	0.078	101
Romania	0.103	0.1224	0.011	0.689	0.022	0.271	0.029	0.130	207
Sweden	0.077	0.055	0.018	0.401	0.034	0.130	0.047	0.092	110
Slovenia	0.074	0.031	0.034	0.142	0.043	0.107	0.056	0.092	9
Slovakia	0.063	0.032	0.023	0.169	0.032	0.096	0.040	0.079	36

Source: own calculation

Table A3: Relative mark down – Dairy

Country	Statistical characteristics of relative mark down								
	Mean	Std. Dev	Min.	Max.	Decile		Quartile		Cases
					1st	9th	1st	3rd	
Total	0.066	0.050	0.006	0.721	0.030	0.110	0.040	0.075	6254
Austria	0.057	0.017	0.028	0.108	0.038	0.084	0.045	0.063	37
Belgium	0.061	0.031	0.016	0.336	0.037	0.093	0.043	0.069	272
Bulgaria	0.094	0.089	0.006	0.459	0.019	0.193	0.040	0.122	79
Czech Republic	0.081	0.076	0.008	0.472	0.021	0.174	0.034	0.101	281
Germany	0.058	0.043	0.014	0.466	0.032	0.089	0.041	0.064	387
Denmark	0.062	0.034	0.024	0.168	0.031	0.096	0.043	0.066	15
Estonia	0.061	0.033	0.009	0.149	0.027	0.104	0.036	0.088	42
Spain	0.069	0.041	0.010	0.405	0.032	0.118	0.043	0.086	557
Finland	0.056	0.023	0.025	0.123	0.032	0.082	0.039	0.067	84
France	0.074	0.050	0.008	0.348	0.036	0.131	0.044	0.084	616
United Kingdom	0.054	0.044	0.006	0.721	0.029	0.083	0.037	0.062	442
Greece	0.056	0.030	0.012	0.224	0.027	0.096	0.036	0.069	203
Hungary	0.063	0.028	0.023	0.166	0.035	0.105	0.040	0.077	64
Italy	0.065	0.045	0.008	0.531	0.033	0.102	0.042	0.073	1665
Ireland	0.041	0.018	0.019	0.071	0.020	0.068	0.022	0.058	17
Latvia	0.059	0.043	0.009	0.261	0.029	0.090	0.037	0.057	70
Lithuania	0.056	0.031	0.011	0.150	0.024	0.098	0.034	0.073	99
Netherlands	0.062	0.028	0.023	0.179	0.034	0.092	0.043	0.075	60
Poland	0.055	0.030	0.009	0.273	0.029	0.088	0.037	0.064	745
Portugal	0.078	0.047	0.021	0.234	0.032	0.141	0.048	0.086	75
Romania	0.104	0.105	0.007	0.521	0.021	0.263	0.034	0.138	305
Sweden	0.062	0.029	0.022	0.146	0.027	0.087	0.039	0.076	26
Slovenia	0.057	0.024	0.027	0.117	0.032	0.094	0.038	0.068	27
Slovakia	0.057	0.029	0.016	0.159	0.031	0.093	0.035	0.067	86

Source: own calculation

Table A4: Relative mark down – Fruits and vegetables

Country	Statistical characteristics of relative mark down								
	Mean	Std. Dev	Min.	Max.	Decile		Quartile		Cases
					1st	9th	1st	3rd	
Total	0.105	0.072	0.010	0.943	0.036	0.186	0.055	0.138	5337
Austria	0.144	0.035	0.071	0.198	0.090	0.180	0.128	0.174	29
Belgium	0.168	0.098	0.021	0.863	0.080	0.237	0.107	0.202	290
Bulgaria	0.090	0.065	0.016	0.329	0.022	0.179	0.044	0.120	59
Czech Republic	0.118	0.042	0.042	0.228	0.073	0.196	0.091	0.135	68
Germany	0.129	0.049	0.040	0.247	0.062	0.193	0.089	0.165	176
Denmark	0.111	0.044	0.029	0.191	0.045	0.177	0.079	0.137	31
Estonia	0.044	0.023	0.017	0.101	0.024	0.074	0.032	0.049	10
Spain	0.110	0.087	0.010	0.914	0.041	0.1943	0.061	0.131	819
Finland	0.108	0.070	0.020	0.359	0.045	0.214	0.059	0.138	51
France	0.151	0.075	0.019	0.943	0.078	0.229	0.104	0.181	447
United Kingdom	0.071	0.038	0.0198	0.214	0.032	0.128	0.043	0.088	546
Greece	0.051	0.034	0.013	0.222	0.023	0.088	0.030	0.059	453
Hungary	0.098	0.043	0.026	0.222	0.045	0.159	0.062	0.128	88
Italy	0.113	0.060	0.012	0.605	0.049	0.180	0.069	0.148	1282
Ireland	NA	NA	NA	NA	NA	NA	NA	NA	NA
Latvia	0.070	0.034	0.034	0.199	0.046	0.091	0.049	0.078	19
Lithuania	0.050	0.011	0.0369	0.077	0.038	0.066	0.041	0.057	19
Netherlands	0.160	0.151	0.018	0.650	0.031	0.325	0.050	0.196	67
Poland	0.074	0.040	0.013	0.236	0.031	0.125	0.043	0.096	519
Portugal	0.116	0.061	0.031	0.453	0.049	0.170	0.072	0.148	88
Romania	0.095	0.102	0.010	0.591	0.021	0.251	0.034	0.125	95
Sweden	0.101	0.041	0.026	0.296	0.061	0.156	0.078	0.110	140
Slovenia	0.120	0.038	0.017	0.160	0.063	0.157	0.109	0.150	18
Slovakia	0.070	0.021	0.024	0.112	0.043	0.096	0.057	0.083	23

Source: own calculation

Table A.5: Development of relative mark down – slaughtering

Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Trend function	R2
EU	0.157	0.154	0.159	0.161	0.173	0.158	0.157	0.159	0.144	0.147	y = 0.163 - 0.001t	0.188
Austria	NA	NA	NA	0.197	0.211	0.237	0.221	0.236	0.212	NA	y = 0.206 + 0.004t	0.215
Belgium	0.202	0.193	0.195	0.209	0.202	0.192	0.191	0.202	0.187	0.203	y = 0.2 - 0.001t	0.041
Bulgaria	0.160	0.129	0.183	0.139	0.137	0.111	0.117	0.139	0.135	0.301	y = 0.122 + 0.006t	0.110
Czech Republic	0.097	0.089	0.100	0.111	0.129	0.120	0.131	0.129	0.103	0.078	y = 0.104 + 0.001t	0.017
Germany	0.237	0.241	0.260	0.240	0.233	0.209	0.239	0.242	0.216	0.164	y = 0.26 - 0.006t	0.434
Denmark	NA	NA	NA	NA	0.191	0.109	0.104	0.117	0.100	0.110	y = 0.164 - 0.012t	0.425
Estonia	0.155	0.123	0.117	0.103	0.108	0.083	0.113	0.094	0.094	0.064	y = 0.143 - 0.007t	0.711
Spain	0.163	0.160	0.160	0.159	0.156	0.140	0.160	0.155	0.144	0.199	y = 0.154 + 0.001t	0.041
Finland	0.250	0.208	0.290	0.308	0.320	0.289	0.271	0.267	0.264	0.206	y = 0.276 - 0.002t	0.016
France	0.223	0.224	0.214	0.212	0.213	0.203	0.210	0.211	0.186	0.171	y = 0.232 - 0.005t	0.736
United Kingdom	0.108	0.106	0.103	0.108	0.106	0.087	0.094	0.098	0.090	0.103	y = 0.108 - 0.002t	0.351
Greece	0.089	0.080	0.077	0.078	0.090	0.076	0.087	0.090	0.085	0.143	y = 0.07 + 0.004t	0.317
Hungary	NA	0.165	0.207	0.199	0.150	0.132	0.189	0.166	0.133	NA	y = 0.193 - 0.006t	0.229
Italy	0.188	0.187	0.197	0.194	0.196	0.178	0.188	0.183	0.169	0.225	y = 0.187 + 0.001t	0.016
Ireland	NA	NA	0.095	0.093	0.091	0.076	0.096	0.099	0.078	0.174	y = 0.072 + 0.006t	0.244
Latvia	0.037	0.037	0.038	0.058	0.061	0.054	0.063	0.069	0.073	0.026	y = 0.041 + 0.002t	0.133
Lithuania	0.044	0.038	0.045	0.043	0.064	0.059	0.077	0.066	0.069	0.027	y = 0.044 + 0.002t	0.095
Netherland	0.152	0.169	0.251	0.192	0.143	0.112	0.114	0.149	0.086	NA	y = 0.209 - 0.011t	0.400
Poland	0.082	0.082	0.092	0.096	0.103	0.090	0.096	0.105	0.081	0.080	y = 0.09 + 0.0002t	0.003
Portugal	0.128	0.128	0.133	0.152	0.164	0.136	0.125	0.121	0.107	NA	y = 0.144 - 0.002t	0.138
Romania	0.049	0.040	0.064	0.078	0.299	0.315	0.141	0.146	0.108	NA	y = 0.059 + 0.016t	0.176
Sweden	0.165	0.173	0.156	0.160	0.164	0.160	0.165	0.172	0.163	0.161	y = 0.164 - 0.0001t	0.001
Slovenia	0.153	0.125	0.151	0.121	0.152	0.114	0.147	0.126	0.095	NA	y = 0.152 - 0.004t	0.290
Slovakia	0.085	0.058	0.066	0.065	0.085	0.069	0.131	0.126	0.094	NA	y = 0.055 + 0.006t	0.413

Source: own calculation

Table A.6: Development of relative mark down - fruits and vegetables

Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Trend function	R2
EU	0.104	0.109	0.112	0.105	0.109	0.104	0.104	0.106	0.098	0.096	y = 0.111 - 0.001t	0.485
Austria	NA	NA	NA	0.176	0.137	0.141	0.145	0.160	0.133	NA	y = 0.163 - 0.004t	0.211
Belgium	0.175	0.171	0.168	0.171	0.162	0.177	0.178	0.156	0.159	0.147	y = 0.179 - 0.002t	0.428
Bulgaria	0.054	0.064	0.125	0.056	0.090	0.122	0.107	0.113	0.058	0.069	y = 0.079 + 0.001t	0.018
Czech Republic	0.113	0.125	0.103	0.105	0.122	0.128	0.125	0.128	0.113	0.102	y = 0.116 + 0.0001t	4E-04
Germany	0.121	0.142	0.153	0.136	0.125	0.130	0.136	0.132	0.115	0.111	y = 0.142 - 0.002t	0.303
Denmark	NA	NA	NA	NA	0.128	0.110	0.111	0.108	0.104	0.129	y = 0.117 - 0.001t	0.009
Estonia	0.102	0.071	0.036	0.032	0.026	0.033	0.017	0.033	0.051	0.046	y = 0.068 - 0.004t	0.259
Spain	0.107	0.115	0.128	0.108	0.120	0.100	0.105	0.111	0.100	0.090	y = 0.121 - 0.002t	0.379
Finland	0.117	0.077	0.075	0.075	0.112	0.090	0.123	0.151	0.126	0.089	y = 0.084 + 0.004t	0.172
France	0.158	0.158	0.152	0.158	0.148	0.147	0.146	0.138	0.142	0.183	y = 0.152 + 0.0001t	4E-04
United Kingdom	0.073	0.073	0.080	0.073	0.068	0.070	0.072	0.072	0.067	0.064	y = 0.077 - 0.001t	0.522
Greece	0.047	0.050	0.052	0.051	0.053	0.050	0.051	0.056	0.052	0.050	y = 0.049 + 0.0003t	0.205
Hungary	NA	0.166	0.114	0.099	0.080	0.107	0.106	0.102	0.087	0.101	y = 0.133 - 0.005t	0.336
Italy	0.107	0.117	0.121	0.117	0.123	0.110	0.114	0.116	0.106	0.090	y = 0.121 - 0.002t	0.281
Ireland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Latvia	0.057	0.062	0.131	0.038	0.062	0.074	0.070	0.079	0.055	0.085	y = 0.07 + 0.0003t	0.001
Lithuania	0.058	0.047	0.043	0.043	0.065	0.048	0.051	0.059	0.045	0.049	y = 0.051 - 0.0001t	0.001
Netherland	0.179	0.166	0.218	0.218	0.191	0.153	0.070	0.156	0.056	0.031	y = 0.24 - 0.018t	0.618
Poland	0.074	0.080	0.080	0.074	0.076	0.074	0.081	0.069	0.060	0.052	y = 0.084 - 0.002t	0.537
Portugal	0.111	0.100	0.129	0.101	0.098	0.114	0.131	0.137	0.118	NA	y = 0.102 + 0.003t	0.251
Romania	0.045	0.052	0.051	0.044	0.230	0.182	0.116	0.096	0.115	NA	y = 0.047 + 0.011t	0.218
Sweden	0.111	0.112	0.118	0.100	0.088	0.094	0.100	0.105	0.099	0.085	y = 0.114 - 0.002t	0.436
Slovenia	0.098	0.113	0.085	0.107	0.131	0.135	0.141	0.150	0.125	NA	y = 0.091 + 0.006t	0.592
Slovakia	0.069	0.063	0.059	0.079	0.069	0.071	0.070	0.071	0.063	NA	y = 0.067 + 0.0002t	0.012

Source: own calculation

Table A.7: Development of relative mark down – dairy

Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Trend function	R2
EU	0.066	0.061	0.060	0.064	0.073	0.069	0.079	0.065	0.057	0.058	y = 0.067 - 0.0002t	0.011
Austria	NA	NA	NA	0.053	0.063	0.052	0.071	0.055	0.044	NA	y = 0.061 - 0.001t	0.07
Belgium	0.054	0.059	0.059	0.060	0.051	0.065	0.088	0.059	0.057	NA	y = 0.055 + 0.001t	0.107
Bulgaria	0.184	0.047	0.104	0.091	0.044	0.069	0.129	0.095	0.081	NA	y = 0.114 - 0.004t	0.064
Czech Republic	0.053	0.056	0.042	0.081	0.095	0.088	0.118	0.102	0.097	0.048	y = 0.056 + 0.004t	0.206
Germany	0.067	0.062	0.055	0.054	0.051	0.052	0.069	0.063	0.063	0.055	y = 0.06 - 0.0001t	0.002
Denmark	NA	NA	NA	NA	0.060	0.064	0.092	0.044	0.045	0.072	y = 0.067 - 0.001t	0.015
Estonia	0.063	0.031	0.044	0.095	0.083	0.080	0.088	0.047	0.034	0.097	y = 0.056 + 0.002t	0.054
Spain	0.071	0.068	0.069	0.073	0.062	0.064	0.086	0.071	0.060	0.038	y = 0.076 - 0.002t	0.210
Finland	0.043	0.055	0.054	0.062	0.051	0.060	0.068	0.059	0.056	NA	y = 0.049 + 0.002t	0.323
France	0.091	0.082	0.083	0.082	0.086	0.072	0.064	0.058	0.054	0.057	y = 0.096 - 0.004t	0.863
United Kingdom	0.062	0.059	0.059	0.064	0.057	0.044	0.058	0.056	0.040	0.050	y = 0.065 - 0.002t	0.476
Greece	0.050	0.055	0.049	0.058	0.065	0.066	0.068	0.057	0.045	0.045	y = 0.057 - 0.0002t	0.007
Hungary	0.035	0.070	0.061	0.055	0.063	0.060	0.094	0.057	0.043	NA	y = 0.054 + 0.001t	0.031
Italy	0.064	0.059	0.061	0.065	0.063	0.064	0.082	0.070	0.058	0.078	y = 0.059 + 0.001t	0.257
Ireland	NA	NA	0.037	0.037	0.047	0.041	0.040	0.039	0.046	NA	y = 0.037 + 0.001t	0.204
Latvia	0.051	0.036	0.045	0.058	0.080	0.080	0.077	0.039	0.057	0.086	y = 0.044 + 0.003t	0.238
Lithuania	0.082	0.089	0.070	0.052	0.073	0.034	0.047	0.043	0.034	0.046	y = 0.087 - 0.006t	0.689
Netherland	0.055	0.053	0.068	0.047	0.055	0.073	0.065	0.071	0.083	0.049	y = 0.054 + 0.002t	0.143
Poland	0.066	0.060	0.052	0.046	0.061	0.050	0.066	0.053	0.043	NA	y = 0.062 - 0.001t	0.193
Portugal	0.048	0.055	0.125	0.092	0.087	0.078	0.092	0.059	0.051	NA	y = 0.081 - 0.001t	0.009
Romania	0.043	0.049	0.041	0.054	0.222	0.230	0.111	0.092	0.080	NA	y = 0.053 + 0.01t	0.134
Sweden	0.076	0.056	0.029	0.057	0.066	0.067	0.068	0.063	0.075	NA	y = 0.053 + 0.002t	0.117
Slovenia	0.060	0.037	0.040	0.035	0.060	0.072	0.087	0.074	0.048	NA	y = 0.041 + 0.003t	0.239
Slovakia	0.034	0.043	0.043	0.042	0.064	0.056	0.097	0.064	0.064	NA	y = 0.031 + 0.005t	0.532

Source: own calculation

Table A.8: Development of relative mark down - milling

Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Trend function	R2
EU	0.061	0.067	0.075	0.068	0.076	0.076	0.074	0.072	0.057	0.069	y = 0.069 + 0.00002t	8E-05
Austria	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Belgium	0.068	0.060	0.079	0.062	0.057	0.044	0.081	0.080	0.053	0.084	y = 0.062 + 0.001t	0.038
Bulgaria	0.031	0.040	0.097	0.108	0.092	0.096	0.111	0.082	0.073	NA	y = 0.055 + 0.005t	0.247
Czech Republic	0.104	0.064	0.081	0.073	0.078	0.089	0.103	0.085	0.089	NA	y = 0.08 + 0.001t	0.047
Germany	0.068	0.064	0.084	0.070	0.075	0.068	0.076	0.081	0.062	0.055	y = 0.075 - 0.001t	0.08
Denmark	NA	NA	NA	NA	0.045	0.093	0.061	0.045	0.048	0.184	y = 0.025 + 0.016t	0.285
Estonia	0.028	0.035	0.032	0.044	0.085	0.083	0.081	0.045	0.077	NA	y = 0.026 + 0.006t	0.47
Spain	0.059	0.055	0.067	0.060	0.058	0.062	0.074	0.068	0.045	0.054	y = 0.062 - 0.0003t	0.016
Finland	0.058	0.068	0.076	0.073	0.059	0.080	0.076	0.120	0.081	0.063	y = 0.063 + 0.002t	0.16
France	0.074	0.077	0.097	0.098	0.088	0.055	0.075	0.094	0.058	0.079	y = 0.086 - 0.001t	0.062
United Kingdom	0.070	0.079	0.077	0.072	0.065	0.068	0.060	0.059	0.041	0.034	y = 0.086 - 0.004t	0.781
Greece	0.048	0.050	0.057	0.051	0.079	0.086	0.075	0.064	0.054	0.037	y = 0.058 + 0.0003t	0.004
Hungary	NA	NA	0.085	0.046	0.058	0.060	0.068	0.075	0.073	NA	y = 0.062 + 0.001t	0.041
Italy	0.053	0.060	0.070	0.059	0.058	0.054	0.077	0.074	0.057	0.066	y = 0.058 + 0.001t	0.12
Ireland	NA	NA	NA	0.085	0.075	0.054	0.064	0.070	0.050	NA	y = 0.084 - 0.005t	0.525
Latvia	0.035	0.030	0.033	0.049	0.068	0.058	0.074	0.083	0.078	NA	y = 0.022 + 0.007t	0.882
Lithuania	0.060	0.063	0.091	0.086	0.068	0.102	0.073	0.033	0.038	0.069	y = 0.082 - 0.002t	0.109
Netherland	0.056	0.158	0.068	0.075	0.055	0.117	0.051	0.029	NA	NA	y = 0.108 - 0.007t	0.176
Poland	0.070	0.092	0.065	0.075	0.074	0.045	0.046	0.072	0.083	NA	y = 0.075 - 0.001t	0.048
Portugal	0.077	0.062	0.075	0.069	0.070	0.067	0.087	0.059	0.038	NA	y = 0.079 - 0.002t	0.227
Romania	0.027	0.050	0.064	0.060	0.235	0.279	0.093	0.063	0.059	NA	y = 0.066 + 0.007t	0.052
Sweden	0.091	0.127	0.095	0.068	0.064	0.043	0.056	0.081	0.084	0.096	y = 0.094 - 0.002t	0.09
Slovenia	0.057	0.035	0.143	0.099	0.093	0.057	0.073	0.064	0.046	NA	y = 0.086 - 0.002t	0.037
Slovakia	0.068	0.078	0.060	0.073	0.058	0.050	0.073	0.065	0.053	NA	y = 0.072 - 0.002t	0.204

Source: own calculation