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The distribution of monopolistic markups in the Polish economy

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The views presented are those of the authors and not necessarily of the National Bank of Poland.

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Abstract

Estimates of monopolistic markups are relatively scarce in the literature mostly due to lack of appropriate data and methodological difficulties, while their behaviour has important implications for the conduct of monetary policy. We estimate the monopolistic markups in the Polish economy in the period of 1995-2009 using Polish firm level data.. We show the association of the markup level with the sectoral characteristics, type of good produced and the form of ownership, as well as investigate the impact of both internationalization and competitive pressure on the level of markups. We show a somewhat puzzling and at the same time robust increase in markups after the EU accession of the Polish economy to the EU in 2004. Moreover, in line with previous findings, we show that price cost margins are countercyclical with respect to the macroeconomic cycle and procyclical at sectoral level

Introduction

Estimates of monopolistic markups are relatively scarce in the literature mostly due to lack of appropriate data and methodological difficulties. The estimates of markup level often play an important role in other economic tools such as macroeconomic simulation and forecasting models. What is probably even more important, especially in macroeconomic forecasts and in the conduct of monetary policy conduct is the response of markups to various external and internal shocks as well as their behaviour over the business cycle. We aim to provide an up-to date picture of the distribution of markups in the economy – both in the sectoral and time dimension. In this study, we estimate the monopolistic markups in the Polish economy in the period of 1995-2009 using Polish firm level data for most non-financial sectors.

Our estimates allow us to observe the behaviour of price cost margins over the business cycle. Moreover, we aim to assess the correlation of the level of markups with the form of firm ownership, including foreign ownership, and the degree of internationalization of firms proxied by the firm's export status and export performance. We also verify the impact of the competitive pressure measured by the levels of industry concentration and import penetration on the level of markups. We investigate whether markups have visibly changed after the EU accession of Poland in 2004.

We apply a well-established methodology that allows for unbiased estimation of markups using firm-level data 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.

Section one contains a short review of literature related to the estimation of monopolistic markups and related empirical studies. Section two provides outlines the empirical model. The third section describes the statistical data and the results of the estimation of monopolistic markups and is followed by a short summary.

Literature review

The markup or a price cost margin (PCM) is the distance between firm's price and marginal cost and is often measured by a Lerner index (difference between price and marginal cost relative to the price). The main difficulty in calculating the Lerner index directly is the unobservable marginal cost. One approach to overcoming this difficulty is to proxy the marginal cost with observable costs such as average cost or average variable cost (see eg. Tybout, 2003) if such data are available. Alternatively, Hall (1988) provides a method of estimation of the markup level from the Solow residual by decomposing the revenue-shares of inputs into the cost-share component and markup. The method was originally applied to aggregate data and since it requires demand-related instruments to account for the endogeneity of the input choices. A modification of the method to firm-level analysis was presented by Klette (1999) and it was applied by Gradzewicz and Hagemejer (2007a) to Polish data. The method proposed by Roeger (1995), extended by Oliveira-Martins and Scarpetta (1999) is based on difference between the primal and dual Solow residual and not only it solves the problem of endogeneity by eliminating the unobservables from the estimation equation but also requires only nominal revenue and cost data, which is usually the only type of data available at firm level. Several papers apply the Roeger method to firm level data and these include Görg and Warzynski (2003), Konings et al. (2005), Könings and Vandenbussche (2005) and Görg and Warzynski (2006), Bellone et al. (2008 and 2009). By exploring the panel structure of firm-level datasets, the Roeger method can provide the time-varying markup estimates for groups of firms (eg. sectors).

Some extensions to the Roeger method allow deviating from the original assumptions of constant returns to scale. These include Altug and Filztekin (2002) who analyze the primal and dual Solow residuals separately and are able to identify returns to scale using instrumental variables. Similar exercise has been performed by Konings, Roeger and Zhao (2011) to account for the existence of fixed factors of production.

The literature is ambiguous on the direction of the response of price-cost margins to changes in the economic cycle. This response in the theoretical model varies with

the assumed market structure. Procyclical markups can result from price rigidity due to collusive agreements (eg. Athey, Bagwell and Sanchirico, 2004) or from competition regime switching depending on the degree of the capacity (Kreps and Scheinkman, 1983). On the other hand, Rotemberg and Saloner (1984) show that in boom periods it may be optimal to cut margins and break the collusive agreement to realize larger profits. Procyclical markups are also found in Bils (1989) and Weitzman (1982). Rotemberg and Woodford (1999) provide a discussion on how the nature of collusive agreements affect the behavior of markups over time.

As far as empirical studies are concerned, Bils (1987) points to procyclical markups. Countercyclical markups are found in Domovitz et al. 1986, Chirinko and Fazzari (1994). In studies based on OECD data, Boulhol (2004) and Oliveira-Martins and Scarpetta (1996), similar results are obtained. More recent, firm-level evidence on the cyclical behaviour of markups is found in Görg and Warzynski (2006), who show pro-cyclical markups with respect to the industry-level cyclical position. Gradzewicz and Hagemejer (2007b, 2007c) show that in the period of 1996-2004, markups in the Polish economy were negatively correlated with the overall measure of the economic cycle, while procyclicality was found at the sectoral level.

The relationship between the degree of competitiveness and the level of markups seems more established: lower industry concentration and more intensive import competition leads to lower markups. The impact of competition on markups was analysed by eg. Boulhol (2004) for OECD countries, Lundin (2004) for Sweden, Abraham et al, (2006) for Belgium. Some papers explore the effects of changes in the institutional environment. Konings et al show that while in Romania and Bulgaria competition reduces markups, higher price cost margins are associated with privatized and foreign owned firms. Görg and Warzynski (2006) show that markups have fallen due to the Single Market Programme of 1992. Boulhol (2006) finds evidence that markups increased over time in OECD countries over thirty years due to declining bargaining power on the part of workers despite intensification of competition in the product markets.

Markups can also be related to firm-level export status may be related to markups through access to larger markets, productivity improvements and quality upgrading

(De Loecker and Warzynski, 2009, Görg, H., Warzynski, F., 2003). Bellone et al. (2009) show using a theoretical trade model with heterogeneous firm and subsequently confirm using firm-level data that markups are positively related to firm export intensity and are higher on the export markets than on the domestic ones.

Methodology

The Roeger (1995) method is based on an assumption that firm's technology is 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[1]:

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

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:

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

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:

[1] The details of the derivations are presented in Gradzewicz, Hagemejer (2007b,2007c).

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

and respectively for *K*. Under perfect competition $\alpha_i = \theta_i$, as $\mu = 1$. Under imperfect competition $\mu > 1$.

The primal Solow residual (SR), based on the production function is defined as:[2]

$$SR = \frac{dY}{Y} - \sum_i \theta_i \frac{dX_i}{X_i} - (1 - \sum_i \theta_i)\frac{dK}{K}, \qquad (5)$$

Using (4) and the homogeneity of the production function, it follows that:

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

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

$$SR = \beta(\frac{dY}{Y} - \frac{dK}{K}) + (1 - \beta)\frac{dE}{E} \qquad (7)$$

In the above equation, $\frac{dE}{E}$ is unobservable, therefore if β is estimated using standard methods, it is likely to be biased due to omitted variables. While the problem can be solved by using instrumental variables, Roeger (op. cit.), solves this problem by using an estimator based on a difference between primal and dual Solow residuals.

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

$$C(w_1,...,w_N,w_K,Y,E) = \frac{G(w_1,...,w_N,w_K)Y}{E}, \qquad (8)$$

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

$$MC = \frac{G(w_1,...,w_N,w_K)}{E} \qquad (9)$$

If markup μ is constant, then $\frac{dMC}{MC} = \frac{dP}{P}$. Log differentiation of equation (10), after applying the Shephard lemma and the definition 8 gives:

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

$$\frac{dP}{P} = \sum_i \alpha_i \frac{dw_i}{w_i} + \alpha_K \frac{dw_K}{w_K} - \frac{dE}{E}. \quad (10)$$

Making use of (4) and rearranging we obtain the dual Solow residual (DSR), as a function of prices, input wages and technical progress:

$$DSR \equiv \sum_i \theta_i \frac{dw_i}{w_i} + (1 - \sum_i \theta_i)\frac{dw_K}{w_K} - \frac{dP}{P} = (1 - \frac{1}{\mu})(\frac{dw_K}{w_K} - \frac{dP}{P}) + \frac{1}{\mu}\frac{dE}{E}, \quad (11)$$

or, using the Lerner index definition:

$$DSR = -\beta(\frac{dP}{P} - \frac{dw_K}{w_K}) + (1-\beta)\frac{dE}{E}. \quad (12)$$

Subtracting equation (12) from (7) and taking into account the definition of DSR and SR, we obtain:

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

As all the variables in equation 14 are observable, the equation can be estimated using ordinary least square. Another advantage of this specification is the fact that all the output and input variables are expressed in nominal terms, removing the need for price deflators which are difficult to obtain at sectoral level and unavailable at firm level in most cases.

Equation (14) can rewritten for the purpose of estimation as:

$$\Delta y_t = \beta \Delta x_t + \varepsilon_t, \quad (15)$$

where Δy_t is the log approximation of the left handside of equation 14 and Δx_t is the log approximation of the term in square brackets on the right handside of equation 14, β is the estimate of the markup and ε_t is the error term.

Equation 14 can be augmented with exogenous explanatory variables, in order to capture the impact of changing economic environment. We follow Oliveira-Martins and Scarpetta (1999), and assume that markups depend on the economic cycle in the following fashion:

$$\beta_t = \beta + \gamma \cdot CYCL_t, \quad (16)$$

where β is a fixed component of markup (average markup over time), $CYCL_t$ is a measure of the business cycle and γ pinpoints the relationship between the cyclical position of the economy and the level of markups. Oliveira-Martins et al. (op. cit) show that in this case the estimating equation becomes:

$$\Delta y_t = \beta \Delta x_t + \gamma \cdot (CYCL_t \Delta x_t + \Delta CYCL_t) + \varepsilon_t . \quad (17)$$

Similarly, we can use the general formula:

$$\Delta y_t = \beta \Delta x_t + \phi Z_t \Delta x_t + \lambda \Delta Z_t + \varepsilon_t . \quad (17)$$

to examine the interaction between markups and other exogenous, time-varying variables. Z_t can include sectoral export and import intensity, as well as concentration ratios, but also firm-level characteristics. For example, following Goerg and Warzynski (2003), we include the firm-level export dummy to compare the levels of markups between exporters and nonexporters. Due to a panel structure of the sample, it is possible to interact Δx_t with both time and sectoral dummies to explore the relevant variation of the markup estimate.

Moreover, the Roeger formula makes it also possible to estimate markups at firm level provided that there is enough observations for a given firm. However, for identification purposes, it is required to assume that, at the firm level, markups are either constant over all the years in the sample or over periods of time. Given the fact that the time span of our dataset is limited, we make the former assumption.

Dataset and variables definition

In this paper, we employ firm-level data based on the financial statements of Polish non-financial sector (companies with over 50 employees), collected by Polish Central Statistical Office. The data cover the period between 1995 and 2009.

We correct the firm's revenues by inventory investment and costs of taxes. Costs are disaggregated to the costs of energy, costs of materials[3], costs of labor[4] and the costs of capital.

Costs of capital are based on the concept by Jorgenson and Griliches (1967) and extended by e.g. Oulton and Srinivasan (2003). The stream of capital services can be measured as a cost of renting capital for production purposes and presented as follows:

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

k_{it} is the measure of capital services, r_t is the rate of return, π_t is a value-added deflator, (so r_t - π_t is the real rate of return) δ_{it} is the depreciation rate and K_{it} is the stock of fixed assets of the firm. The rate of return is proxied by the yield on 5Y government bond. 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 as the average from values at the beginning and the end of the year.

Total number of observations in the initial dataset amounts to over 275 thousand. We subject the data to filtering as erroneous observations are common in these kinds of datasets. We dropped observations where employment, labor cost, capital or output were negative or where capital or labor efficiency were extremely high (deviation of logarithm of a particular value by a company exceeded the logarithm of average value for their NACE class by three). In order to get rid of influential outliers, we have also excluded from the sample one percent of extreme top and one

[3] Costs of materials augmented by costs of outsourcing and value of sold goods and materials, especially relevant in trade companies

[4] Wages augmented by social security costs and other employee-related expenses

percent of extreme bottom observations of *dx* and *dy*, directly used in the regression of margins.

Our dataset is an unbalanced panel. The estimating procedure requires the subsequent year pairs to be balanced in order to calculate the required first differences. This fact, together with the trimming procedure above, has reduced the sample to roughly 165 thousand observations.

We perform the analysis for different groups of entreprises. The markups are estimated separately for manufacturing and services. Due to changes in the NACE classification, we are able to pinpoint consistently only major service industries, where changes in the classification were not fundamental (wholesale and retail trade; repair, transportation and storage, hotel and restaurants etc).

We are also able to differentiate markup estimates by forms of ownership: private domestic, multi-national corporations or state-owned companies. Using the firm-level data we calculate Herfindahl-Hirschman (HHI) concentration index within 4-digit NACE industries in order to account for the level of competition. Moreover, we distinguish four types of goods: investment goods, intermediate goods, durable consumer goods or non-durable consumer goods, in order to capture the potential of heterogeneity of markups in this dimension.

We also explore the importance of international trade for both the sectoral and firm-level composition of margins. The export activity of firms is quantified in two ways. On the extensive margin we classify the entreprises as exporters and non-exporters, on the basis of their export sales. We also look at the intensive margin, by incorporating the export intensity of an exporter, defined as the ratio of export sales to total sales, in the markup estimation equation.

Import penetration is measured at the sectoral level. We have used the data on imports of goods from the UN COMTRADE database (expressed in USD and in the SIC nomenclature). This data is further converted to NACE sectors and into Polish zloty using average market exchange rates. We obtain a synthetic measure of import intensity by division of total imports by total sales of a NACE 3-digit group, what allows us to divide the groups of companies into more or less affected by import competition.

In the analysis we measured also connection between the business cycle and level of markups. We used GDP as a proxy for the cyclical position of the economy and value added (in constant prices) in every sector and alternatively every division (by 2-digit NACE classification)[5] to create two types of sectoral cycles measures. We reconstructed this series by taking logarithms and subtracting long run trends approximated by HP filter. Due to recent changes in the NACE classification consistent data about value added from sectors and divisions are available until year 2008, and therefore the analysis of markup behavior over the economic cycle is limited to the period of 1995-2008.

[5] Data from Statistical Yearbook of Industry

Table 1: Summary statistics

Variable	All	Manufacturing
dy	-.0109	-.0119
	(.0933)	(.1004)
dx	-.0114	-.0096
	(.3986)	(.3942)
exporter	.4016	.6486
	(.4902)	(.4774)
Export share	.1368	.2442
	(.2641)	(.3203)
HHI	.0825	.0955
	(.1174)	(.1156)
GDP cycle	.0029	
	(.0195)	
Section cycle	.0019	
	(.0275)	
Division cycle		.061
		(3.2074)
Observations	165100	78445

Standard deviations in parentheses

Results

In the overall sample the estimate of the price cost margin amounts to 7.8%. The PCM varies over time. It ranges from 4.7% in 1996 to 10.7% in 2009. The data reveal that markups have visibly increased after 2004, what happened despite increased openness and greater potential competition connected with EU accession.

In the entire period of estimation PCMs were significantly higher in manufacturing (9.1%), than in services (4.8%). But significant discrepancies also exist between specific service sectors. The PCMs for the trade and repair, the largest service section, amount to 3.3%, whereas in transportation and storage the estimate stands at 6.1% and in hotel and restaurants at 10.1%.

The PCMs are also heterogonous across different forms of ownership. The subsidiaries of multinational companies exhibit the highest markups. Among domestic firms the state-owned enterprises reveal a higher level of markups than private enterprises, but this result can be attributed to structural differences between those groups. When we estimate the PCMs for manufacturing only, the estimates for multinationals remain the highest, but markups in the state-owned firms and of firms owned by local governments, are significantly lower than those of private domestic units.

We also estimated the PCMs for different types of manufactures (investment, intermediate, durable consumer goods and non-durable consumer goods) based on the OECD 3-digit classification of NACE sectors. PCMs turn out to be higher for investment and intermediate goods, than for consumer goods, both durable and non-durable.

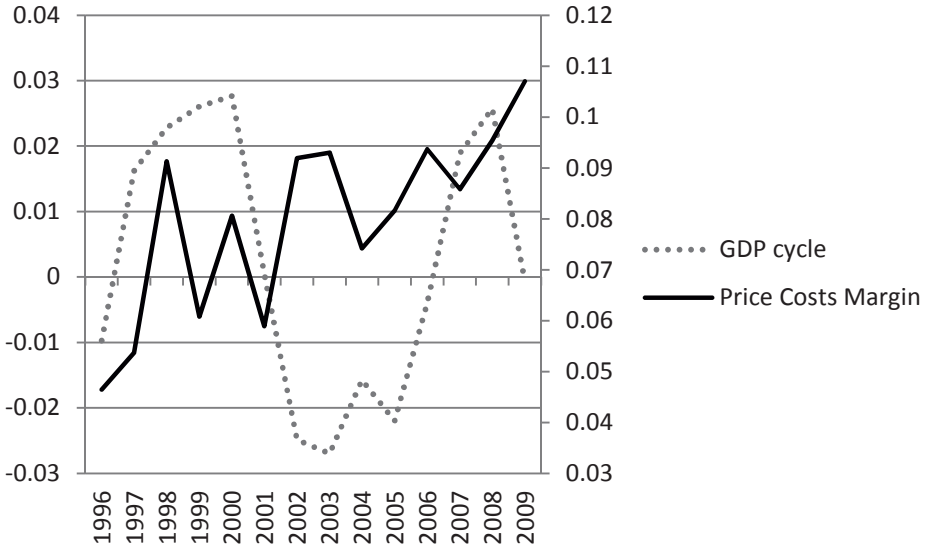
Table 2: Average price cost margins, by year, sector and form of ownership

VARIABLES	(1) all	(2) all	(3) all	(4) all	(5) all	(6) all	(7) manufacturing
dx	0.0782***		0.0699***				
1996		0.0465***					
1997		0.0537***					
1998		0.0913***					
1999		0.0608***					
2000		0.0806***					
2001		0.0589***					
2002		0.0919***					
2003		0.0930***					
2004		0.0742***					
2005		0.0816***					
2006		0.0937***					
2007		0.0858***					
2008		0.0954***					
2009		0.1070***					
EU integration (post-2004)			0.0234***				
manufacturing				0.0908***			
services				0.0481***			
other				0.102***			
manufacturing					0.0908***		
trade and repair					0.0331***		
transportation and storage					0.0605***		
hotels and restaurants					0.107***		
other					0.0853***		
private domestic						0.0719***	0.0871***
state owned						0.0791***	0.0761***
local government						0.0995***	0.0413***
multinational						0.107***	0.116***
Observations	165,100	165,100	165,100	165,100	165,100	164,909	78,355
R-squared	0.111	0.117	0.114	0.120	0.120	0.114	0.130

Standard errors omitted

*** p<0.01, ** p<0.05, * p<0.1

Figure 1. Price costs markups vs. economic cycle



Cyclicality of price cost margins

The analysis of the impact of business cycle on price cost margins (PCMs) are presented in table 1. The interpretation of results shown in Table 3 should be following. PCMs are pro-cyclical if the estimated parameter at the interaction of dx and cycle measure is significant and positive. Similarly, PCMs are countercyclical if the estimate is significantly negative. In table 3 and in all subsequent tables, we suppress the irrelevant regression results, such as constants and other included variables that lack economic interpretation.

The results show that the general economic cycle is negatively correlated with the level of markups, while the sectoral cycles of economic activity seems to be positively correlated with the level of markups. However statistical significance of those results depends on the specification of the estimated equations.

Therefore the economic cycle, measured by the deviation of GDP from its long run trend is not a significant driver of PCMs, unless we control for the sectoral cycles.

Table 3: Cyclicality of the price cost margins

	(1)	(2)	(3)	(4)	(5)
VARIABLES	all	all	manuf.	all	manuf.
dx	0.0782***	0.0758***	0.0889***	0.0760***	0.0895***
dx*GDP cycle	-0.0284			-0.136***	-0.151***
dx*sectoral cycle		0.0736***		0.140***	
dx*division cycle			0.00830		0.0200**
Observations	165,100	152,188	77,972	152,188	77,972
R-squared	0.112	0.106	0.124	0.106	0.125

Standard errors omitted

*** p<0.01, ** p<0.05, * p<0.1

According to our estimates the impact is highly economically significant. An increase in GDP deviation from its long run trend by 1 pp. is associated with a decrease in PCMs by 0.14 or 0.15 pp., depending on the definition included in the regression.

We have also examined the correlation of PCMs with the sectoral cyclical position. The results show pro-cyclical relationship with sector-level cycle. The division level

(by 2-digit NACE classification code, that is available for manufacturing only) cycle becomes positively correlated when we control for general economic cycle.

Table 4: Cyclicality of the price cost margins by main industrial groupings

VARIABLES		(1) manuf.	(2) manuf.	(3) manuf.	(4) manuf.
investment	dx	0.102***	0.103***	0.0971***	0.0980***
consumer non-durable	dx	0.0729***	0.0728***	0.0713***	0.0714***
intermediate	dx	0.103***	0.104***	0.100***	0.101***
Consumer durable	dx	0.0769***	0.0768***	0.0655***	0.0665***
investment	dx*GDP cycle		-0.172*		-0.194**
consumer non-durable	dx*GDP cycle		-0.0215		0.00165
intermediate	dx*GDP cycle		-0.224***		-0.189**
consumer durable	dx*GDP cycle		-0.442**		-0.355**
investment	dx*division cycle			0.0309**	0.0469***
consumer non-durable	dx*division cycle			-0.0178	-0.0166
intermediate	dx*division cycle			0.000668***	0.000697***
Consumer durable	dx*division cycle			0.00476	0.00768
Observations		78,445	78,445	72,184	72,184
R-squared		0.130	0.132	0.124	0.126

Standard errors omitted

*** p<0.01, ** p<0.05, * p<0.1

Gradzewicz et al. (2010) show that industrial output and the variations in external demand are highly correlated and is generally much more variable than consumption demand where the length of the cycle is also much longer. We try to establish whether the type of good produced in a sector has an impact on the cyclical behavior of markups, with a idea in mind that production of investment and intermediate goods is more susceptible to cyclical variations than that of consumption goods (especially consumer non-durables). We therefore expect that in investment and intermediate goods producing sectors, demand is driven by the enterprise sector itself and by the external demand and therefore the sectoral cycle could serve as an approximation of relevant demand variations. At the same time, we could expect that the deviations in the overall GDP cycle should reflect variations in overall demand in the economy and therefore be a better proxy for changes in consumer demand.

The level of markups clearly depends on the type of good produced by a company (the division into main product groups is available for manufacturing only). The highest markups are found among the producers of investment and intermediate goods: over 10%, while the margins by producers of both consumer durable and non-durable goods are below 8%. Also the impact of economic cycle on PCMs by those groups of companies is differentiated. GDP cycle is negatively correlated to markups of producers of all sorts of goods besides consumer non-durables. The biggest quantitative "impact" the economic cycle has on the level of markups by the producers of consumer durable goods. An increase of GDP deviation from its long run trend by 1% is associated with decrease of markups by about 0.5% of durable consumer goods producers.

As far as the sector or division level cycles are concerned, markups set by producers of investment and intermediate goods turns out to be statistically pro-cyclical. Though the estimate of the elasticity parameter for producers of intermediate goods is very low and doesn't have greater economic significance.

Markups and exporting activity

We also explore the association between markups and export activity of entreprises. Previous literature (eg. Görg and Warzynski, 2003) have found a positive correlation between the export and markups. We explore this subject in two ways, ie. we divide entreprises in our sample into categories based on the share of exports in total sales and alternatively, we include an interaction of export share in total sales and the *dx* variable in the markups estimation equation.

The results show that exporters are characterized by a markup that is on average about 2.6 pp. higher than in the case of non-exporters (column 1 of Table 4). In manufacturing, the premium is closer to 2 pp (column 6). The significant exporter premium is not largely affected by accounting for the sector specificity by including a interaction between the *dx* variable and 3-digit sectoral dummies (sectoral estimates are not shown).

Table 5: Exporting premium and effect of export intensity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	all	all	all	all	all	mnfcg	mnfcg	mnfcg	mnfcg	mnfcg
VARIABLES		3-dig dum.		exporters	exporters		3-dig dum.		exporters	exporters
non-exporter	0.0680***	0.0493				0.0780***	0.106***			
exporter	0.0937***	0.0630**				0.0978***	0.125***			
dx			0.0716***	0.0839***				0.0822***	0.0877***	
exp_share*dx			0.0479***	0.0282***				0.0347***	0.0261***	
exp_share<p10					0.077***					0.0890***
p10<exp_share<p25					0.086***					0.0907***
p25<exp_share<p50					0.089***					0.0914***
p50<exp_share<p75					0.095***					0.0982***
p75<exp_share<p90					0.102***					0.106***
p90<exp_share					0.109***					0.109***
Observations	165,037	165,037	165,070	66,274	82,967	78,393	78,393	78,437	50,840	58,174
R-squared	0.114	0.151	0.115	0.141	0.137	0.129	0.148	0.129	0.144	0.142
Group comparisons (pvalues)										
pvalue P0=P1	0	0			0.00100	0	0			0.642
pvalue P1=P2					0.349					0.867
pvalue P2=P3					0.00762					0.0208
pvalue P3=P4					0.0188					0.0164
pvalue P4=P5					0.0581					0.438

Only relevant parameters reported. All – overall sample, Mnfcg – manufacturing, 3-dig dummies – markups vary by 3-digit Nace sector

Standard errors omitted. Significance levels *** p<0.01, ** p<0.05, * p<0.1

Moreover, the subsequent categories of firms characterized by higher export share, have significantly higher markups than the categories with low export share (column 3 for the overall sample and column 8 for manufacturing). The positive relationship is preserved when only the exporters are taken into account (columns 4 and 8).

In order to account for possible non-linearities in the relationship, we compare the groups of firms based on their export performance (within exporters). In the overall sample, there are significant differences between the compared percentiles of firms (except the case of the comparison between the second and third group). PCM estimate for a subsample up to 10th percentile in the export share is about 3 pp. lower than a similar estimate for a subsample with export share in and over the 90th percentile. In manufacturing, however, the differences are less visible for firms with export shares below the 50^{th} percentile. Significant differences exist for firms within the range of 50^{th} and 90^{th} percentile with no visible extra premium of being in the 90^{th} percentile. The difference in PCMs between the manufacturing firms subsample up to 10th percentile in the export share is about 2 pp. lower than a similar estimate for a subsample with export share in and over the 90th percentile.

These results are consistent with the estimates of interaction the interaction term of the *dx* variable with the export share: they indicate that the increase of export share by 1 pp. results in increase of PCMs by about 0.03 pp. (0.025 pp. in manufacturing).

Another interesting issue is the impact of exchange rate on the markup level. In order to check, if it is a significant factor affecting markups, we included the level of nominal effective exchange rate (NEER) in the markup regressions. The results suggest a negative correlation between strength of national currency and PCMs by both, exporters, where this impact is stronger, and non-exporters. However when we control for the level of economic activity (total and sectoral or division) this effect weakens for exporters, and become insignificant for non-exporters.

Table 6 Exchange rate and export activity

VARIABLES	(1) all	(2) all	(3) all	(4) exporters	(5) exporters	(6) exporters
non-exporter*dx	0.0685***	0.0665***	0.0666***			
exporter*dx	0.0938***	0.0908***	0.0904***			
NEER*non-exporter*dx	-0.0251***	-0.0112	-0.00993			
NEER*exporter*dx	-0.0618***	-0.0476***	-0.0398***			
exp_share<p10*dx				0.0788***	0.0791***	0.0786***
p10<exp_share<p25*dx				0.0879***	0.0889***	0.0884***
p25<exp_share<p50*dx				0.0902***	0.0904***	0.0898***
p50<exp_share<p75*dx				0.0956***	0.0914***	0.0915***
p75<exp_share<p90*dx				0.0971***	0.0940***	0.0934***
p90<exp_share*dx				0.102***	0.0963***	0.0955***
NEER*exp_share<p10*dx				-0.0485***	-0.0365*	-0.0278
NEER*p10<exp_share<p25*dx				-0.0563*	-0.0505*	-0.0498*
NEER*p25<exp_share<p50*dx				-0.00818	0.00368	0.00795
NEER*p50<exp_share<p75*dx				-0.0640***	-0.0289	-0.0226
NEER*p75<exp_share<p90*dx				-0.0768***	-0.0407	-0.0332
NEER*p90<exp_share*dx				-0.0989***	-0.0507	-0.0388
GDP cycle*dx		-0.00143	0.0475		-0.252***	-0.123**
section cycle*dx		0.103***			0.168***	
division cycle*dx			0.0374***			0.0494***
Observations	165,007	152,131	150,179	82,955	76,157	75,811
R-squared	0.115	0.110	0.110	0.142	0.132	0.133

Standard errors omitted

*** p<0.01, ** p<0.05, * p<0.1

Unless we control for the economic cycle, the strength of negative correlation between the exchange rate and PCMs is also different among specified groups of exporters characterized by grade of export intensity. Our results confirm that the higher export intensity the bigger negative impact of NEER on markups (excluding one group of exporters, between p25 and p50, where NEER seem to be insignificant factor explaining level of PCMs). However this result disappears when we include in regression variables quantifying economic cycle, what can be attributed to some correlation between levels of economic activity end exchange rate.

Price cost margins and the intensity of competition

We consider a straightforward hypothesis of a negative impact of the intensity of competition on the level of markups. We use two measures of both internal and external competition. We proxy the level of competition by a Herfindahl-Hirschman concentration index and the external competition by the ratio of imports in every 3-digit NACE group to total sales of firms located in Poland within the same sector.

The results confirm that higher market concentration, leads to a higher level of markups - the parameter estimate of the interaction term of HHI and *dx* is positive and statistically significant, for the overall sample and manufacturing. Including 3-digit dummies interactions with the *dx* variable and therefore correcting for industry specificity does not affect the obtained estimators. Furthermore, average PCM for the 10% of companies that are located in a sector with the lowest HHI, amounts to 5.2% and is about 4 pp. lower then average PCM for the sectors with top 10% concentration. The results for manufacturing prove to be similar.

Due to the suspected low reliability of the sectoral import data, we decided to only report the group comparison based on the levels of import penetration. There seems to exist no linear relation between our import measure and markups. Though one fact should be stressed- in the group of 10% companies with the lowest import penetration measure, which means that in the manufacturing sectors with the lowest level of imports, the price cost margins are significantly higher than in other sectors.

Table 7: Impact of market concentration and penetration by import

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	all	all	all	mnfcg	mnfcg	mnfcg	mnfcg
VARIABLES		3-dig dum.			3-dig dum.		
dx	0.0730***	0.0727***		0.0867***	0.0867***		
HHI*dx	0.0621***	0.0666***		0.0416***	0.0392***		0.0332***
HHI<p10			0.0521***			0.0634***	
p10<HHI<p25			0.0679***			0.0802***	
p25<HHI<p50			0.0727***			0.0808***	
p50<HHI<p75			0.0873***			0.0968***	
p75<HHI<p90			0.0920***			0.0987***	
p90<HHI			0.0913***			0.0974***	
imp<p10							0.112***
p10<imp<p25							0.0753***
p25<imp<p50							0.0816***
p50<imp<p75							0.0899***
p75<imp<p90							0.0934***
p90<imp							0.0825***
Observations	165,070	165,070	164,672	78,437	78,437	78,304	66,642
R-squared	0.113	0.121	0.115	0.128	0.132	0.128	0.126
Group comparisons (pvalues)							
pvalue P0=P1			0			0.00574	0
pvalue P1=P2			0.00697			0.847	0.0329
pvalue P2=P3			0			0	0.00109
pvalue P3=P4			0.00782			0.447	0.233
pvalue P4=P5			0.737			0.690	0.00230

Only relevant parameters reported. all – overall sample, mnfcg – manufacturing, 3-dig dummies – markups vary by 3-digit Nace sector. Standard errors omitted. Significance levels *** p<0.01, ** p<0.05, * p<0.1.

Price cost margins and the EU integration

In the subsequent regression, we include a post-2004 dummy (EU integration) interaction with the *dx* variable in order to capture the effect associated with EU integration. In columns 1 and 5, we provide results of a simple regression containing just the interaction term, whereas in subsequent columns we include some of the variables analyzed in the previous sections to account for competition a cyclical effects.

Table 8: Price cost margins and the EU integration

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	all	all	all	all	mfcng	mfcng	mfcng	mfcng
dx	0.0699***	0.0702***	0.0578***	0.0571***	0.0820***	0.0814***	0.0690***	0.0971***
EU integration*dx	0.0234***	0.0206***	0.0185***	0.0212***	0.0245***	0.0217***	0.0200***	0.0241***
GDP_cycle*dx		-0.222***	-0.173***	-0.175***		-0.221***	-0.203***	-0.171***
sectoral_cycle*dx		0.164***	0.132***	0.136***				
2-dig_cycle*dx						0.0214**	0.0251***	0.0240**
exporter*dx			0.0162***	0.0181***			0.00902***	0.0104***
exporter*dx*eu				-0.00655***				-0.0109**
export_share*dx			0.0144***	0.0147***			0.0112***	0.0103***
hhi*dx			0.0556***	0.0554***			0.0401***	0.0335***
p10<imp<p25								-0.0341***
p25<imp<p50								-0.0305***
p50<imp<p75								-0.0219***
p75<imp<p90								-0.0172***
p90<imp								-0.0294***
Observations	165,100	151,914	151,857	151,857	78,445	71,915	71,869	66,186
R-squared	0.114	0.107	0.113	0.113	0.129	0.123	0.128	0.132

Standard errors omitted

*** p<0.01, ** p<0.05, * p<0.1

It is important to note, that the conclusions concerning the direction of both cyclical and competition affects remain largely unaffected. However, the estimated difference in the average markup after the Polish integration with the EU is positive and varies between 1.9 and 2.5 percentage points and proves to be somewhat robust, indicating that markups have increased significantly after 2004, even when cyclical effects are taken into accounts. What is even more interesting is that, in fact, the post-2004 markup premium proves to be higher for non-exporters than it is for

exporters (in fact, it is more than twice as high). The increase in the post-2004 premium for exporters is not surprising – Polish companies gained access to a much larger market than they had access to before together with lower barriers to imports of intermediate goods. At the same time, the import competition factor must have turned out to be relatively weak, at least as far as the level of markups are concerned. The reason why non-exporters increased markups to a larger extent, might be at least two-fold: first, the exporting industries are also expected to import more and therefore face stronger competition and second, with the expansion of the Polish economy, the growth of domestic demand, especially for higher markup luxurious groups may have been higher than the growth of external demand in the years following the EU accession. However, both hypotheses remain so far untested.

Adjustment for returns to scale

The Roeger analysis can be extended by allowing for returns to scale. In this case, β in equaition (7) will take the form: $1-\frac{\lambda}{\mu}=\beta$, where λ is the scale elasticity.

Following the Dobrinski et al. (2006), we correct the estimates using scale elasticities obtained for the same sample by Gradzewicz and Hagemejer (2007a). The estimating equation is transformed to become:

$$\Delta y_t - \Delta x_t = -\frac{1}{\mu}\lambda \Delta x_t + \varepsilon_t,$$

Each observation of the explanatory variable is multiplied by the sectoral estimate of scale elasticity (time-invariant). Selected results of those corrections (after recalculating the Lerner index in the usual form) are given in the table Table 9.

Due to the fact that economies of scale are more important in manufacturing, the corrected average markup is higher in that sector, while it is almost unchanged in services and the remaining sectors. A closer look on the service sector shows that the only estimate that is visibly affected is the transport sector, where decreasing returns to scale are present and therefore the sector is close to marginal cost pricing. Correction for returns to scale intensifies the difference between the foreign- and domestically-owned firms due to the fact that foreign owned-firms are more likely to locate in increasing returns to scale sectors.

The correction for returns to scale does not alter the conclusions on the cyclical behavior of markups nor the effects of EU integration or involvement in international trade in a significant way.

Table 9: Price cost margins corrected for scale effects

VARIABLES	(1) all	(2) all	(3) all	(4) all	(5) mfcng
dx				0.066***	0.142***
manufacturing	0.119***				
services	0.047***				
other	0.098***				
manufacturing		0.119***			
trade and repair		0.039***			
transportation and storage		0.039			
hotels and restaurants		0.108***			
other		0.081***			
private domestic			0.085***		
state owned			0.089***		
local government			0.087***		
multinational			0.125***		
EU integration*dx				0.0179***	0.0199***
GDP_cycle*dx				-0.207***	-0.119**
sectoral_cycle*dx				0.179***	
2-dig_cycle*dx					0.00988
exporter*dx				0.0252***	0.00308
exporter*dx*eu				-0.00135	-0.00648
export_share*dx				0.00949***	-0.00215
hhi*dx				0.0970***	0.0823***
p10<imp<p25					-0.0427***
p25<imp<p50					-0.0416***
p50<imp<p75					-0.0331***
p75<imp<p90					-0.0347***
p90<imp					-0.0438***
Observations	165,100	165,100	164,909	152,131	66,186
R-squared	0.945	0.945	0.944	0.945	0.934

Standard errors omitted

*** p<0.01, ** p<0.05, * p<0.1

Firm-level price cost margins

In order to observe the shape of the distribution of markups and to provide another robustness check, we measure markups at firm level (for firms with minimum of 10 observations). Observation of obtained markup distribution (Epanechnikov kernel densities) of the graphs confirms most of the previous conclusions. The average obtained level of markups is 8.5% which is in line with the previous result. Distribution of markups is more concentrated than the normal distribution and is positively skewed.

On average PCMs in manufacturing are higher than in services, with the average markup in manufacturing equal to 9.7%, while in services the markup amounts to 5.1%. The distribution of markups in manufacturing has a large part of its mass concentrated to the right of the respective distribution for services and is less concentrated and more symmetric.

As far as ownership impact is concerned, while the distribution of the privately-owned domestic firms is visibly shifted to the left, the markups of state-owned firms and multinationals are roughly in line. The average markup for privately-owned firms amounts to 7.2%, for state-owned 10.5% and for multinationals 12.4%. The distribution of markups in privately-owned domestic firms is the most concentrated and also less skewed then of the others groups.

The shape of the distribution suggests that only producer of nondurable consumer goods are characterized by lower markups than the others, but values of mean estimates confirm that producers of both durable and non-durable goods set lower markups (8.8% and 7.4% respectively) than producers of investment and intermediate goods (10.8% and 11.9% respectively). The most concentrated are the markups of firms producing investment goods.

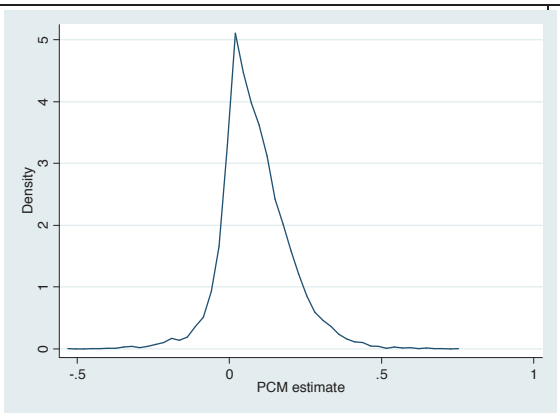
Distribution of PCMs for exporters is shifted to the right with respect to those of non-exporters which confirms the existence of the export premium. The average markup estimate for exporters amounts to 10.8%, while for non-exporters it is 7.5%. Also the export intensity is positively related to height of markups. The average markup of exporters with over 50% share of export sales amounts to 11.6%, while of the exporters with domination of domestic sales, 9.7%. The distribution of markups

within the non-exporter group is more concentrated than that of exporters and the distribution of margins of exporters with lower export share is more concentrated than that of exporter with higher share of exports in sales.

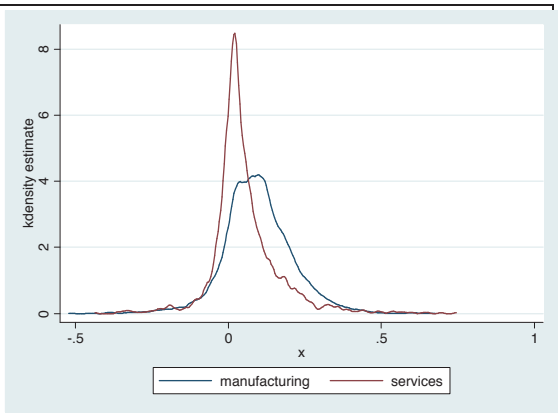
The results confirm also that PCMs of companies operating in more concentrated markets are on average higher than those of remaining firms. Average markup estimated for companies that operate in markets characterized by the HHI index exceeding the median value amounts to 9.5%, and average markup of the remaining firms is smaller by at least 2 pp. Kurtoses of distribution of markups by these groups are similar, but the skewness of the distribution of markups firms operating in more concentrated markets is higher.

Also our measure of import penetration seems to play significant role in effecting markups. Though the shapes of distributions are not very suggestive, the average markup for companies operating in the markets characterized by the import penetration index below 10th percentile amounts to 13.2% and is by over 3 pp. higher analogous value for the rest of firms. The skewness and kurtosis are similar in these groups.

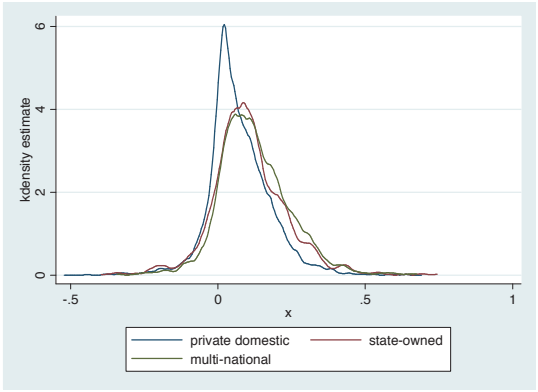
Figure 2: Distribution of price cost margins between different groups of firms



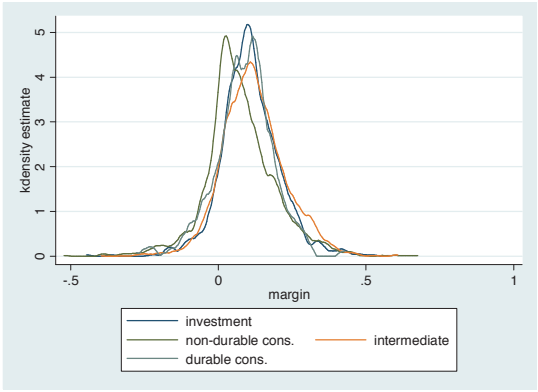
	skewness	kurtosis	median	mean
total	0.47612	5.30202	0.07125	0.08520



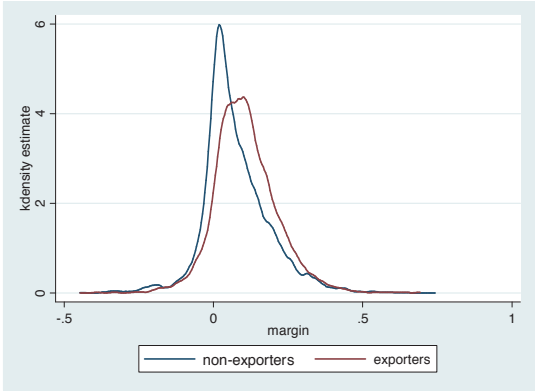
	skewness	kurtosis	median	mean
manufacturing	0.11588	4.81802	0.09113	0.09696
services	1.13723	8.52178	0.03153	0.05132



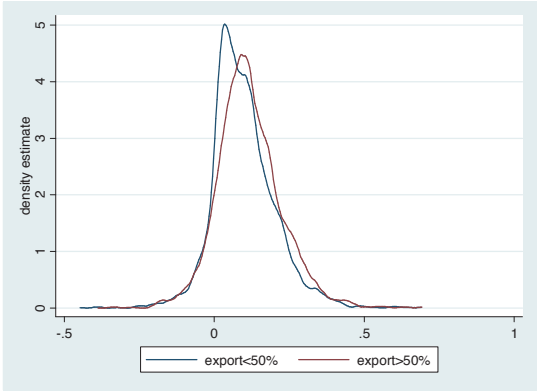
	skewness	kurtosis	median	mean
private domestic	0.37157	5.56912	0.05793	0.07188
state owned	0.38996	5.00943	0.09497	0.10517
multinational	0.53300	4.36773	0.11082	0.12426



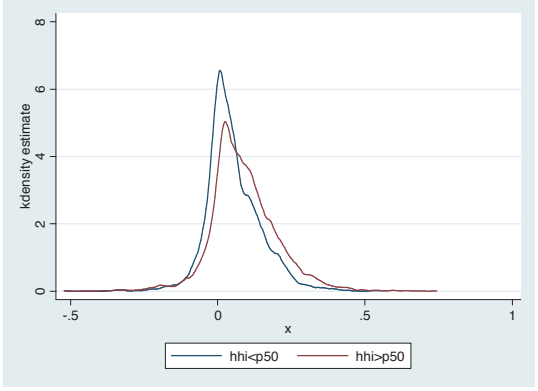
	skewness	kurtosis	median	mean
investment	0.13537	5.46131	0.10251	0.10845
consumer non-durable	0.22425	5.15257	0.06323	0.07413
intermediate	0.23232	4.09075	0.11290	0.11933
Consumer durable	-0.34112	4.31255	0.09562	0.08810



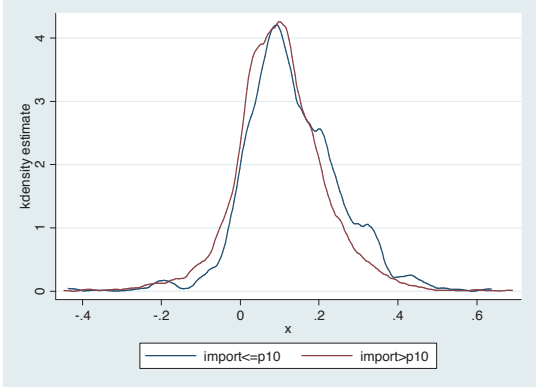
	skewness	kurtosis	median	mean
Non-exporter	0.604764	5.607055	0.055107	0.075722
exporter	0.470398	5.159061	0.099620	0.108481



	skewness	kurtosis	median	mean
Export share<median	0.57241	5.72737	0.08552	0.09761
Export share>median	0.46156	4.70451	0.10668	0.11634



	skewness	kurtosis	median	mean
HHI<median	0.27292	5.14260	0.06147	0.07476
HHI>median	0.59654	5.18158	0.08218	0.09537



	skewness	kurtosis	median	mean
import<p10	0.14285	4.79993	0.11746	0.13158
import>p10	0.11634	4.89448	0.09636	0.10059

Conclusions

In this paper, we have presented a set of up-to date estimates of monopolistic markups for the Polish economy. Our findings confirm the conclusions of much earlier studies performed for Poland even given the somewhat longer history of the available dataset. Our results confirm that the cyclical behavior of the price cost margin is visible only when both sectoral and macroeconomic cycles with a countercyclical reaction to the macroeconomic cycle and a pro-cyclical reaction to the economic situation in the relevant section or division. Our methodology allows us to compare groups of firms based both firm-level and sectoral characteristics. The form of ownership affects the level of markups with the clear premium of multinationals and selected form of state ownership. We show that there is a considerable variation of markups depending on the type of good produced classified by its use (consumer goods producers have lower markups than eg. investment good producers) and it also turns out that there is a heterogeneity as far as response to the cycle is concerned..

We assess the impact of pressure from both internal from external competition on the level of markups as well as the association of markups with the export status and export performance. Markups are also sensitive to changes in exchange rates. Appreciation of Polish Zloty is associated with a fall in markups that is more pronounced in exporters.

While in sectors that are more concentrated and more open to imports markups are lower, export participation tends to be correlated with higher markups. These results are also confirmed by the firm-level analysis of the markup level.

While markups vary considerably over time in the analyzed period, we observe a robust increase of their level after the accession to the EU in 2004. We are not able to tie this results to increased export participation and the cyclical position of the economy in that period. Moreover, effects of EU integration are more pronounced in the domestic market-oriented sectors suggesting important wealth effects of EU accession.

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