Impact of competition and business cycles on the behaviour of monopolistic markups in the Polish economy

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Draft version

The aim of this study is to analyse the impact of competition, both internal and external, and of the business cycle on monopolistic markups in the Polish economy. The results show that there are significant markups in several sectors of the economy which complies with earlier estimations by the authors. According to the estimations carried out, competition has a significant impact on the level of markups. This result applies both to internal competition, measured by market concentration, and foreign competition, measured by import penetration ratios. In addition, there was a significant negative correlation between markups and the macroeconomic cycle which seems to confirm the conclusions from numerous theoretical macro and microeconomic models. The results also point to a positive but less clear correlation between the sectoral cycle and the level of markups. A different reaction of markups to the sectoral and macroeconomic cycles may result from a different nature of adjustments of businesses in reaction to exogenous shocks affecting either the sectoral or the macroeconomic environment of the enterprises.

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Introduction

The aim of the study is to analyse the impact of the level of competition, both internal and external, and the impact of the business cycle on monopolistic markups in the Polish economy. In order to examine these issues, it is necessary to estimate the change of monopolistic markups over time within a given sector. The applied methodology allows for unbiased estimation of variable markups without the necessity to use instrumental variables in order to eliminate the impact of technological disturbances on the results of the estimation. Using the sectoral time-varying estimates, authors carried out a panel regression of markups on internal and external competition measures. Behaviour of markups over the business cycle is an issue which was analysed additionally using panel methods. A simple correlation analysis of relations between the markups and the business cycle at the level of branches and at the macroeconomic level was also performed.

Section one contains a short review of literature related to the estimation of monopolistic markups and theoretical and empirical studies, describing the impact of competition and the business cycle on monopolistic markups. Section two provides the theoretical basis for the empirical model. The subsequent section describes the statistical data and the results of the estimation of monopolistic markups. It contains the results of the analysis of the impact of competition on margins and the behaviour of markups during the business cycle. Last section is followed by a short summary.

1. Review of literature

The majority of economic literature concerning the price-cost margins relies directly or indirectly on the methodology developed by Hall (1988) who estimates monopolistic markups in the American economy using aggregated sectoral data with the assumption of constant returns to scale[1]. If there are two production factors (labour and capital), the empirical specification of Hall boils down to the equation where the dependent variable is a change in the logarithm of the volume of production per unit of capital and independent variable is a change in the logarithm of employment per unit of capital, multiplied by the labour share in the total

[1] Klette (1999) proposes the method of simultaneous estimation of markups and scale elasticity using the unit data without assuming constant returns to scale. This method is also based on the study by Hall. It was the basis for the estimation of long-run markups and scale elasticity in the Polish economy in the study by Gradzewicz and Hagemejer (2006).

production cost. The estimated slope coefficient is equivalent to the monopolistic markup (expressed as a percentage of marginal cost). The theoretical grounds for the equation estimated by Hall are presented in the second part of this study.

There is a problem of endogeneity since there is a correlation between the error term (which is a function of productivity) and the dependent variables. Identification of the markup is based on the use of instrumental variables which influence the changes in employment and demand and at the same time they do not affect productivity. The use of demand-related instrumental variables is necessary to separate the supply-related fluctuations of the economy affecting the unobserved productivity term. However, identification of appropriate instrumental variables is problematic. Hall uses such measures as the level of government military spending, world price of oil and a variable that indicates that a specific political party is in power.

Roeger (1995) proposes an alternative methodology of markup estimation. It allows for elimination of the unobserved productivity term from the regression equation. This solves the problem of endogeneity and proper identification of the markup estimator. Estimation based on the difference between Solow residuals calculated from the production function (the so-called primal residuals) and the cost function (dual residuals) may thus be carried out using ordinary least squares.

Martins and Scarpetta (1999) estimate markups in the manufacturing sectors of selected developed countries using the Roeger's method. Estimators obtained using gross output data (studies mentioned earlier studies rely on value added) are lower than in the case of studies by Roeger and Hall. In addition, using value added requires additional correction, since otherwise the estimators are biased upwards (Roeger, p. 325). Martins and Scarpetta also show that in the case of increasing returns to scale, estimates of Hall and Roeger constitute an upper limit of markups that actually occur in the economy.

Roeger's (1995) methodology was commonly applied in the studies on markups in European countries, with the use of microeconometric data. It is applied by, among others, by Konings and Vandenbussche (2005) in the estimation of markups in the European Union firms. A similar methodology is applied by Konings, Van Cayseele and Warzynski (2003) in the study on the behaviour of Bulgarian and Romanian companies.

One natural question that arises is what determines the level of margins in individual sectors. The answer requires not only a cross-section analysis of sectors but also a detailed look into the behaviour of markups over time.

The basic factor influencing markups is the level of internal competition (number of competing companies, industry concentration, etc.) and external competition (imports of goods competing with the products of a given sector). The impact of internal competition on the level of markups is emphasized in the studies by Rotemberg and Woodford (1999) and Galí and Zilibotti (1995). Influence of industry concentration (measured by the Herfindahl-Hirschmann index) on the long-term level of markups was examined by Gradzewicz and Hagemejer (2006) but the authors did not find any clear-cut positive correlation (however, there is a significant correlation between the economies of scale and the level of concentration which suggests that there are high barriers to entry in some sectors). Intersectoral heterogeneity of markups may thus result from other factors (level of product differentiation, price regulations, etc.) which are not measured by the Herfindahl-Hirschmann index. In addition, changes in concentration over time probably have a larger impact on the level of markups in individual sectors than it would result from the cross-section comparison. It is obvious that the impact of changes in the Herfindahl-Hirschmann index on changes in the level of markups cannot be examined when markups are assumed to be constant over time.

There exists a great deal of literature investigating the impact of external competition on the level of the markup of price over marginal cost. Such research include, among others, the study of Lundin (2004) for Sweden, where apart from import competition, the product differentiation level was included as a factor affecting the level of markups; or the study of Abraham, Konings and Vanormelingen (2006) for Belgium, where along with the impact of external factors on prices, the importance of trade unions in wage setting was examined. Moreover, Görg and Warzynski (2003) show a significant positive impact of export participation on the level of markups.

A separate issue is the behaviour of monopolistic markups along different stages of the business cycle. Theoretical literature on the subject provides contradictory hypotheses. On one hand, Athey, Bagwell and Sanchirico (2004) who, basing on classic literature by Sweezy (1939) and Hall and Hitch (1939), point to the existence of price rigidity in sectors with small number of companies operating in a collusive environment. This rigidity results from a reluctance to adjust prices as the level of

marginal cost changes, in fear of undermining collusive agreements. Therefore, for example, a negative technology shock (which causes an increase of marginal cost) results in a reduction of monopolistic markups under fixed prices. This indicates procyclicality of markups. Similar conclusions stem from the Green and Porter model (1984). In the Kreps and Scheinkman model (1983) companies quickly reach their production capacities during boom period and start competing in quantities (Cournot competition) as opposed to the recession period when firms compete in the Bertrand fashion due to unused production capacities and the possibility to satisfy larger demand share. Thus, firms' profits increase during the boom period and decrease during the recession period.

On the other hand, Rotemberg and Saloner (1984) build a theoretical model which shows that the increase of markups in the case of recession (countercyclicality of markups) is possible. If demand is rising, short-term profits from a price undercut by a single firm may be large enough for the company to decide to terminate the collusive agreement. In the case of a recession, short-term benefits from competitive activities are so low that it is profitable to maintain prices at the level fixed by the cartel and realize long-term profits. The theoretical models of Bils (1989) and Weitzman (1982) predict similar behaviour of markups. However, existing empirical studies do not provide a clear-cut solution to the problem of markups cyclicality either. The study by Martins and Scarpetta, carried out for selected OECD countries, points to the countercyclicality of markups. In a study based on OECD data, Boulhol (2004) also comes to similar conclusions. Paper by Marchetti (2002), studying the cyclicality of markups in the Italian economy, points to clear countercyclicality of markups in strongly concentrated sectors. The study by Small (1997), based on the British data, points to procyclicality of markups, both in the manufacturing and in the services sector.

This study uses the Roeger's methodology (1995) to estimate markups in the Polish economy using firm-level data. The selection of this particular methodology was motivated by the fact that with firm-level data it is possible to obtain markups estimates at the sectoral level for each year. As a consequence, it is possible to obtain sectoral-yearly changes in markups which, in turn, allows to examine the impact of external variables on the level of monopolistic markups and the relationship between the markup fluctuations and the changes in the business cycle. It should be once again mentioned that the methodology is based on the assumption of constant

returns to scale. However, if sectoral scale elasticity is constant over time, then the bias of estimators which results from the actual occurrence of the effects of scale is constant (which results directly from the work of Martins and Scarpetta) and does not have an impact on the markup dynamics[2].

2. Theoretical model

Let us assume that a firm produces using technology described by the following homogeneous of first degree production function:

$$Y(X_1,...,X_N,K,E) = F(X_1,...,X_N,K)E, \tag{1}$$

where K denote firms' stock of fixed assets and X_i's denote all remaining production inputs employed in the production process and E measures a Hicks-neutral technical progress (total factor productivity). Log differentiation of equation (1) gives:

$$\frac{dY}{Y} = \sum_i \frac{\partial F}{\partial X_i}\frac{dX_i}{F} + \frac{\partial F}{\partial K_i}\frac{dK_i}{F} + \frac{dE}{E} = \sum_i \frac{\partial Y}{\partial X_i}\frac{dX_i}{Y} + \frac{\partial Y}{\partial K_i}\frac{dK_i}{Y} + \frac{dE}{E}. \tag{2}$$

Assuming that input markets behave in a perfectly competitive fashion, prices of production factors are equal to the value of their respective marginal product corrected by the markup of the producing firm. We assume that the size of the markup is the same for all factors and is equal to the markup of price over marginal cost (MC). Let r and w_i denote respectively the prices of capital and other inputs, P – the price of final good and μ - the markup over marginal cost ($\mu = P/MC$). We can then write: $w_i = \frac{\partial Y}{\partial X_i}\frac{P}{\mu}$ and $r = \frac{\partial Y}{\partial K}\frac{P}{\mu}$. By the homogeneity assumption, we can express the total costs as a product of the marginal cost and output. Taking that into account, we can rewrite (2) as:

$$\frac{dY}{Y} = \sum_i \frac{w_i X_i}{YP/\mu}\frac{dX_i}{X_i} + \frac{rK}{YP/\mu}\frac{dK}{K} + \frac{dE}{E} = \sum_i \frac{w_i X_i}{Y \cdot MC}\frac{dX_i}{X_i} + \frac{rK}{Y \cdot MC}\frac{dK}{K} + \frac{dE}{E}$$

or:

$$\frac{dY}{Y} = \sum_i \alpha_i \frac{dX_i}{X_i} + \alpha_K \frac{dK}{K} + \frac{dE}{E}, \tag{3}$$

[2] Although, one should bear in mind, that according to the study of sectoral markups conducted in Gradzewicz and Hagemejer (2006), there could be a possibility of changes in the elasticities of scale over time in the manufacturing industry.

where α_K and α_i denote the input shares in the total production cost, defined as $\alpha_i = w_i X_i / MC \cdot Y$ for X_i and analogously for *K*. Cost share of factor X_i in the total revenue of the firm is denoted by $\theta_i = w_i X_i / PY$. We can then rewrite the cost shares:

$$\alpha_i = \frac{P}{MC}\frac{w_i X_i}{PY} = \theta_i \mu \qquad (4),$$

and respectively for *K*. Under perfect competition $\alpha_i = \theta_i$, as $\mu = 1$. Under imperfect competition $\mu > 1$. By homogeneity of the production function, the Euler theorem states that:

$$\sum_i \alpha_i + \alpha_K = 1 \qquad (5)$$

We can define the so-called primal Solow residual (SR), based on the production function:[3]

$$SR = \frac{dY}{Y} - \sum_i \theta_i \frac{dX_i}{X_i} - (1 - \sum_i \theta_i)\frac{dK}{K}, \qquad (6)$$

Using (4) and (5), it is easy to show that (details of the derivations are given in the Annex A.1):

$$SR = \frac{dY}{Y} - \sum_i \theta_i \frac{dX_i}{X_i} - (1 - \sum_i \theta_i)\frac{dK}{K} = (1 - \frac{1}{\mu})(\frac{dY}{Y} - \frac{dK}{K}) + \frac{1}{\mu}\frac{dE}{E}, \qquad (7)$$

In (7), $(1 - \frac{1}{\mu}) = \beta$, where β is the Lerner index. Then:

$$SR = \beta(\frac{dY}{Y} - \frac{dK}{K}) + (1 - \beta)\frac{dE}{E} \qquad (8)$$

Hall (1988) estimates Lerner indices using an equation similar[4] to (8), however, due to the possibility of correlation of the unobserved $\frac{dE}{E}$ variable with the explanatory variables, it is necessary to use instrumental variables, the choice of which is rather problematic. Roeger (1995), solves this problem by using an estimator based on a difference between primal and dual (cost function-based) Solow residuals.

The cost function corresponding to the production function (1) is of the form:

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[3] See Solow (1957) and Hall (1988).

[4] To arrive at the equation estimated by Hall in the current notation, one has to transform equation (3) to the following form:

$$\frac{dY}{Y} - \frac{dK}{K} = \mu\left[\sum_i \theta_i\left(\frac{dX_i}{X_i} - \frac{dK}{K}\right)\right] + \frac{dE}{E}, \text{ using (4) and (5).}$$

$$C(w_1,...,w_N,w_K,Y,E)=\frac{G(w_1,...,w_N,w_K)Y}{E}, \tag{9}$$

where G is homogeneous of first degree. Marginal cost is equal to:

$$MC=\frac{G(w_1,...,w_N,w_K)}{E} \tag{10}$$

Log differentiation of equation (10), after applying the Shephard lemma[5] and the definition (9) gives:

$$\frac{dMC}{MC}=\sum_i \alpha_i \frac{dw_i}{w_i}+\alpha_K \frac{dw_K}{w_K}-\frac{dE}{E}. \tag{11}$$

If markup μ is constant, then the growth rate of price is equal to that of marginal cost. Thus, $\frac{dMC}{MC}=\frac{dP}{P}$. Substituting $\frac{dP}{P}$ in (11), making use of (4) and rearranging (details are given in Annex A.2), we obtain the so called dual Solow residual (based on the cost function – DSR), as a function of prices, input wages and technical progress:

$$DSR\equiv \sum_i \theta_i \frac{dw_i}{w_i}+(1-\sum_i \theta_i)\frac{dw_K}{w_K}-\frac{dP}{P}=(1-\frac{1}{\mu})(\frac{dw_K}{w_K}-\frac{dP}{P})+\frac{1}{\mu}\frac{dE}{E}, \tag{12}$$

or, using the Lerner index definition:

$$DSR\ =-\beta(\frac{dP}{P}-\frac{dw_K}{w_K})+(1-\beta)\frac{dE}{E}. \tag{13}$$

Subtracting equation (13) from (8) and taking into account the definition of DSR and SR, we obtain:

$$\begin{aligned} SR-DSR &= \frac{dY}{Y}+\frac{dP}{P}-\sum_i \theta_i(\frac{dX_i}{X_i}+\frac{dw_i}{w_i})-(1-\sum_i \theta_i)(\frac{dX_K}{X_K}+\frac{dw_K}{w_K})= \\ &= \beta\left[\frac{dY}{Y}+\frac{dP}{P}-(\frac{dK}{K}+\frac{dw_K}{w_K})\right] \end{aligned}, \tag{14}$$

It can be easily seen that both left and the right hand side of the above equation contains only observable variables ($\frac{dE}{E}$ was eliminated). We can approximate changes in variables in (14) by appropriate log differences and estimate it using ordinary least squares without running into the risk of omitted variable bias.

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[5] $\frac{\partial G}{\partial w_i}\frac{Y}{E}=X_i$, where X_i denotes for factor *i*. Analogous relation is true for capita.

3. Statistical data and results of monopolistic margins estimation

3.1 Description of statistical data

Statistical data used in this research comes from financial reports and balance sheets of enterprises and has been gathered by the Polish Central Statistical Office (GUS – forms F-01 and F-02). The data covers the period of 1996-2004 and was collected on the annual basis. The time dimension of the dataset roughly corresponds to one business cycle[6].The database covers enterprises from manufacturing sector (sections C, D and E) and from market services (sections G, H, I and K), employing at least 50 persons. The total number of observations (in raw data) equals approx. 162 thousand. The original database has been cleared of extreme and unreliable observations. Observations, for which production, employment, capital or labour costs are not positive, have been eliminated. Moreover, the sample has been cleared of enterprises with extreme measures of labour or capital productivity (measured with value added per employee or per unit of fixed assets respectively). Extreme values are defined as those where absolute deviations of logarithm of a given variable from the logarithm of its median (determined in a relatively homogeneous branch defined at four-digit PKD level) exceeds 3. Trimming procedures have reduced the number of observations by approx. 6.7% in total. An unbalanced data panel of firms has been used for markup estimations.[7]

It has been assumed that production is equal to the revenue from sales, adjusted by a change in inventories and by the total of taxes paid by the enterprise that cannot be attributed directly to relevant factors' of production costs[8]. Material costs cover, besides the direct cost of materials, costs of purchase of external services and the value of goods and materials purchased for resale (important item in the case of

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[6] The time dimension of the sample is relatively short but thanks to panel data methods it is possible to formulate formal conclusions, however, the ability to make long-run judgments is somewhat limited.

[7] In the context of this study, the procedure balancing the data panel ensures equal number of degrees of freedom for time-variable estimators of monopolistic margins under a separate branch. However, the balancing procedure involves a selection effect in the group of analysed enterprises, which may potentially lead to positive bias of the obtained markup estimators. Since the positive bias may also result from ignoring the possibility of positive returns to scale (see Gradzewicz, Hagemejer, 2006), the authors decided to minimise the potential bias and to use an unbalanced dataset.

[8] Taxes include excise, property, transport equipment taxes and non-deductible part of value added tax.

enterprises engaged in trade). Labour costs cover, on top of wages and salaries, social insurance premiums paid by the employer and other prime costs[9]. Similarly to Klette (1999), this study considers energy costs as a separate production factor input. Empirical research (see Hyde and Perloff, 1995) shows that estimators of monopolistic markups are sensitive with respect to selection of cost categories, and greater disaggregation of these increases the efficiency of estimators. Estimation with only labour and capital data may lead to inflated estimators.

In order to construct a measure of capital costs, authors have used a concept introduced to efficiency and productivity analysis by Jorgenson and Griliches (1967) and extended by e.g. Oulton and Srinivasan (2003). It allows for the calculation of a stream of capital services generated by a given stock of capital. According to this concept, the stream of capital services is proportional to and may be measured as a cost of renting capital for production purposes and presented as follows:

$$k_{it} = (r_t - \pi_t + \delta_{it}) \cdot K_{it}, \tag{15}$$

where: k_{it} is the measure of capital services, r_t is the rate of return, π_t is a value-added deflator, δ_{it} is the depreciation rate and K_{it} is the stock of assets of the firm. The rate of return (expected return on capital engaged in an alternative project) has been proxied by the interest rate of five-year government bonds. Depreciation rate has been determined at the level of an enterprise, as a ratio of the depreciation value to the fixed assets in purchasers' prices, while the fixed assets cover both tangible and intangible assets, measured in the middle of the year.

The analysis of the volatility of monopolistic margins uses data for manufacturing aggregated at the sectoral level (two-digit division according to NACE). Business cycle measures have been based on the gross value added of a given sector according to the *Statistical Yearbooks of Industry* (*Roczniki Statystyczne Przemysłu*) published by the GUS. Import penetration in a given section has been defined as a ratio of import value to the value of gross output plus the import value and minus the export value. The measure of export intensity in a given section was calculated as the ratio of export value to the value of gross output. Data on the sectoral output have been based on the GUS' *Statistical Yearbooks of Industry*. Data on international

[9] The remaining costs constitute a heterogeneous category and contain, apart from the costs related to employment (e.g. business trip costs, death benefits, accident compensation), other cost categories (e.g. property insurance). However, it has been decided that this category of costs is included in labour costs.

trade come from[10] OECD databases (ITCS). International trade data have been converted from six-digit HS classification to two-digit level of NACE classification using a translation table prepared by Eurostat.

Herfindahl-Hirschman Index (HHI) has been calculated on the four-digit (according to NACE) disaggregation level (on the basis of the data from forms F-01 and F-02), and then aggregated and brought to the adequate branch definition through averaging using production levels of branches as weights. HHI may be treated as an index of market competitiveness and its reverse can be interpreted as a number of hypothetical symmetric enterprises competing in a given market.

3.2 Results of time-variable monopolistic margins estimation

To estimate time-varying monopolistic markups, a procedure proposed by Roeger (1995) and described in chapter 2 of this study has been used. One of the main assumptions of this method are constant returns to scale. This means, in the case of existence of scale economies, that the estimates relate to the markup over average cost instead of marginal cost. This assumption is, however, necessary since no method to estimate time-varying markups allowing for variable returns to scale has been developed yet. Research carried out by Gradzewicz and Hagemejer (2006) with the use of a different method based on Klette (1999) and allowing for simultaneous estimation of margins and scale effects, shows that in the case of many sectors of the economy, we can observe increasing returns to scale[11] (some sectors can be characterised by decreasing returns to scale). Occurrence of positive scale effects implies potentially negative bias on monopolistic markups estimators obtained in this study (see Martins, Scarpetta, 1999).

Table 1 summarises the results of monopolistic markups estimation for sections D, G, H, I and K, as well as for the disaggregated manufacturing sector, estimated on the basis of equation (14), where changes in continuous time are approximated in

[10] Statistical Yearbooks of Industry, published by GUS, contain information on international trade in manufacturing products since 2000. As the period of the analysis covers the years 1996-2004, the authors decided to use OECD databases, which are a coherent source of data through the entire analysed period.

[11] For instance, in overall manufacturing industry increasing returns to scale have been estimated at 3%, but in such branches as manufacture of textiles, paper, printing, manufacture of chemicals and chemical products, non-metallic mineral products and basic metals and fabricated metal products, returns to scale have been estimated at least at 10%.

discrete time. It presents the average values of obtained markup estimates[12] and their standard deviations as measures of monopolistic margin volatility in time. The last column of Table 1 contains volatility ratio (relation of standard deviation to the mean). More detailed markup estimates, together with disaggregation of sections included in market services, are presented in the Annex B. In general, when estimating markups, it could be observed that the goodness of fit of the estimated model (measured by R^2 coefficient) decreases with the number of firms in a given sector. This effect is probably resulting from the assumption that margins are constant in a given industry in a given year, which, together with an increase in the number of observations and thus heterogeneity, implies a decrease in the fit of the model.

When comparing average margins with estimators of monopolistic markups obtained for manufacturing branches by Gradzewicz and Hagemejer (2006), it can be said that approximately in half of the cases, estimators obtained using both methodologies are similar. In the remaining cases, estimators obtained in this study are higher[13]. In ten manufacturing sections similar margin estimators were obtained, while in nine sections higher estimators have been obtained, including such sections as manufacture of food products; manufacture of textiles; publishing, printing and reproduction of recorded media; manufacture of chemicals, chemical products and man-made fibres; manufacture of plastic products; manufacture of non-metallic mineral products; manufacture of basic metals and fabricated metal products; manufacture of machinery and equipment; manufacture of electrical and optical equipment; and manufacture of medical, precision and optical instruments. It is difficult to interpret the negative markup estimator for the "other transport equipment" sector[14]. It is worth noting, that in both papers, similar markup estimates for the entire manufacturing sector have been obtained, i.e. approximately 9-10%.

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[12] Margin estimates presented in the table, after multiplication by 100, reflect monopolistic markup on marginal cost in percent.

[13] Klette (1999), on which Gradzewicz and Hagemejer (2006) build, emphasizes that estimators obtained using his method are relatively low with respect to alternative methods of markup estimation. Moreover, estimators obtained in this study may be treated as short-run estimates, while those obtained in the study by Gradzewicz and Hagemejer (2006), as long-run estimators.

[14] In the study by Gradzewicz and Hagemejer (2006) a negative markup estimate was obtained for the same sector. It may result from a relatively high heterogeneity of this sector. Detailed results presented in annex B show a very low markup estimate in 2001, which has a major effect on the average presented here. This sector will be excluded from further analysis (see section 3.3).

Table 1 Summary of the results of monopolistic margins estimation

Name	NACE	Margin		Volatility ratio
		average	st. dev.	S(X)/E(X)
Manufacturing	**D**	0.091	0.075	0.828
Manufacture of food products and beverages	15	0.224	0.125	0.560
Manufacture of tobacco products	16	0.158	0.092	0.586
Manufacture of textiles	17	0.108	0.023	0.213
Manufacture of wearing apparel; dressing and dyeing of fur	18	0.054	0.083	1.526
Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	19	0.071	0.058	0.814
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	20	0.185	0.047	0.253
Manufacture of pulp, paper and paper products	21	0.182	0.083	0.455
Publishing, printing and reproduction of recorded media	22	0.213	0.042	0.198
Manufacture of coke, refined petroleum products and nuclear fuel	23	0.062	0.104	1.680
Manufacture of chemicals and chemical products	24	0.130	0.019	0.143
Manufacture of rubber and plastic products	25	0.165	0.020	0.123
Manufacture of other non-metallic mineral products	26	0.244	0.036	0.147
Manufacture of basic metals	27	0.054	0.060	1.115
Manufacture of fabricated metal products, except machinery and equipment	28	0.167	0.030	0.179
Manufacture of machinery and equipment n.e.c.	29	0.073	0.079	1.078
Manufacture of office machinery and computers	30	0.009	0.119	12.893
Manufacture of electrical machinery and apparatus n.e.c.	31	0.146	0.057	0.394
Manufacture of radio, television and communication equipment and apparatus	32	0.046	0.057	1.245
Manufacture of medical, precision and optical instruments, watches and clocks	33	0.268	0.132	0.494
Manufacture of motor vehicles, trailers and semi-trailers	34	0.060	0.030	0.505
Manufacture of other transport equipment	35	-0.092	0.237	-2.579
Manufacture of furniture; manufacturing n.e.c.	36	0.086	0.042	0.493
Recycling	37	0.112	0.110	0.981
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	**G**	0.033	0.015	0.444
Hotels and restaurants	**H**	0.089	0.123	1.384
Transport, storage and communication	**I**	0.322	0.108	0.336
Real estate, renting and business activities	**K**	0.223	0.175	0.786

Similarly to the study by Gradzewicz and Hagemejer (2006), relatively low markup estimators for section G (wholesale and retail trade and repair) have been obtained. For all other sections of market services (in particular transport and real estate and business activities), the estimators obtained are relatively high (in particular, higher than for manufacturing).

Sectoral differentiation of margin volatility in time is relatively high. Looking at the ratios of markup volatility, authors assumed that sectors where margins deviate from the mean by less than 50% are quite stable, while those where volatility ratio exceeds 1.5 are very volatile. In the majority of manufacturing sectors (11 cases) we can

observe a relative stability of markups changes over time. In four sectors (manufacture of textile, coke, petroleum refining, office machinery and computers and other transport equipment) one can observe high markup volatility, which suggests that the results of further analyses for those sections may carry substantial error. In the case of services, markup volatility is relatively low (in particular in trade, transport and communication) and, excluding hotels and restaurants, lower than for overall manufacturing industry.

3.3 *The influence of competition and business cycle on the level of markups*

This section analyses the relationship between the level of competition in a given sector and the level of monopolistic markups. Moreover, the connection between export intensity and pricing strategy of firms will be analyzed. Furthermore, the behaviour of monopolistic markup within a business cycle, both macroeconomic and sector-specific, will be investigated.

The following research hypotheses have been formulated:

1. Higher values of the Herfindahl-Hirschmann index, reflecting a lower number of hypothetical symmetric enterprises competing within a branch, result in a higher level of monopolistic markups. The choice of the Herfindahl-Hirschmann index, and not the number of enterprises, is dictated by the authors' conviction that there is a nonlinear relation between the number of enterprises and the level of margins – the higher the number of enterprises, the smaller the influence of entry of an additional enterprise on the margins. Also, due to asymmetry of firms, firm number may overestimate the level of competition within an industry.
2. Higher level of import penetration, reflecting stronger foreign competition in the domestic market, results in lower monopolistic markups.
3. Firm participation in export markets results in a higher level of markups on products sold in the domestic market. It may result from a higher demand elasticity in the domestic market than in foreign markets, due to their higher competitiveness. An enterprise entering a foreign market can also apply diversified price policy, cross-subsidizing foreign sales with higher incomes from domestic sales[15]. Moreover, as theoretic models of international trade indicate

[15] This argument may be particularly significant in the case of the Polish economy, which still experiences an increase of the role played by international trade..

(Melitz, 2003), exporting enterprises are more effective than other domestic enterprises, hence they achieve lower marginal cost, which – given the fixed sale prices in the domestic market – allows them to set higher markups.

4. There is connection between the level of monopolistic margins and business cycle. As it was mentioned before (see chapter 1), theoretical and empirical literature gives contradictory conclusions on the character of this relation.

Table 2 shows the regression results, where the level of monopolistic markup in a given sector and time period (see the discussion in chapter 3.2) is the dependent variable. Independent variables are: export intensity (defined as the relation of export value to production value), import penetration (measured as the share of import in total supply of goods into the domestic market), concentration measured by the Herfindahl-Hirschmann index and various definitions of business cycle based on percent deviations of the value added from the trend, calculated by the HP filter or log linear filter. The analyzed sample covers the period of 1997-2004 and includes all branches of manufacturing except for waste processing (for which data concerning trade were unavailable). Fixed effects panel estimation was performed. Such choice of specification was made on the basis of the Hausman test (the statistics are given in the table 2).

The first column corresponds to the model with only internal and external competitiveness variables included. This model was estimated on a full sample of manufacturing firms. Parameter estimates of the model are insignificant (although their signs are as expected), and the overall fit of the model measured by the R^2 ratio is very poor. The relatively weak performance of the first specification considered is mainly due to the fact that the markup estimators in some sectors seem to be highly volatile (see Table 1).

Subsequent models are estimated on a sample including only those sectors, in which markups do not change radically over time. Similarly, as in section 3.2, the group of branches with very volatile markups was defined as the branches where standard deviation of margins amounts to over 150% of the mean markup. Tobacco sector was also removed from the sample, due to the fact that the method of including excise tax (by either increasing costs or reducing revenues) influences considerably the estimated level of markups.

Table 2 Estimations results

Variable	1	2	3	4	5	6	7	8	9
Export intensity [X/Q]	0.116	0.441	0.123	0.386	0.44	0.177	0.184	0.292	0.300
	[0.99]	*[3.14]****	*[1.87]**	*[2.70]****	*[3.14]****	*[1.17]*	*[1.22]*	*[2.03]***	*[2.09]***
Import penetration [M/(Q-X+M)]	-0.155	-0.717		-0.592	-0.667	-0.405	-0.411	-0.502	-0.509
	[1.28]	*[3.18]****		*[2.52]***	*[2.88]****	*[1.73]**	*[1.76]**	*[2.18]***	*[2.21]***
Import penetration [M/Q]			-0.297						
			*[2.92]****						
Concentration	0.104	0.816	0.686	0.806	0.812	0.677	0.680	0.689	0.694
	[0.63]	*[3.29]****	*[2.92]****	*[3.28]****	*[3.28]****	*[2.82]****	*[2.84]****	*[2.84]****	*[2.86]****
Sectoral cycle [HP]				0.075		0.127	0.125		
				*[1.71]**		*[2.82]****	*[2.79]****		
Sectoral cycle (linear)					0.043			0.097	0.094
					[0.94]			*[2.04]***	*[2.00]***
Macro cycle [GDP- HP]						-1.306			
						*[3.23]****			
Macro cycle [v. added - HP]							-1.363		
							*[3.20]****		
Macro cycle [GDP - linear]								*-1.230*	
								*[3.08]****	
Macro cycle [v. added - linear]									*-1.271*
									*[3.02]****
Constant	0.123	0.158	0.147	0.128	0.139	0.149	0.148	0.148	0.147
	*[3.18]****	*[3.19]****	*[3.00]****	*[2.45]***	*[2.60]***	*[2.94]****	*[2.92]****	*[2.86]****	*[2.84]****
Observations	176	136	136	136	136	136	136	136	136
No of sectors	22	17	17	17	17	17	17	17	17
Hausmann test	18.11***	29.74***	26.78***	28.89***	28.96***	11.95**	12.38**	16.53***	17.13***
R-squared	0.010	0.110	0.100	0.130	0.120	0.210	0.200	0.190	0.180

Absolute t statistics in brackets
* significant at 10%; ** 5%; *** 1%
1 - all observations, 2-9 - observations where E(X)/S(X) < 1.5

Model 2 is built almost identically as model 1, with the sole exception that it is estimated on a reduced number of branches. Elimination of extreme observations results in a considerable improvement of the fit of the model – the R^2 rises to 11%. Furthermore, estimators related to competitiveness are significantly different from zero and considerably higher (in absolute value) in relation to specification 1. Estimators have expected signs. Estimate of the export intensity coefficient indicates that an increase in exports relative to production by 1 percentage point is accompanied by an increase in markup by 0.4 percentage point. In turn, an increase of import penetraton by 1 percentage point results in a decrease of markups by 0.7 percentage point. Higher (in absolute value) elasticity of markups with respect to import than to export (in all the analyzed models) shows a relationship between the level of markups and the advancement of processes of opening of the economy. That is, even growth of both exports and imports results in the lowering of the margins of domestic producers.

The influence of the number of firms operating in an industry on the level of markups is nonlinear and depends on the original number of firms operating in a sector. The estimated coefficient on concentration variable implies, that increasing the number of symmetric firms for instance from 2 to 3 results in a decrease of markup by 13.6 percentage points, but an increase in the number of enterprises from 10 to 11 results in a decrease of margin by 0.7 percentage point, while an increase in the number of enterprises from 100 to 101 results in a negligible decrease of markups[16].

Model 3 investigates the sensitivity of estimation results with respect to changes in the definition of import penetration. Definition of import penetration was changed to the ratio of imports to the volume of production instead of total supply to domestic market. This caused a decrease of the significance level of the estimate of the coefficient related to export intensity. Estimate of the concentration coefficient decreased slightly, and the estimated influence of import penetration on the markup level fell considerably. The latter effect is caused by a lower average level of import penetration calculated using the standard method (model 1 and 2) than in the case of penetration ratio calculated using the alternative method.

As a result, estimates related to concentration ratio and import penetration decreased. Besides the sole effect of the change in value of average import penetration[17], such drop in the obtained estimates is due to the correlation between concentration ratio and import penetration. This correlation varies from 0.1 for the definition used in model 2 to 0.5 in the case of the alternative specification used in model 3.

In model 4, the standard definition of import penetration was restored and additionally a variable measuring business cycle on the sectoral level was included. It was calculated as a deviation of the value added in a sector from its trend calculated using the HP filter. In comparison to specification 2, the R^2 ratio increased slightly, and the estimates of coefficients related to the competitiveness level did not change significantly. Nevertheless, the relationship of the markup level with the sectoral business cycle is very weak and statistically insignificant (with the standard, 95% level of significance). A change of the definition of sectoral business cycle (by calculating the trend estimator using a log-linear filter – model 5) does not influence

[16] This relation is falling also in the case of percent change of the number of firms. In the case of an increase of the number of enterprises from 10 by 10% the decrease of markups amounts to 0.74 percentage points, and when the number of firms equals 100, only 0.07 percentage points.

[17] A change in definition of import penetration leads to an increase in average value of this measure.

the results considerably, and still, the estimate of the coefficient related to the cycle is statistically insignificant.

In model 6, assuming existence of both sectoral and macroeconomic cycle (similarly as in Boulhol, 2004) a measure of aggregate business cycle (calculated as percent deviation of GDP volume from its trend calculated using the HP filter) was introduced, along with the sectoral cycle based on the HP trend. Correlation coefficients between macroeconomic and sectoral cycle presented in table 3 further in the text show that there is a strong relationship between these two notions for aggregated industries, while for narrowly defined sectors of manufacturing, this relationship is less clear-cut or non-existent[18]. The overall fit of the model has improved considerably, as a result of introduction of macroeconomic cycle. Export intensity estimate decreased in comparison to the previous specifications and turned out to be statistically insignificant. Similarly, the strength of import penetration's influence on markups and its statistical significance fell (it becomes significant at the 10 percent level). Both of these effects are probably resulting from the correlation between aggregate business cycle and import penetration together with export intensity (respective partial regressions indicate a significant correlation between the two variables)[19]. The estimate of the concentration coefficient remains statistically significant and does not change considerably in comparison to previous specifications. Both estimates of business cycle coefficients are statistically significant, they differ, however, in signs and in size. Results of model 6 estimation suggest that markups are countercyclical with respect to aggregate business cycle and procyclical with respect to the sectoral cycles. Reaction of markups to aggregate cycle is stronger by an order of magnitude. This is related to larger cyclical fluctuations of production within a sector than in the cycle measured at the level of national economy (standard deviation of the cycle measured at sectoral level is higher than respective deviations at the aggregate level in all analyzed branches). Furthermore, other sectors of the national economy create intermediate demand for products of a given branch, which may contribute to a stronger reaction of profit margins to macroeconomic cycle.

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[18] Authors assume that the overall cyclicality of markups is a combination of sectoral and macroeconomic cyclicality. The sensitivity of the results with respect to the particular method of calculation of the cycle is presented later.

[19] Elimination of import penetration from the regression equation considerably weakens the fit of the model, which is an argument to leave that variable in the model, although it has only limited statistical significance.

As part of the sensitivity analysis with respect to the choice of a definition of macroeconomic cycle, model 7 was estimated, where macroeconomic cycle was based on the volume of value added instead of GDP. Change in the definition of the cycle has turned out to have no significant impact on parameter estimates. In models 8 and 9, the cycle was calculated using log-linear trend for respectively value added and GDP. Estimates of the cycle parameters are slightly lower than in model 7, which results probably from a slightly larger variation of the cycle based on log-linear trend (than that based on HP trend). Estimates of import penetration and export intensity coefficients change as well, their size is close to that of model 4 and 5. Comparing to model 7, the fit of the regression equation drops slightly.

Why is the relation between markups and the business cycle positive in the case of sectoral cycle and negative in the case of macroeconomic cycle? One of the possible explanations of this phenomenon is that the adjustment of firms to macroeconomic and sectoral disturbances is different. Let us consider a case of a positive demand shock affecting only producers in a given sector, with the level of aggregate demand and average prices unchanged. If firms face a downward-sloping demand curve, the positive sectoral demand shock results in an upward shift of the demand curve, increase in supply and increase in prices (relative demand changes, which causes a change in relative prices[20]). Increase in prices may be higher than the increase in costs (inducing an increase of markups) due to constant wages and capital costs in the economy as a whole, which hinders the growth of marginal costs in a given sector (growth of sectoral wages is also limited by reallocation of factors to the branch, where demand shock took place). Positive sectoral supply shock (the growth of efficiency of production in a given sector) results in shifting marginal costs curves downwards, which, given unchanged aggregated demand and prices, causes an increase of monopolist markups in short run. Thus, sectoral shocks may result in procyclical behaviour of monopolist margins in short term, under the assumption that there is price rigidity. On the contrary, an aggregate demand shock leads to an increase in wages and capital costs that is more than proportional to the growth of prices, as a result of limited availability of production factors in the short run. Limited resources cause a relatively high increase of marginal costs (due to more intense adjustments of production factors along the intensive margins: overtime pay and increase of capital utilization costs together with higher intensity of capital

[20] In the analysis of effects of sectoral shocks it is assumed that the sector is small when compared to the rest of the economy.

utilization and increased depreciation) inducing countercyclical variations in markups. This interpretation of markup variation heavily relies on the existence of price rigidities. These may result from oligopolistic mechanisms or high menu costs, which lead to relatively low frequency of price changes (see e.g. Atkinson and others, 2006). Arguments proving that countercyclicality of margins exists at the aggregated levels can be found, among others, in the study of Woodford and Rottemberg (1999). Moreover, this assumption is often adopted when building macroeconomic models, which take into consideration monopolist competition in the goods market and real and nominal rigidities (e.g. Christiano, Eichenbaum, Evans, 2005 and Comin and Gertler, 2006).

Table 2 Correlation of margins and business cycles

Industry	EKD	Correlation of the margins with the cycle		Correlation of the sectoral cycle with the macroeconomic cycle	Correlation of the margins with the cycle
		HP Filter	Log-lin. Filter		
Manufacturing	**D**	-0.078	-0.334 *	0.732	-0.635
Food products and beverages	15	-0.212	-0.210	0.665	-0.434
Tobacco products	16	-0.182	-0.241	-0.479	-0.067
Textiles	17	-0.640	-0.711	0.199	-0.739
Wearing apparel and furs	18	-0.291	-0.171	0.570	0.339
Leather and leather products	19	0.814	0.737	0.211	0.395
Wood and wood products	20	0.065	-0.059	0.436	0.007
Pulp, paper and paper products	21	-0.015	-0.553 *	0.673	-0.778
Publishing, printing and reproduction of recorded media	22	0.429	0.420	0.782	0.330
Coke and refined petroleum products	23	0.378	0.147 *	-0.046	0.010
Chemicals and chemical products	24	0.079	-0.266	0.572	-0.636
Rubber and plastic products	25	0.151	-0.476 *	0.689	-0.175
Other non-metalic mineral products	26	0.497	0.383	-0.648	0.400
Basic metals	27	0.369	0.186 *	0.545	-0.240
Metal products	28	0.584	0.075 *	-0.158	-0.137
Machinery and equipment n.e.c.	29	-0.069	-0.137	0.182	-0.116
Office machinery and computers	30	-0.733	-0.782	0.649	-0.480
Electrical machinery and apparatus	31	0.616	0.579	0.448	-0.128
Radio, television and communication equipment	32	-0.267	-0.076	0.611	0.544
Medical, precision and optical instruments	33	0.367	0.396	0.875	0.480
Motor vehicles, trailers and semi-trailers	34	0.537	0.100 *	-0.285	-0.788
Other transport equipment	35	0.210	0.182	0.775	-0.468
Furniture, manufacturing n.e.c.	36	-0.067	-0.145	0.325	0.056
Recycling	37	-0.122	-0.388 *	0.507	-0.279
Trade and repair	**G**	-0.336	-0.495	0.653	-0.298
Hotels and restaurants	**H**	-0.286	-0.399 *	0.727	-0.550
Transport, storage and communications	**I**	-0.349	-0.622	0.122	-0.107
Business and real estate services	**K**	-0.358	-0.244 *	-0.395	-0.573

* branches in which cyclicality of margins cannot be unambiguously determined on the basis of the cycle definition

The different character of the relation between markups and business cycle seems to be confirmed to a large extent by the results of correlation analysis between phases of the cycle and margins in particular sectors. Negative correlation between macroeconomic cycle and markups seems to prevail (negative correlation was observed in 15 of the 27 analyzed sectors, and also in the manufacturing aggregate,

while positive correlation was observed only in 2 sectors), but the relation between markups and sectoral cycle is very diversified. Procyclicality of sectoral markups seem to be more common than antyclicality[21]. In the remaining branches there is no clear correlation between the sectoral cycle and monopolist margins. It must be noted here that in some sectors, where there is positive correlation between the sectoral cycle and the macroeconomic cycle (e.g. food, clothes, manufacture of office equipment), the correlation between margins and the sectoral business cycle is negative or non-existent. It also seems to indicate that the correlation of margins with the macroeconomic cycle is stronger than with the sectoral cycle. By contrast, in some sectors (e.g. manufacture of leather, coke, non-metallic and metal products) there is a weak correlation between the sectoral cycle and the macroeconomic cycle, which can partially explain positive correlations between the sectoral cycle and the margins.

Summary

The aim of this study is an estimation of short-run monopolistic markups in the Polish economy and an assessment of their relationship with the degree of competition, both internal and external. In addition, the behaviour of markups along the business cycle was analyzed.

Methodology employed is based on widely cited work by Roeger (1995), where the level of margins in the American economy is estimated in an unbiased manner. This methodology, designed to estimate sectoral markups using time series data, if applied to firm-level data, allows for estimation of time-varying sectoral markup estimates. Using Roeger's model, the authors managed to obtain information on the behaviour of markups in all manufacturing and selected service sectors within the period of 1997-2004. Time span of analyzed markup estimates correspond approximately to the length of one business cycle and it allows authors to examine the volatility of monopolistic margins within the cycle, however, one has to bear in mind that extending inference on future behaviour of markups and making long-run conclusions is rather problematic.

Results suggest that there are considerable markups in many sectors of the Polish economy. The overall level of markups is, to a large extent, in line with the previous

[21] In this very short time serie, it impossible to say anything about statistical significance of correlation, since the minimal significant level of correlation (with the 95% confidence) amounts to roughly 70%.

study by the same authors that focused on the issue of long-term monopolistic margins and returns to scale. Stability of obtained estimates in time is satisfactory in most sectors (only in 4 sectors the volatility of margins was very high, and in those sectors the estimates are of little relevance and usefulness). In most of other cases, however, the overall fit of the markup estimation equations was satisfactory.

According to the obtained panel estimates, competition is an important factor affecting the level of markups. It applies both to the internal competition, measured by the market concentration, and the foreign competition, measured by the import penetration ratios. An increase in import penetration by 1 percentage point results in a decrease in markups by approximately 0.7 percentage point. The postulated relationship between the number of companies and the margins is non-linear – the increase in the number of companies from 2 to 3 results in the decrease in markups by approximately 13.6 pp, while an increase in the number of firms from 10 to 11 causes a decrease in margins by approximately 0.7 pp. These figures vary slightly depending on the specification of the regression equation.

The negative correlation between margins and the macroeconomic cycle found in the Polish data seem to confirm the conclusions from many theoretical models. The correlation is observable on the level of the economy as a whole and in most of individual sectors. The results also point to a positive but less clear correlation between the sectoral cycle and the level of markups. The differences may result from a different nature of adjustments of businesses in reaction to external shocks at the sectoral level and the whole economy level, as well as different shocks affecting individual sectors and the economy as a whole. Limited time span of data available does not allow to carry out an appropriate verification of such hypotheses. This is undoubtedly an interesting issue for further empirical studies.

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Annex A. Derivations

A.1 Derivations of (7)

Applying definition (4) to equation (3) we obtain:

$$\frac{dY}{Y} = \sum_i \theta_i \mu \frac{dX_i}{X_i} + \theta_K \mu \frac{dK}{K} + \frac{dE}{E}.$$

Making use of (5) and subtracting $\frac{dK}{K}$ from both sides gives:

$$\frac{dY}{Y} - \frac{dK}{K} = \sum_i \theta_i \mu \frac{dX_i}{X_i} - \sum_i \theta_i \mu \frac{dK}{K} + \frac{dE}{E}$$

Dividing the above equation by μ and subtracting $\frac{dY}{Y}$ from both sides gives in turn:

$$-(1-\frac{1}{\mu})\frac{dY}{Y} - \frac{1}{\mu}\frac{dK}{K} = \sum_i \theta_i \frac{dX_i}{X_i} - \sum_i \theta_i \frac{dK}{K} + \frac{1}{\mu}\frac{dE}{E} - \frac{dY}{Y}$$

By subtracting $\frac{dK}{K}$ from both sides and rearranging, we arrive at equation (7) in section 2:

$$\frac{dY}{Y} - \sum_i \theta_i \frac{dX_i}{X_i} - (1-\sum_i \theta_i)\frac{dK}{K} = (1-\frac{1}{\mu})(\frac{dY}{Y} - \frac{dK}{K}) + \frac{1}{\mu}\frac{dE}{E}$$

A.2 Derivations of (12)

Applying definition (4) to equation (11) we obtain:

$$\frac{dMC}{MC} = \sum_i \theta_i \mu \frac{dw_i}{w_i} + \theta_K \mu \frac{dw_K}{w_K} - \frac{dE}{E}$$

Making use of (5), applying $\frac{dMC}{MC} = \frac{dP}{P}$ and subtracting $\frac{dw_K}{w_K}$ from both sides we obtain:

$$\frac{dP}{P} - \frac{dw_K}{w_K} = \sum_i \theta_i \mu \frac{dw_i}{w_i} - \sum_i \theta_i \mu \frac{dw_K}{w_K} - \frac{dE}{E}$$

Dividing the above equation by μ and subtracting $\frac{dP}{P}$ from both sides results in:

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

Adding $\frac{dw_K}{w_K}$ to both sides of the equation and rearranging, we arrive at equation (12):

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

Annex B. Detailed results of monopolistic margins estimations

Table 1. Volatility of monopolistic margins in time

	NACE	1997	1998	1999	2000	2001	2002	2003	2004
Manufacture of food products and beverages	15	0.20 *(0.03)*	0.12 *(0.04)*	0.30 *(0.05)*	0.03 *(0.04)*	0.26 *(0.07)*	0.29 *(0.09)*	0.44 *(0.19)*	0.15 *(0.03)*
Manufacture of tobacco products	16	0.12 *(0.04)*	0.30 *(0.03)*	0.27 *(0.01)*	0.15 *(0.06)*	0.11 *(0.01)*	0.14 *(0.02)*	0.16 *(0.01)*	0.01 *(0.16)*
Manufacture of textiles	17	0.10 *(0.01)*	0.07 *(0.04)*	0.08 *(0.03)*	0.13 *(0.03)*	0.13 *(0.01)*	0.11 *(0.01)*	0.13 *(0.01)*	0.11 *(0.01)*
Manufacture of wearing apparel; dressing and dyeing of fur	18	-0.14 *(0.20)*	0.07 *(0.02)*	0.08 *(0.02)*	0.07 *(0.04)*	0.12 *(0.05)*	0.09 *(0.03)*	0.10 *(0.02)*	0.04 *(0.10)*
Manufacture of leather and leather products	19	0.12 *(0.03)*	0.16 *(0.04)*	0.08 *(0.06)*	-0.02 *(0.02)*	0.07 *(0.03)*	0.03 *(0.04)*	0.03 *(0.04)*	0.10 *(0.02)*
Manufacture of wood and wood products	20	0.22 *(0.02)*	0.17 *(0.03)*	0.09 *(0.07)*	0.21 *(0.06)*	0.16 *(0.01)*	0.24 *(0.01)*	0.19 *(0.01)*	0.21 *(0.01)*
Manufacture of pulp, paper and paper products	21	0.15 *(0.00)*	0.12 *(0.02)*	0.17 *(0.02)*	0.03 *(0.00)*	0.20 *(0.02)*	0.26 *(0.01)*	0.27 *(0.01)*	0.26 *(0.02)*
Publishing, printing and reproduction of recorded media	22	0.24 *(0.04)*	0.15 *(0.05)*	0.27 *(0.05)*	0.23 *(0.05)*	0.26 *(0.02)*	0.16 *(0.04)*	0.20 *(0.05)*	0.20 *(0.01)*
Manufacture of coke, refined petroleum products and nuclear fuel	23	0.13 *(0.00)*	0.15 *(0.00)*	-0.07 *(0.01_*	-0.05 *(0.08)*	-0.06 *(0.00)*	0.09 *(0.01)*	0.12 *(0.00)*	0.18 *(0.00)*
Manufacture of chemicals, chemical products	24	0.13 *(0.02)*	0.12 *(0.03)*	0.11 *(0.03)*	0.10 *(0.04)*	0.13 *(0.04)*	0.15 *(0.01)*	0.14 *(0.02)*	0.15 *(0.02)*
Manufacture of rubber and plastic products	25	0.15 *(0.01)*	0.14 *(0.01)*	0.17 *(0.01)*	0.16 *(0.02)*	0.15 *(0.01)*	0.20 *(0.01)*	0.16 *(0.02)*	0.19 *(0.04)*
Manufacture of other non-metallic mineral products	26	0.25 *(0.03)*	0.25 *(0.03)*	0.16 *(0.05)*	0.23 *(0.05)*	0.26 *(0.04)*	0.25 *(0.02)*	0.27 *(0.02)*	0.28 *(0.02)*
Manufacture of basic metals	27	0.08 *(0.00)*	0.07 *(0.00)*	0.04 *(0.03)*	0.00 *(0.05)*	0.01 *(0.02)*	-0.02 *(0.02)*	0.07 *(0.02)*	0.17 *(0.00)*
Manufacture of fabricated metal products, except machinery and equipment	28	0.16 *(0.08)*	0.14 *(0.05)*	0.19 *(0.04)*	0.14 *(0.03)*	0.16 *(0.02)*	0.14 *(0.04)*	0.19 *(0.03)*	0.22 *(0.04)*
Manufacture of machinery and equipment n.e.c.	29	0.11 *(0.04)*	0.09 *(0.03)*	0.06 *(0.04)*	-0.11 *(0.24)*	0.08 *(0.05)*	0.11 *(0.03)*	0.15 *(0.02)*	0.09 *(0.03)*
Manufacture of office machinery and computers	30	-0.01 *(0.00)*	0.02 *(0.02)*	0.01 *(0.01)*	-0.25 *(0.19)*	0.01 *(0.02)*	0.18 *(0.06)*	0.03 *(0.03)*	0.08 *(0.03)*
Manufacture of electrical machinery and apparatus n.e.c.	31	0.24 *(0.04)*	0.16 *(0.01)*	0.15 *(0.03)*	0.11 *(0.04)*	0.05 *(0.03)*	0.11 *(0.04)*	0.19 *(0.01)*	0.17 *(0.02)*
Manufacture of radio, television and communication equipment and apparatus	32	-0.01 *(0.09)*	0.11 *(0.03)*	0.11 *(0.03)*	0.03 *(0.01)*	0.02 *(0.01)*	0.06 *(0.01)*	0.10 *(0.00)*	-0.04 *(0.09)*
Manufacture of medical, precision and optical instruments, watches and clocks	33	0.26 *(0.14)*	0.27 *(0.15)*	0.32 *(0.15)*	0.23 *(0.13)*	0.56 *(0.18)*	0.20 *(0.07)*	0.19 *(0.02)*	0.13 *(0.03)*
Manufacture of motor vehicles, trailers and semi-trailers	34	0.02 (0.01)	-0.04 (0.01)	0.06 (0.03)	0.08 (0.01)	-0.63 (0.02)	0.07 (0.01)	-0.20 (0.04)	-0.10 (0.01)
Manufacture of other transport equipment	35	0.02 *(0.01)*	-0.04 *(0.06)*	0.06 *(0.03)*	0.08 *(0.04)*	-0.63 *(0.19)*	0.07 *(0.08)*	-0.20 *(0.11)*	-0.10 *(0.02)*
Manufacture of furniture; manufacturing n.e.c.	36	0.03 *(0.03)*	0.14 *(0.03)*	0.10 *(0.03)*	0.01 *(0.05)*	0.10 *(0.02)*	0.09 *(0.02)*	0.11 *(0.01)*	0.10 *(0.01)*
Recycling	37	0.16 *(0.05)*	0.07 *(0.03)*	0.23 *(0.01)*	0.14 *(0.08)*	-0.12 *(0.17)*	0.16 *(0.07)*	0.07 *(0.02)*	0.19 *(0.06)*

Percentage standard errors given in brackets

Table 4. Volatility of monopolistic margins in time (continued)

	NACE	1997	1998	1999	2000	2001	2002	2003	2004
Electricity, gas, steam and hot water supply	40	0.39 *(0.04)*	0.38 *(0.07)*	0.36 *(0.05)*	0.47 *(0.06)*	0.23 *(0.07)*	0.37 *(0.08)*	0.21 *(0.04)*	0.25 *(0.03)*
Collection. purification and distribution of water	41	0.27 *(0.01)*	0.32 *(0.03)*	0.32 *(0.01)*	0.34 *(0.04)*	0.34 *(0.01)*	0.33 *(0.04)*	0.44 *(0.03)*	0.41 *(0.02)*
Sale. maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	50	0.02 *(0.04)*	0.05 *(0.02)*	0.05 *(0.01)*	0.03 *(0.02)*	0.05 *(0.01)*	0.06 *(0.02)*	0.05 *(0.01)*	0.04 *(0.00)*
Wholesale trade and commission trade. except of motor vehicles and motorcycles	51	0.03 *(0.02)*	0.03 *(0.00)*	0.01 *(0.01)*	0.02 *(0.02)*	0.05 *(0.01)*	0.04 *(0.01)*	0.06 *(0.02)*	0.06 *(0.02)*
Retail trade. except of motor vehicles and motorcycles; repair of personal and household goods	52	0.06 *(0.01)*	0.09 *(0.03)*	-0.20 *(0.05)*	0.05 *(0.04)*	0.05 *(0.02)*	0.01 *(0.01)*	0.02 *(0.00)*	0.05 *(0.01)*
Hotels and restaurants	55	0.08 *(0.10)*	-0.18 *(0.12)*	0.08 *(0.15)*	0.05 *(0.09)*	0.16 *(0.02)*	0.13 *(0.02)*	0.19 *(0.01)*	0.21 *(0.02)*
Land transport; transport via pipelines	60	0.46 *(0.20)*	0.31 *(0.15)*	0.45 *(0.11)*	0.14 *(0.09)*	0.42 *(0.15)*	0.12 *(0.03)*	0.19 *(0.03)*	0.29 *(0.11)*
Water transport	61	-0.02 *(0.01)*	0.01 *(0.03)*	0.03 *(0.03)*	0.05 *(0.00)*	0.12 *(0.01)*	-0.04 *(0.01)*	0.12 *(0.01)*	0.08 *(0.00)*
Supporting and auxiliary transport activities; activities of travel agencies	63	0.63 *(0.03)*	0.26 *(0.03)*	0.50 *(0.09)*	0.54 *(0.06)*	0.44 *(0.06)*	0.32 *(0.02)*	0.42 *(0.05)*	0.35 *(0.05)*
Post and telecommunications	64	0.46 *(0.04)*	0.19 *(0.02)*	0.19 *(0.09)*	0.34 *(0.02)*	0.36 *(0.01)*	0.29 *(0.06)*	0.43 *(0.05)*	0.49 *(0.01)*
Real estate activities	70	0.02 *(0.01)*	0.04 *(0.04)*	0.17 *(0.04)*	0.13 *(0.03)*	0.12 *(0.02)*	0.06 *(0.02)*	0.13 *(0.03)*	0.10 *(0.07)*
Renting of machinery and equipment without operator and of personal and household goods	71	0.73 *(0.19)*	0.64 *(0.11)*	0.50 *(0.13)*	0.31 *(0.09)*	0.89 *(0.01)*	0.60 *(0.00)*	0.32 *(0.11)*	0.25 *(0.08)*
Computer and related activities	72	0.06 *(0.05)*	0.06 *(0.08)*	0.26 *(0.04)*	0.15 *(0.02)*	0.13 *(0.04)*	0.20 *(0.02)*	0.15 *(0.01)*	0.15 *(0.01)*
Other business activities	74	0.02 *(0.26)*	0.29 *(0.10)*	0.18 *(0.07)*	0.11 *(0.01)*	0.13 *(0.06)*	0.03 *(0.01)*	0.18 *(0.04)*	0.30 *(0.00)*

Percentage standard errors given in brackets