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Monopolistic markups in the Polish food sector

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Abstract: Agri-food sectors are commonly considered as highly regulated, traditional and of strategic importance, mainly due to the food security issues. Changes in the related market structures are subject of constant interest because of their importance for competition and economic welfare of food producers and consumers. In Poland, a rising concentration among various branches of the food industry can be observed. The main objective of the article was to depict the changes of the market power execution in the Polish food sector and its branches in the period 2002-2013. As a measure of this phenomenon the markups of price above the marginal cost were applied and for their estimation two methods were used, namely the Roeger method involving primal and dual Solow residuals and the method based on the marginal cost of labor. Yearly data for 32 food sector branches and various accounting categories were used in the calculations. It was found that in the analyzed period the markup over marginal cost on average amounted to 10.4% and it was increasing over time. The labor input category seemed to be not sufficient for the markup calculation. The evolution of the monopolistic power in the Polish food sector appears to be associated not only with the business cycle, but also with the sector developments accelerated by the accession to the EU. Moreover, the differences in results for the branches indicate a considerable heterogeneity in the Polish food industry companies pricing practices.

Introduction

The market structures in the food sector are subjected to constant changes. As early as in 1966 in the report prepared by the US National Commission on Food Marketing it was admitted, that the concentration in many branches of the U.S. food sector reached too high, undesirable level, and the marketing and promotion expenses were excessive. It was also found, that through mergers and acquisitions companies are getting bigger exceeding sizes needed to maintain their operational efficiency (Sexton, 2000, pp. 1087-1104). The intensification of the concentration processes in

the agro-food sector has a worldwide character and has been noticed in many countries for a long time. Figiel & Kufel (2013) proved high and statistically significant correlation between the value of the world agro-food production and the value of mergers and acquisitions in the world in the period 2000-2010.

Also in the Polish food industry concentration processes occur. In 2010 companies hiring more than 250 workers, constituting only 1.7% of all nearly 16 thousands companies operating in the sector, made 36.9% of all employment and 54.1% of all production value. Three capital groups generated 85.7% of revenues in the oil manufacturing, 78.5% in brewing manufacturing, 76.9% in tobacco industry, 75.6% in potato manufacturing and 69.6% in sugar manufacturing. In the period 2003-2010, while the production value increased from 102.7 to 158,9 billions of zl, the number of entities decreased from 19.52 to 15.97 thousands. The concentration ratio in sales in 2013 amounted to 0.79 in the food production, in the production of beverages – 0.66, and in tobacco industry – 0.37. It is also envisaged, that the process of concentration in the food sector will be continued and the role of large firms will grow (see Szczepaniak, 2012, pp. 78-87).

Potentially, a high concentration can contribute to non-competitive conduct of the main players in the industry, leading to higher markups of price above the marginal cost[1]. There are plenty of research results concerning relation between concentration and market performance, e.g. (Tirole, 1988; Carlton & Perloff, 2005, pp. 263-267) and it turns out that most of the time the relation between these variables is positive and statistically significant, but week. Therefore, increasing concentration in the Polish food sector data may be a sign of the increasing markups, what may influence competition and economic welfare of food producers and consumers. However, this may not be truth, as already in 70-ties it was proved, that the positive correlation between concentration and market performance is consistent with the increasing effectiveness hypothesis, as the company may create innovations, which decrease costs and improve quality. This makes it possible to increase markups and profits, as well as to gain dominant position in the market, what accelerates the concentration processes (compare Demsetz, 1973, pp. 1-9).

Consequently, the main aim of the article is to depict changes of monopolistic markups in the Polish food sector in the period 2002-2013. Moreover, two additional research questions were formulated. Firstly, can the markup be considered as a symptom of market power? Secondly, were labor markups changes good indicators of market power execution changes in the Polish food sector in the period 2003-2012? In order to answer the

[1] This paradigm is known as Structure-Conduct-Performance (SCP) hypothesis.

first question, the concept of markup and its estimation methods will be presented. Afterwards, the key aspects of methodology for markup estimation will be discussed, in particular the Roeger (1995) and the Rotemberg & Woodford (1999) methods. Then, the results of applications of both methods will be showed and compared in order to assess the appropriateness of the second method for the Polish food sector.

It needs to be added, that there have been no enough extensive attempts to measure market power in the Polish food sector and the main point has been rather to discover the price transmission mechanism or the power distribution among the food marketing chain actors (compare Seremak-Bulge, 2012, pp. 5-24; Urban, 2001, pp. 1-120). The only studies were carried out by Gradzewicz & Hegemajer (2007a,b). The average markup in the Polish food sector in the period 1996-2004 estimated with the Roeger method markups amounted to 0.224, what was the third highest result among all manufacturing industry branches.

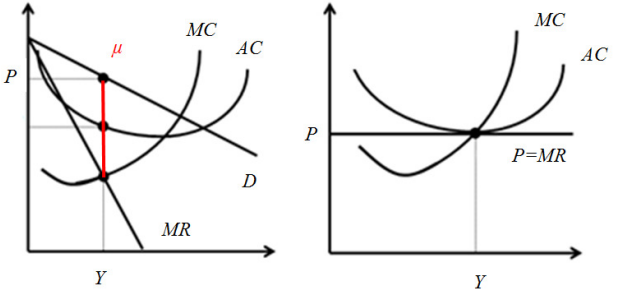
The concept of markups and methods of their estimation

The markup is a gap between the price (P) that a firm charges and its marginal cost (MC): $\mu = P/MC$ (see Samuelson & Marks, 2009, pp. 118-120; Pindyck and Rubinfeld, 2013, pp. 372-373). The total revenue (TR) of the company can be written as follows: $TR = Y \cdot P$, where Y is an output, and the change in total revenue caused by production of an additional unit is: $MR = \frac{dTR}{dY} = P + Y \cdot \frac{dP}{dY}$. From the other side, a price elasticity of demand can be expressed as follows: $\varepsilon == \frac{\frac{dY}{Y}}{\frac{dP}{P}} = \frac{dY}{dP}\frac{P}{Y}$. Hence we have: $\frac{P}{\varepsilon} = Y \cdot \frac{dP}{dY}$ and $MR = P + \frac{P}{\varepsilon} = P(1 + \frac{1}{\varepsilon})$. The optimal markup is a markup received under the profit maximizing condition: $MR = MC$. From the formula for markup we get: $MC = \frac{P}{\mu}$. Consequently we have: $P\left(1 + \frac{1}{\varepsilon}\right) = \frac{P}{\mu}$, and the optimal markup can be expressed as follows: $\mu = \frac{1}{1+\frac{1}{\varepsilon}}$. Two main conclusions are, that the increase of price elasticity of demand (absolute value) causes the markup to fall and vice versa, and that

the optimal markup calculation allows the enterprise to set the profit maximizing price: $P = \frac{MC}{1+\frac{1}{\varepsilon}}$.

Olive (2002) enumerated five economic meanings of markups. Firstly, they indicate a market power. Also according to Church (2000), a market power is a firm ability to profitably rise the price above the marginal cost[2]. Although markups are rather a realization of this ability, not this ability itself, because the markup grows along with the perturbation between a price and a marginal cost, it's commonly used as a measure of market power and this two concepts are used interchangeable. Because a firm has a market power, when it concerns rising price above marginal cost as profitable, the market power depends on the market structure. The situations of perfect competition and monopoly are presented in figure 1. We can see that while in the first situation market power of the monopoly amounts to μ, in the perfect competition a firm has no ability to exercise market power and because price equals marginal cost, the markup amounts to zero.

Figure 1. Market power in monopoly and perfect competition*



*AC – average costs

Source: own elaboration based on Marks & Samuelson (2009, pp. 436-440, 468-479).

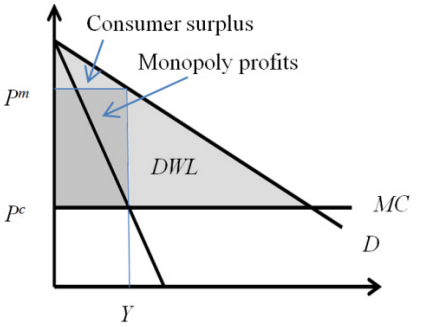
The reason for the dependence of the markup on the market structure is its relationship with price elasticity of demand, so on the character of the demand curve. In the case of homogenous goods, the higher number of competitors, and in the case of diversified products – the higher cross-price elasticities of demand, the higher is the price elasticity of demand and the lower is the market power exercised by the company on the imperfectly

2 This is the most common definition of market power. However, also other can be met, e.g. in the opinion of Pindyck and Rubinfeld (2013) a market power is either a seller or a buyer ability to influence a price of a product.

competitive market (see Church & Ware, 2000, pp. 31-34). Tremblay & Tremblay (2012, pp. 328) concluded, that the market power measured by markups is growing when: there are entry barriers, what implies higher concentration on the market; there are no potential entries; products are diversified; firms compete more by quantity than by price; firms create effective cartel; firms make strategic investments in order to decrease costs or to rise prices in the future. Because these factors intensities are different depending on the market, also the markups illustrating market power are different depending on the market. What should be added however is, that while calculating market power a proper attention should be paid to the time and market boundaries. Moreover, the business cycle and technological change can matter (Church & Ware, 2000, pp. 147).

The second meaning of markups is that they represent the welfare loss for the society (see Olive, 2002, pp. 3). The common welfare measure is the total surplus, being the sum of consumer and producer surpluses. It's a value, which producers and consumers are willing to pay for the equilibrium quantity at the equilibrium price. This welfare measure is maximized in the competitive equilibrium and each departure decreases its value. The competitive equilibrium is characterised by the desired efficiency and welfare levels and according to the Pareto rule, no actor can improve its position without worsening the situation of the other one (see Carlton & Prestoff, 2005, pp. 69-71). In order to measure this effect of markup pricing, the so called deadweight loss (DWL) is calculated. It's a cost of inefficient market performance incurred by the society, measured by the loss in total surplus comparing to the situation of competitive equilibrium. Church & Ware (2000) highlighted, that this allocative inefficiency leading to lowering the volume of production is the main outcome of market power execution. DWL in the situation of a monopoly is presented on the figure 2. We can observe that the output in the monopoly is lower than the optimal one $(Q^m < Q^c)$. The loss of welfare in the uncompetitive market structures may be an effect of: monopolistic pricing practices, achieving excessive profits, reduced production, unused production capacity, weak tendency to cost reduction and to innovate because of the lack of competitive pressure.

Figure 2. DWL on the monopolistic market



Source: own elaboration based on Church & Ware (2000, pp. 33-36)

Thirdly, according to Olive (2002) markups are incentives for investment and technological change. Yet Schumpeter (1965) noticed that market power encourages to research and development. Without the perspective of monopolistic profits companies wouldn't have enough incentives to conduct research and development. What is interesting, DWL will have positive meaning, when it enables innovation regarding products and technologies leading to growth of the economic as well as life quality standards.

Fourthly, markups at the aggregated level change along the business cycle and are used as an argument in the macroeconomists discussions on the character of cyclicality of real wages (see Olive, 2002, pp. 3). Finally, markups are used as key exogenous variables in the macroeconomics models of inflation and general equilibrium models (see Olive, 2002, pp. 3), especially in the New Keynesian dynamic stochastic general equilibrium (DSGE) models, utilized nowadays in the majority of central banks for the needs of monetary policy, in which the markups level is an exogenous variable and the assumptions about theirs cyclicality are used for the construction of the supply side.

The point is that high markups and their variability influence the price dynamics in the business cycle, what influences the monetary policy effectiveness. Monopolistic structures in the economy, reflected by high markups, change economy response to both demand and supply disturbances. Anticyclical markups and its positive influence on inflation imply asymmetric reaction of monetary policy and economic activity variation. During economic downturns the fact, that inflation doesn't fall as much as when markups were stable, limits the abilities of central banks to sustain the aggregated activity level through the decrease of interest rates. On the contrary, the markups decrease in the expansion phase limits the inflation pressure and enables central banks to delay introduction of an restrictive monetary policy.

What is interesting, the Keynesian models depend on countercyclical markups only since early 80-ties. Before, the leading was assumption about sticky wages (compare Taylor, 1980, pp. 1-23), but because the earlier models appeared to contradict the cyclical properties of real wages, researchers changed the assumption of sticky wages for the one of sticky prices (see Gordon, 1981, 493-530; Rotemberg, 1982, pp. 517-531). As stated Nekarda & Ramey (2013), from the Woodford model (2003), in all New Keynesian models markups fall in response to positive demand shifts. Sticky prices together with procyclical marginal cost cause, that an expansionary monetary or government spending shock decreases the average markup. This is also true in the newest models built in the New Keynesian spirit joining sticky prices and sticky wages, e.g. (Erceg et. al., 2000, pp. 281-313; Smets & Wouters, 2003, pp. 1123-1175; Christiano et al., 2005, pp. 1-45). In the inspiring model of Jaimovich and Floetotto (2008), procyclical entry of firms leads to countercyclical markups, and then to procyclical TFP. Regarding inflation, Ball et al. (2003) or Steinsson (2005) in their New Keynesian models assume positive correlation between markups and inflation, and a markup change is that of the a cost nature. It's also worth highlighting, that understanding the mutual relation between markups and prices is especially important in countries, which set inflation targets, e.g. in Poland.

The above discussion show that markups are and can be regarded as symptoms of market power. Moreover, it can even be stated, that they are the only right indicator of the market power execution, and it's hardly impossible to think about the better one. In practice, in order to assess the market power execution, the so called Lerner index is utilized: $\mathcal{L} = \frac{P-MC}{p}$. Its values for different structures in the static setting are presented in table 1. For diversified products and dynamic markets characterized by today's production and sales influencing future profits, e.g. those including learning-by-doing, the Lerner indexes formulations are far more complicated, see (Tremblay & Tremblay 2012, pp. 336-337).

Table 1. Lerner index in different market structures*

Market structure	$\mathcal{L}$
Perfect competition	0
Bertrand oligopoly	0
Cournot oligopoly	$1/(n \cdot \varepsilon)$
Cartel	$1/\varepsilon$
Monopoly	$1/\varepsilon$

*ε – the absolute value of the price elasticity of demand, n – the number of firms with perfectly homogenous

Source: Tremblay & Tremblay (2012, pp. 314).

Because the Lerner index calculation is usually problematic, mostly because of the lack of data on marginal costs (available data typically include only average cost), other market power measures have been developed. Majority of them is focused on profitability, e.g. q Tobin, rate of return, profit to sales ratio, relative profit diversification (see Tremblay & Tremblay, 2012, pp. 311-318), and they are not free from drawbacks. Firstly, price can exceed marginal cost even when profits are zero, e.g. in the monopolistic competition. Secondly, most of companies it's hard to identify share of revenue, costs and assets connected with the certain products or markets. Thirdly, they employ accounting profits being only a weak approximation of economic ones (compare Carlton & Perloff, 2005, pp. 249-252).

Consequently several methods of indirect markups estimation were developed, e.g. total cost function estimation, the price response to a change in costs, New Empirical Industrial Organization (NEIO), stochastic frontier method, game theory, overall efficiency loss estimation, single input margin (see Tremblay & Tremblay, 2012, pp. 318-326; Einac & Levin, 2010, pp. 145-162; Rotemberg & Woodford, pp. 1051-1135). The main disadvantage of them is, hard to state, which part of the difference between revenues from sales and marginal costs is a result of market power (a relationship between price and marginal costs), and which is a result of economies of scale (a relationship between average and marginal costs) (compare Gradzewicz & Hagemejer, 2007a, pp. 515-540). Then, it is assumed that there are no economies of scale.

Methodology of the research

In order to assess market power execution in the Polish food sector two methods were chosen because they are the most well-known and the most frequently applied regarding problems on micro and macro levels (compare Gradzewicz & Hagemejer, 2007b, pp. 13-27; Nekarda & Ramey, 2013, pp. 1-47). The first one was developed by Roeger (1995), and the second one by Rotemberg and Woodford (1999).

The Roeger method is one of the methods studying the price response to a change in costs. The main idea of this group of methods is that on the perfectly competitive market each increase in costs will be completely transmitted on consumers, whereas on the imperfect one the pass-through is different from zero. Therefore, the range, in which price responds to change in costs, can be used for markup estimation. In most studies taking advantage of this broad category of methods, directly or indirectly Hall

(1988) developments are used. He calculated markups from the following equation: $\Delta \ln \frac{Y}{K} = \mu \Delta \ln \frac{X}{K} \cdot \theta + \xi$, where Y is output, K is a capital input, X is a labor input, and θ is a share of labor costs in production value. The main problem with this method was that, disturbances in unobserved productivity are a part of random error of the model and therefore could be correlated with the production factors, what induces a markups estimates bias. This problem was solved by introducing instrumental variables influencing unobserved residual in the Solow model, which influence changes in employment and demand, and not in productivity, e.g. world oil price, government military expenditures, dummy variable connected with ruling party. Additionally, because data must be in real terms, there is a problem concerning the influence of products quality changes on prices. Finally, markups estimates were too high comparing with no profits in certain branches.

The great deal of these problems was solved by Roeger (1995). Whereas Hall took advantages of the primal Solow residual (SR) based on the production function, Roeger added the dual Solow residual (DSR) based on the cost function. By SR we understand a share of a technology change in the production, and by DSR a share of a technology change in the change of total costs of production. Using primal and dual Solow residuals enables elimination of unobserved productivity variable from the regression equation (no bias under constant returns to scale), what gives more precise and closer to reality markup estimates (see Gradzewicz & Hagemejer, 2007b, pp. 13-27). Consequently, the estimation could be performed with normal least square method. There is no need to look for instrumental variables.

Moreover, because of the assumption, that markups are constant in particular branch in particular year, data may be in nominal terms (see Gradzewicz & Hagemejer, 2007b, pp. 13-27). Additionally, because of the assumption of constant returns to scale, if returns to scale are constant, the estimators are equally burdened in time (compare Gradzewicz & Hagemejer, 2007b, pp. 13-27), what doesn't influence the markups dynamics. Consequently, this method is relevant to study markups dynamics, as well as the impact of exogenous variables on markups. Roeger estimates represent lower bound of markups in branches with growing returns to scale, large sunk costs and strong rigidity of adjustments over the business cycle (compare Martins et al. 1996, pp. 1-47). The assumption of constant returns to scale was however broadly criticized.

If we assume, that the production function is: $Y(X_1, \ldots, X_N, K, E) = F(X_1, \ldots, X_N, K)E$, where Y is an output, K is a capital input, X_i are inputs of production factors from 1 to N, and E is a

neutral Hicks technology change, after logarithmic differentiation we get: $\frac{dY}{Y} = \sum_i \frac{\partial Y}{\partial X_i}\frac{dX_i}{Y} + \frac{\partial Y}{\partial K}\frac{dK}{Y} + \frac{dE}{E}$ (see Gradzewicz & Hagemejer 2007b, pp. 13-27). Assuming perfectly competitive production factor markets, we have: $w_i = \frac{\partial Y}{\partial X_i}\frac{P}{\mu}$, and $w_k = \frac{\partial Y}{\partial K}\frac{P}{\mu}$, where w_k and w_i are prices of capital and other production factors accordingly, P is a price of a final product, μ is a markup. Assuming homogeneity of production function, we have: $TC = MC \cdot Y$. The shares of production factors costs in the total costs can be expressed as: $\alpha_K = \frac{w_K K}{Y \cdot MC}$ and $\alpha_i = \frac{w_i X_i}{Y \cdot MC}$. We get then: $\frac{dY}{Y} = \sum_i \frac{w_i X_i}{Y \cdot MC}\frac{dX_i}{X_i} + \frac{w_K K}{Y \cdot MC}\frac{dK}{K} + \frac{dE}{E}$. Because the shares of production factor costs in total revenue are as follows: $\theta_i = \frac{w_i X_i}{PY}$, we obtain: $\alpha_i = \frac{w_i X_i}{Y \cdot MC} = \theta_i \mu$, and $\alpha_k = \theta_k \mu$, accordingly. Assuming constant returns to scale, from the Euler theorem, we have: $\sum_i \alpha_i + \alpha_K = 1$. Then: $\frac{dY}{Y} = \sum_i \theta_i \mu \frac{dX_i}{X_i} + \theta_k \mu \frac{dK}{K} + \frac{dE}{E}$. After transformations we can get the primal Solow residual: $SR = \frac{dY}{Y} - \sum_i \theta_i \frac{dX_i}{X_i} - \left(1 - \sum_i \theta_i\right)\frac{dK}{K} = \left(1 - \frac{1}{\mu}\right)\left(\frac{dY}{Y} - \frac{dK}{K}\right) + \frac{1}{\mu}\frac{dE}{E}$.

From the cost function we can obtain marginal cost: $MC = \frac{G(w_1, \ldots, w_N, w_K)}{E}$. After logarithmic differentiation we get: $\frac{dMC}{MC} = \sum_i \frac{\partial G}{\partial w_i}\frac{dw_i}{G} + \frac{\partial G}{\partial w_k}\frac{dw_k}{G} - \frac{dE}{E}$. In accordance with Shepard lemma we notice that: $X_i = \frac{\partial C}{\partial w_i} = \frac{\partial G}{\partial w_i}\frac{Y}{E}$. Hence, we have: $\frac{dMC}{MC} = \sum_i \frac{X_i dw_i}{Y \cdot MC} + \frac{K dw_k}{Y \cdot MC} - \frac{dE}{E}$. Assuming constant markups in certain year in a certain branch $\frac{dMC}{MC} = \frac{dP}{P}$, we have: $\frac{dP}{P} = \sum_i \frac{\theta_i \mu dw_i}{w_i} + \frac{(1 - \sum_i \theta_i \mu) dw_k}{w_k} - \frac{dE}{E}$. After transformations we can get the dual Solow residual:

$$DSR = \sum_i \theta_i \frac{dw_i}{w_i} + \left(1 - \sum_i \theta_i\right)\frac{dw_K}{w_K} - \frac{dP}{P} = \left(1 - \frac{1}{\mu}\right)\left(\frac{dw_K}{w_K} - \frac{dP}{P}\right) + \frac{1}{\mu}\frac{dE}{E}.$$

Then, subtracting DSR from SR, would give us the Nominal Solow Residual (NSR), with the technological change cancelled out:

$$NSR = \frac{dY}{Y} + \frac{dP}{P} - \sum_i \theta_i \left(\frac{dX_i}{X_i} + \frac{dw_i}{w_i}\right) - \left(1 - \sum_i \theta_i\right)\left(\frac{dX_K}{X_K} + \frac{dw_K}{w_K}\right) = \left(1 - \frac{1}{\mu}\right)\left[\frac{dY}{Y} + \frac{dP}{P} - \left(\frac{dK}{K} + \frac{dw_K}{w_K}\right)\right]$$

.

Using the differential calculus for two variables, we can observe that our NSR is the approximation of the following equation: $\Delta ln(Y \cdot P) - \sum_i \theta_i \, \Delta ln(X_i \cdot w_i) - (1 - \sum_i \theta_i) \Delta ln(K \cdot w_K) = \left(1 - \frac{1}{\mu}\right) [\Delta ln(Y \cdot P) - \Delta ln(K \cdot w_K)]$, and estimating the expression $\left(1 - \frac{1}{\mu}\right)$ we can finally obtain μ.

The second method applied concern single input margins and it was developed by Rotemberg & Woodford (1999). Because marginal cost of increasing production by increasing any of the production factors should be equal, markups may be measured using only the one chosen. The source of such a reasoning lies in the fact, that: $MRP_i = MR \cdot MP_i$, where MRP_i is a marginal revenue of production factor i, and MP_i is a marginal product of production factor i (see Samuelson & Marks, 2009, pp. 234-235). Because profit maximization condition is: $MR = MC$, the optimal markup can be expressed as follows: $\mu = \frac{P \cdot MP_i}{MRP_i}$. Consequently, the minimizing cost firm should cover the marginal cost of increasing production, taking into account all possible margins (compare Nekarda & Ramey, 2013, pp. 1-47).

According to Rotemberg & Woodford (1999), the most appropriate measure of marginal cost concerns increasing production by changing labor input, with other costs constant. In particular, they considered the number of hours per worker, which was explained by the fact, that while there are adjustment costs of hanging a number of worker and capital stocks, there are no adjustment costs of changing working hours[3]. If the production function is as follows: $Y = F(ZhN, \ldots)$, where N is a number of workers, Y is an output, Z is a labor augmenting technology, h is a number of hours per worker, and W_A is an average hourly wage, we obtain: $MC = \frac{W_A' h + W_A}{F_1(ZhN, \ldots)Z}$, where F is a derivative of production function against effective labor ZhN (see Nekarda & Ramey, 2013, pp. 1-47). We can notice, that in the numerator we have marginal revenue of increasing hours per worker and in denominator – marginal product per worker.

Assuming that production function is of Cobb-Douglas type, and marginal wage equals average wage, we get: $\mu = \frac{P}{W_A / \left[\alpha\left(\frac{Y}{hN}\right)\right]} = \frac{\alpha}{s}$, where α is an exponent in the production function (elasticity of output against labor input), and s is a labor share in production value. The change in inversed labor share indicates the change of markup. Although this method is

[3] This choice can be also explained by the fact, that it is regarded that in the short period capital costs are stable, the cost of materials increases proportionally to the production value, and only labor costs may vary (Samuelson & Marks, 2009, pp. 278-280).

appropriate for a situation of increasing production by increasing working hours, it was also applied to labor costs calculated with no consideration of working hours, (see Klein, 2011. pp. 1-22). Moreover, markups were approximated by the ratio of price of final product to a labor input price (see Phelps, 1994, pp. 678-711).

Few important problems are connected with labor markups (Nekarda & Ramey, 2013). The first one concerns not including overhead labor, which consists of all activities necessary for firm functioning, which can't be connected with products or services offered by the firm. In other words, these activities don't generate profits directly. Overhead expenses include e.g. costs of accounting, advertisement, insurance, legal fees, taxes, rent, repairs, telephone bills. The second problem is not allowing for elasticity substitution between production factors, whereas the third one concerns using average wages, not marginal ones. Although in the standard New Keynesian literature it was assumed, that average wage is a proper measure of marginal increase in working hours, this assumption was neglected by Bils (1987), who argued, that average wage could increase in average hours per worker because of the costs of overtime hours.

Consequently, the labor method was further developed. Rotemberg & Woodford (1999) presented corrections of their method by taking into account: non- Cobb-Douglas production function, overhead labor, marginal wage not equal average wage, costs of labor input adjustment, labor hoarding, and variable capital utilization. An attempt of omitting some of these problems and applying the results to real data was undertaken by Nekarda & Ramey (2013).

Moreover, Rotemberg &Woodford (1999) analysed three single input markups measures, alternative to labor markups. The first one was indirect inputs, like energy and materials. The conditions for its use were, that the production technology can't utilize these inputs proportionally to the primary production factors (see Basu, 1995, pp. 512-531), and that there are no adjustment costs. What is interesting, came to the conclusion, that if a production function is isoelastic with respect to labor and materials, a markup is proportional to the both labor share and materials share, so both shares should move proportionally to each other, and their sum should be a multiple of a markup (see Domowitz et al., 1986, pp. 1-17). The second one was stocks of final goods, where it was assumed, that for the firm minimizing costs, marginal cost of decreasing stocks has to be equal to marginal cost of additional production. The third one relies on cost of capital stocks including adjustment costs.

Because of a lack of data on working hours and because we have some doubts if firms in our converging economy actually equalize the marginal cost of rising output across all possible margins, the Roeger markups were

assumed as the reference indicators of market power execution in the Polish food sector. Consequently, in order to answer the question if labor markups changes were good indicators of market power execution changes in the Polish food sector in the period 2003-2012, the changes in labor markups will be compared with results received with the Roeger method.

Polish food sector in the period 2002-2013

Individual or sectorial approaches may be distinguished regarding markups calculation (compare Nekarda & Ramey, 2013, pp. 1-47). The first one relies on the data from individual entities coming from the firms financial statements and the sectorial data concerns separate branches or sectors of the economy. The major advantage of the first one is their appropriateness for the impulse reaction analysis, that is monetary shocks or government spending shocks because of theirs higher frequency, whereas the second one enables to take advantage of the instruments identifying demand and supply shocks typical for a certain branch. There is also the third option concerning aggregation of individual date to the branch level. In our analysis, because of the data confidentiality, we could only get the data of the third type. They come from the F-01 financial statements prepared by the companies hiring more than 9 workers at the end of the fourth quarter and concerning the whole calendar year on the voluntary basis.[4]

The way of calculation categories used for markup estimation are presented in table 2. The analysis covered a period 2002-2013. The yearly data were acquired from the IAFE-NRI, and the portal www.obligacjeskarbowe.pl. They cover divisions: 10 – food, 11 – non-alcoholic beverages of section C – manufacturing of the Polish Activity Classification 2007. The data from 11 main groups and 32 classes were analyzed. Regarding labor markups, because of no access to data on working hours in food sector branches, the labor share was calculated as the ratio of labor costs to production value.

Table 2. The data used in the analysis

Variable	Characteristics
Production value	Sales revenue adjusted for the change in inventories and taxes levied on the company costs (excise tax, property tax, tax on means of transport and nondeductible VAT)
Materials	Costs of materials, external services and commodities and materials

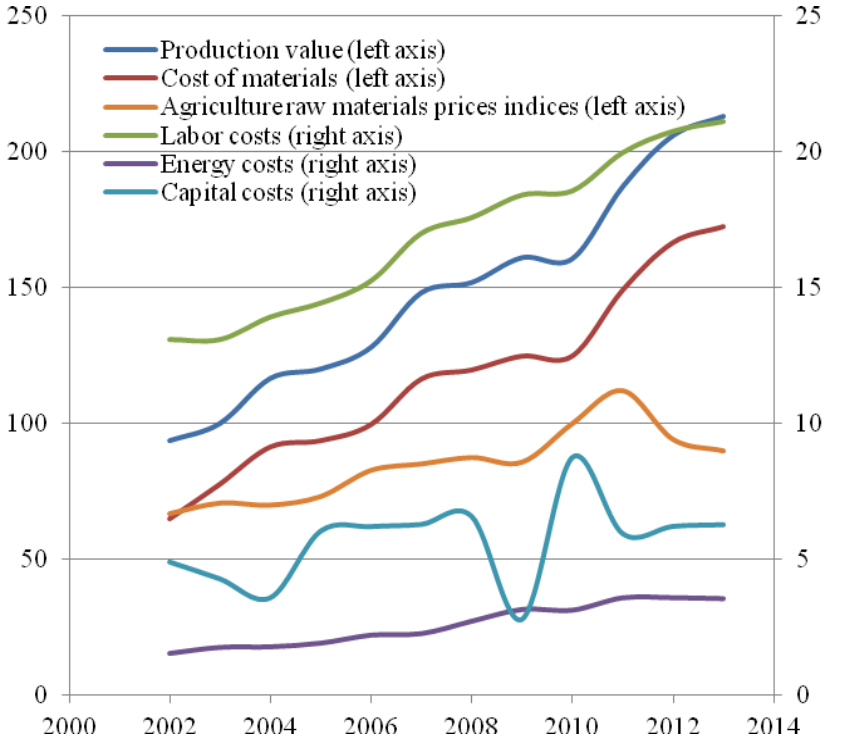
[4] Because some of the needed categories are lacking in this statement, we were forced to calculate them in an indirect way.

costs	purchased for resale
Labor costs	Wages and salaries, social security contributions paid by the employer, other generic costs (staff costs – including travel expenses, death benefit, accident compensation and others, e.g. property insurance)
Energy costs	Extracted as a separate production factor
Capital costs	Instead of the assets value the following value of a flow of capital services in branch i is used: $k_i = (r - \pi + \delta_i) \cdot K_i$, where: r is the rate of return defined as expected return on capital employed in the alternative project, measured by the interest rate of government bonds; π is a value added deflator; δ_i is a depreciation rate (the ratio of depreciation to the assets value); K_i is the fixed and intangible assets value (see Jorgenson & Griliches,1967, pp. 249-283; Oulton and Srinivasan, 2003, pp. 1-88)

Source: own elaboration based on the Gradzewicz & Hagemajer (2007b, pp. 11-27)

Figure 3 presents the values of each category, as well as agricultural products prices indices. Table 4 presents main characteristics of the data.

Figure 3. Production value and costs of production factor costs (in mln zl) in the Polish food sector and prices of the world agricultural products (2010=100, real 2005 US dollars) in the period 2002-2013



Source: own calculations based on IAFE-NRI (2014), www.obligacjeskarbowe.pl

Table 4. Main characteristics of analysed categories

Item	Production value	Cost of materials	Labor costs	Energy costs	Capital costs
Mean (in mln zl)	148.83	116.81	16.94	2.61	5.64
Minimum (in mln zl)	93.71	64.82	13.08	1.55	2.79
Maximum (in mln zl)	212.93	172.65	21.14	3.59	8.73
Coefficient of variation (in %)	25.17	27.66	16.61`	28.57	26.54
Growth (in %)	127.22	166.37	61.58	129.85	27.97
Yearly growth (in %)	7.34	8.12	4.84	8.42	3.19
Change of share in production value (in %)	-	17.23	-28.89	1.16	-43.68
Variability explained by growing linear trend (in %)	97.37	96.49	98.36	95.92	17.92

Source: own calculations based on IAFE-NRI (2014), www.obligacjeskarbowe.pl

Although food sector in Poland is often treated as traditional one and of diminishing importance, we could observe the enormous growth of the

production value of analysed companies in the period 2002-2013. In 2013 it reached its maximum of 212.93 mln zl. Comparing with 2002, it was a growth by 127.22%. The main reason was undoubtedly joining the EU and export growth. It should be noticed, that in the period 1995-2013 export of the whole Polish agro-food sector increased from 3 to 14 bln euro, and for example in 2012 almost 77% of it went on the EU markets (see Łopaciuk, 2013, pp. 7-14).

Also all the series of distinguished cost categories can be characterised by growing trends, which explained more than 90% of their variability, apart from capital, changes of which were more of the cyclical character. Comparing to the production value, materials costs were growing in the faster pace, and labor costs were growing one third slower. While energy was increasing the fastest, the weakest growing trend may be observed in capital cost data. Consequently, while the share of the cost of materials in the production value increased, the shares of labor and capital costs decreased.

Looking at the correlations between analysed data series, we can observe that the capital costs correlations with the rest of variables were the weakest (0.34-0,39), whereas correlation between other variables were between 0,95 and 0,99. The drop in capital costs in 2009 may be an effect of the world economic crisis. As early as in 2010 companies seemed to rebuild their capital costs. Simultaneously, with the high worldwide inflation of agricultural products in 2010 and 2011 (of appropriately 0.16 and 0.12), what influenced food prices, the food production value started to increase faster. Moreover, probably because of the higher market uncertainty and restructurings, the pace of rising of labor costs wasn't so high.

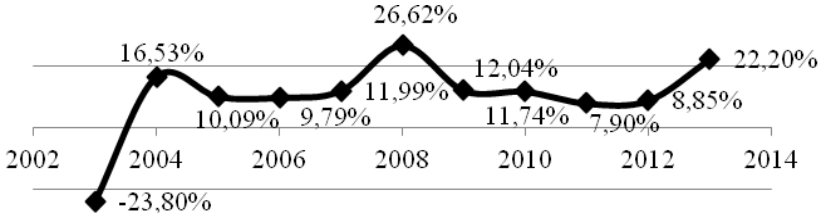
Roeger markups

Figure X presents the estimated Roeger markups in the period 2003-2013[5]. The average markup amounted to 1.10, what can be seen as rather moderate. The standard deviation from the mean was also relatively low – 0.12, and the coefficient of variation amounted to 0.11. What is interesting however, elimination of the first observation, which is an outlier, increases the mean to 1.14, decreasing the standard deviation to 0.06 and the coefficient of variation to 0.05. Although since the accession to the EU markups increased by 0.06 (from 2003 it was by 0.46 p.p.), no linear trend

[5] Although all the regression results were statistically significant (at the level 0.1), the set of explanatory variables was not always sufficient. Especially in years 2003, 2006, 2012 and 2013 some other factors mattered.

was found in the data. Particularly, its negative sign in 2003 was caused by the high increase in costs of materials (agricultural products prices) before the entrance.

Figure 4. Roeger mark-ups (over MC) in the Polish food sector in the period 2003-2013

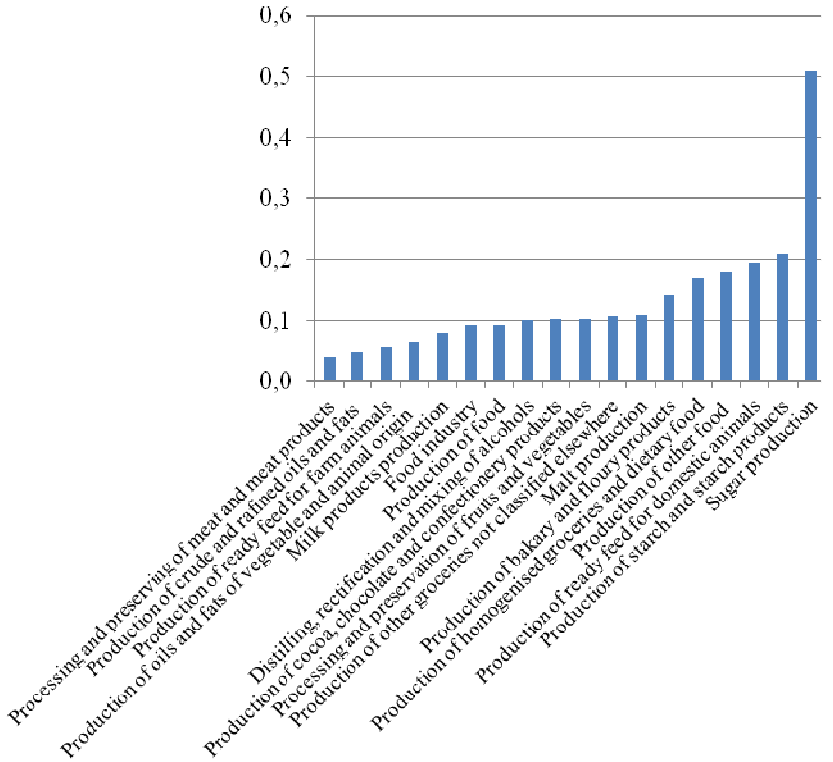


Source: own calculations based on IAFE-NRI (2014)

Comparing with the level of the Polish food sector markups estimated for the period 1996-2004 by Gradzewicz and Hagemejer (2007b), the average Roeger markup over MC decreased (from 0.22 to 0.10), and its variability increased (from 0.56 to 1.18). Higher variation of markups could be related with the convergence processes taking place in the Polish economy after entering the EU, as well as with the effects of the 2007 crisis.

Additionally the average markups over MC in the food sector branches in the period 2003-2013 were calculated. But only for 18 out of 46 categories the results were statistically significant. They are presented in figure 5. Extremely high markups were observed in the sugar production reaching 0.51. To other relatively high markup include production of starch and starch products (0.21) and ready food for domestic animals (0.20). The lowest markup food industry branches were as follows: processing and preserving of meat and meat products production (0.04), as well as production of crude and refined oils and fats (0.05).

Figure 5. Roeger markups (over MC) in selected branches

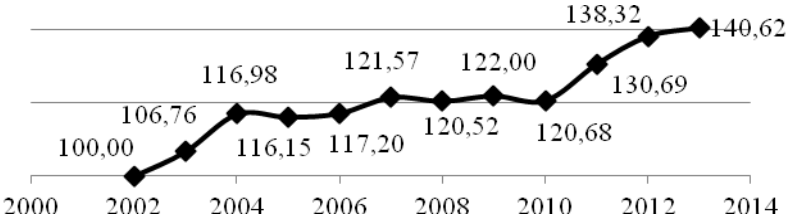


Source: own calculations based on IAFE-NRI (2014), www.obligacjeskarbowe.pl

Labor input markups changes

Figure 6 presents the labor markups changes calculated for the period 2002-2013, assuming constant elasticity of output with respect to labor input. The coefficient of variation amounted to 0.09. In the whole period these indexes were increasing on average by 0.025 yearly, what means, that labor markups were increasing by 2.5% yearly, and R^2 amounted to 0.88, what implies the existence of a strong growing trend. Growing labor input markups means that the share of the costs of labor in the value of production was decreasing in the analyzed period.

Figure 6. Labor markups changes in the Polish food sector in the period 2002-2013 (2002=100)



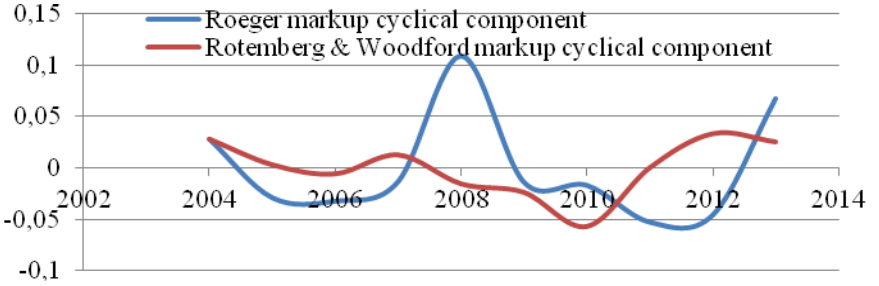
Source: own calculations based on IAFE-NRI (2014)

Three subperiods can be identified: the first one between 2002 and 2004 characterized by the fast increase, the second quite stable between 2004 and 2010, and the third from 2010 to 2013 with again faster increase in labor markups. We suppose the changes were caused by the shocks connected with the EU accession and the world financial crisis. Comparing the labor markup growth with the Roeger markup growth, we can observe, that while the Roeger markups from 2003 increased by 60.36% (and by only 4.86% from 2004), the change in labor markups amounted to 40.62% (20.21% from 2004). Excluding 2003 as the year which stands out (regarding the Roeger markups), we can state, that labor markups change was higher. Consequently, in comparison with Roeger markups, the Rotemberg & Woodford markups seem to overestimate the change in the market power execution in the Polish food sector in the period 2004-2012. This could mean that the assumption of constant elasticity of output with respect to a labor input may not be appropriate for this period (it decreased) and the positive change in labor productivity in the Polish food sector after joining the EU took place.

Moreover, in order to assess, if our labor markups changes were good indicators of market power changes in the Polish food sector, we compared

their variability with the one of the Roeger markups (data in logs) in the period 2004-2013. The results are presented in figure 7. It appeared, that the correlation between the data is very weak and it amounted to 0.04. Suprisingly, it was very high until 2007 (0.96) and in the period 2008-2013 it amounted to 0.01. These results might show then, that the Rotemberg and Woodford markups changes is quite relevant for the part of the analyzed period. The discrepancies regarding period 2008-2013 might incicate that the wages in the Polish food sector were too rigid in this period and should have grown faster, what could be a sign of unions weaknesses in the Polish food companies.

Figure 7. Detrended Roeger and labor markups in the period 2004-20013 (HP filter)



Source: own calculations based on IAFE-NRI (2014), www.obligacjeskarbowe.pl

Conclusions

The main aim of the article was to depict changes of monopolistic markups in the Polish food sector in the period 2002-2013 as indicators of the market power execution. The theoretical background was presented in order to prove that the markup can be considered as a symptom of market power. The Roeger and Rotemberg & Woodford methods were applied. The average Roeger markup (above MC) amounted to 0.10, what can be seen as rather moderate and in 2013 it equaled 0.22. The differences in results for the branches indicate a substantial heterogeneity in the Polish food industry companies pricing practices.

Because from 2004 to 2012 the change in Roeger markups (+4.86%) was lower than in the labor markups (+40.62%), the labor markups changes seems to overestimate the change in market power execution in the Polish food sector. Also because of weak correlation between detrended series, we considered simple inversed labor input as insufficient indicator of the market power execution changes in the Polish food sector in the period 2004-2013. The application of this method for the Polish condition needs

further improvements, e.g. aadditional data on hours per worker are needed (no adjustment cost), and the values of elasticity of output with respect to labor input will enable calculation of absolute markups values. Additionally, the following possible amendments should be included: CES production function, overhead labor, marginal wage. Nevertheless, because of the restructurings in the Polish food sector and because of the crisis, the assumption that a cost minimizing firm equalizes the marginal cost of rising output across all possible margins may be too strong.

Regarding data, some drawbacks should be here highlighted. Firstly, the main obstacle was no access to data on the firm level and consequently no possibility to clean the database. Secondly, the data frequency was to low (yearly basis) to analyse the cyclical proprieties of markups.

Finally, some rather general conclusions regarding competition policy in the food sector can be formulated. It should still focus on the antitrust laws execution, but most effort should be put on creating strategic trade policy, which will contribute to broader and faster development of the Polish food sector and especially to the more intense international trade promotion. Regarding regulation and deregulation, a special focus should be put on regulations promoting vertical arrangement between firms as well as vertical integration, both in the framework of the CAP and the national agricultural policy. In particular, special attention should be paid to the concentration processes and pricing practices in the production of sugar starch and starch products, ready food for domestic animals, homogenized groceries and dietary food, as well as bakery and floury products.

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