Competitive Pressure and its Social Consequences in EU Member States and in Associated Countries

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Workpackage 1: "Competitive Pressure in the Corporate Sector, its Institutional Aspects and Policy Framework"

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"Competition in imperfect markets and firms' responses to institutional interventions"

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1. Introduction

The deepening and widening of international economic integration within the enlarging EU reduces the cross-border barriers to market competition and has a profound impact on firm behaviour. Workpackage 1 "Competitive pressure in the corporate sector, its institutional aspects and policy framework" seeks to provide a better understanding of the effect of the growing competitive pressure associated with economic integration on the performance of the enterprise sector in some of the new and prospective EU member states. Its main research objective is to identify and investigate empirically how the growing competitive pressure within an enlarged EU affects firm behaviour and performance. The main focus of research is on some of the new EU members that joined the Union in 2004 (such as Hungary and Slovenia) and on the candidate countries that have set for themselves the target to do so in 2007 (Bulgaria and Romania).

During the first phase of research (undertaken in 2003) WP1 assessed the evolution of competition policy and institutional framework in these countries and addressed issues related to the actual measurement of competitive pressure in the corporate sector. The main emphasis was on the definition of relevant and adequate quantifiable indicators which would reflect the level of competitive pressure that firms in these countries are subject to and on the actual quantification of these indicators for the participating countries which would allow not only to gauge the level of competitive pressure in the corporate sector of each country but also to make cross-country comparisons.

During the second phase of research (undertaken in 2004) the focus of research turned to aspects of enterprise adjustment to competitive pressure in imperfect markets. The new EU member countries Hungary and Slovenia and, even more so, the EU candidates Bulgaria and Romania are countries that have undergone (and are still undergoing) a fundamental economic transformation and restructuring. Their transitional markets are immature and still marred by numerous imperfections that affect all aspects of firm performance, including the firms' price-setting mechanisms. During this phase we developed research methodology to examine empirically, and on a comparative basis, the aspects of behaviour and adjustment of manufacturing firms to competitive pressure, in the environment of imperfect markets and tested this methodology on the basis of empirical data for the countries concerned.

In the third phase of research (undertaken in 2005) we developed further our methodological approaches and applied them extensively on firm level data for these countries. The empirical research efforts in this phase, as reflected in this report, followed two main directions. First, we continued the comparative empirical analysis of firm adjustment to competitive pressure, by developing a methodology for analyzing some aspects of firms' behaviour and performance in imperfect markets and applying this methodology to empirical data. Second, we analyzed the effects of competitive pressure on the corporate sector in the context of the institutional and policy environment, by developing a methodology for analyzing the firm's responses to changes in this environment and applying this methodology to empirical data.

2. Competitive pressure in imperfect markets and the effect of market imperfections on firms' pricing behaviour and performance

2.1 Theoretical background

Some of the important results of the neoclassical production theory are derived under the standard assumptions of perfect competition in product and factor markets, sometimes coupled with that of constant returns to scale. In particular, under perfect competition in efficient product and factor markets, firms producing homogeneous products set their prices at their marginal costs which, under constant returns to scale, also equal their average costs. Put differently, under perfect competition firms adjust their output level and cost structure so that to set their marginal costs equal to the exogenous price level.

The assumptions of perfect competition and constant returns to scale – as well as the theoretical results derived in a framework that incorporates them – are often applied in empirical studies as well, including microeconomic studies based on firm-level data. However, perfect competition in efficient markets is a purely theoretical notion that hardly matches reality even in mature market economies. This is even more so when considering economies that are still undergoing a fundamental transition from planned to market economic systems. Given the legacies of the past and the difficulties experienced during the transition period, domestic product and factor markets in these economies are still marred by numerous deep-seated imperfections.

Recent theoretical advances as well as the related empirical research have shown that the departure from the standard assumptions of perfect competition and constant returns to scale may have important implications with respects to the derived theoretical behavioural characteristics of representative firms and the validity of the conclusions based on the related empirical analysis. Relaxing some of the assumptions of perfect competition and constant returns to scale has led to various extensions of the standard neoclassical results related to the pricing behaviour of firms endowed with monopolistic power (see, among others, Hall, 1988 and Roeger, 1995).

The acceding post-transition economies are mired by market imperfections by their nature: they started from a non-market economy, where institutional settings were specifically designed to substantially constraint market competition and to block some of the most important consequences of the competitive adjustment process. Market structure at the onset of transition was almost entirely the outcome of previous centrally planned and directed investment decisions. Centrally planned economies were overindustrialized and the industrial structure was heavily concentrated in large state-owned firms that often enjoyed monopolistic position. Domestic markets were further protected by non-convertible exchange rates that amplified the firms' monopoly power. Prices were as a rule set centrally by the planning authorities (the extent of price controls differed from country to country) and had no market clearing properties; as a result shortages were endemic (Kornai, 1980). Financial markets were virtually non-existent or only existed in a rudimentary form; the allocation of bank credit was to a large extent directed by the planning authorities. The labour market was deeply distorted; the artificially low wages produced the appearance of labour shortages. The resultant structure of relative prices, in particular factor prices (relatively cheap labour and relatively expensive capital equipment) induced a distorted production structure and factor mix, deterring the introduction of modern technologies.

Transition was indeed the process of implementing institutional reforms for removing these obstacles, and the adjustment process in which economic agents gradually adjust their behaviour to the norms of a functioning market economy. Reforms undertaken during the transition have undoubtedly contributed to the evolution of the market environment in these countries; nevertheless, deep-seated market imperfections – inherited from the past or related to the difficult process of economic transformation – are still endemic. One of the important specificities of the market environment of economies in transition is that some of the ongoing changes (especially those involving structural and institutional transformation) involve a long adjustment process during which the functioning of markets is affected by carryover effects and inertia, often leading to significant distortions. To name but a few of the typical distortions of transitional markets.

Restructuring of firms (often involving demonopolization measures), subsequent privatization of state-owned firms as well as the removal of entry barriers to the domestic market have contributed to major changes in market structure. Nevertheless, a number of firms retained dominant positions on the domestic market for a sufficiently long period after the start of market reforms. Transition-specific corporate governance problems have had a major impact on enterprise behaviour and performance, especially during the earlier phases of transition. Prior to privatization, state-owned firms were often left in a governance vacuum; soft budget constraints were endemic leading to the emergence of distorted and perverse managerial incentives (Dobrinsky et al., 2001a). The emerging financial markets (in the first place, the market for commercial credit) performed under considerable information asymmetries as firms had no proper track record of creditworthiness; this resulted in considerable distortions in the allocation of financial flows to the corporate sector. The housing market was slow to develop, reducing the mobility of labour and giving rise to a segmentation of the labour market. The deep transformational recession experienced by all transition economies (Kornai, 1993) implied a lasting period of excess capacity for most firms as sunk capital surfaced as a result of the knock-on effect of economic liberalization. The problem was further compounded by the inherited distortions in the capital structure. All these specificities suggest that markets in transition economies are marred by much deeper imperfections than those in well functioning mature market economies.

Importantly, the extent to which such transition-specific distortions are still present in the market environment of individual countries largely depends on their progress in economic transformation and market reforms. For example, while the acceding post-transition countries are similar in the sense that they are all former centrally planned economies that embarked on a process of economic and political transformation in 1989, during the transition countries followed very different policies, which in effect produced divergent outcomes in terms of their economic performance and path of institutional change.

It is a well-established result in production theory that under perfect competition in efficient product and factor markets, firms producing homogeneous products set their prices at their marginal costs. In addition, if the production technology is characterized by constant returns to scale, and there are no dynamic effects, average costs equal marginal costs and hence the output price. These conditions do not necessarily hold in a world of imperfect competition, as typical of the economies in transition. In particular, the incidence of a monopolist endowed with market power may result in a shift of the equilibrium point away from its would-be position under perfect competition. If the demand curve faced by a monopolist producing product y is downward sloping, the equilibrium price p_y will exceed the marginal cost μ by a markup θ ($\theta > 1$) which depends on the price elasticity of demand η:

$$\theta = p_y / \mu = 1/(1 + 1/\eta) \quad (1)$$

In other words, monopolistic firms may use their market power to set prices above their marginal costs.

While price markups over marginal costs are considered to be important characteristics of firms' behaviour in imperfect markets, they are not directly observable. Apart from the theoretically justifiable expectation that $\theta > 1$ (as the elasticity of demand η for a downward sloping demand curve is negative) there are no other priors as to the values of the markups. Their actual measurement has long interested empirical economists and various approaches to their indirect estimation have been suggested in the literature. The differences in approaching the measurement issue stem both from the underlying theoretical methodology and from the specific objective of the measurement exercise (e.g. to quantify the markups charged by individual firms on individual products, or to measure the average markups of individual firms, or to estimate the average markups across specific industries).

The definitional identity (1) offers two possible straightforward approaches to the measurement of the firm's markups: one of them requires relevant data on the firm's output prices and marginal costs; the second necessitates the quantification of the price elasticity of demand faced by the firm. Roberts and Supina (1996, 2000) have applied the first of these approaches to analyze the price markups charged by different producers on a set of 13 homogeneous products. Morrison (1992) uses a similar method to analyze the markup behaviour of U.S. and Japanese firms. The second approach has been explored in Justman (1987) and Shapiro (1987), among others. The main practical problem of these two approaches is that they require detailed firm-level price and cost information which, in general, is not readily available and may be difficult to obtain.

Another strand in the empirical literature originates in the seminal paper by Hall (1988) who analyzed the implications of market power on productive efficiency, factor demand and pricing behaviour. Using a two-factor production function, Hall showed that under imperfect competition the primal Solow residual is not solely attributed to autonomous technical change, but may partly reflect monopolistic pricing behaviour. Hall's approach was tested and extended in a number of subsequent studies (Shapiro, 1987; Domowitz, Hubbard and Petersen, 1988, among others). Roeger (1995) established that in the presence of market power (violating the conditions for perfect competition), the dual Solow residual can also be decomposed into two such components: one attributed to autonomous technical change and another one – to the markup charged by the monopolistic firm. One of the most attractive features of Roeger's approach is the fact that it is based on easily accessible data.

Hall's work and, especially, Roeger's result inspired a series of empirical studies, mostly based on longitudinal sectoral data (time series of aggregated sectoral data), rather than firm data proper. Thus Oliveira Martins, Scarpetta and Pilat (1996) and Oliveira Martins and Scarpetta (1999) estimated sectoral markup ratios on the basis of longitudinal data for the OECD economies. Several studies related variations in markup ratios to the business cycle (Bloch and Olive, 2001; Linnemann, 1999; Weiss, 2000; Wu and Zhang, 2000). In a cross-country study, Hoekman, Kee and Olarreaga (2004) analyzed the impact of import competition and domestic market regulation on the formation of industry-level markups. Kee (2002) used an extension of Roeger's approach for the case of non-constant returns to scale (both Hall and Roeger assume constant returns to scale) to compute markups for Singapore's manufacturing industries, again on the basis of longitudinal sectoral data for 1974-90.

More recently the same method has been applied to firm-level data (using either cross-sectional or pooled enterprise data), which in principle opens wider opportunities to analyze micro behaviour. Basu and Fernald (1997) emphasize the importance of inter-sectoral heterogeneity when analyzing the relationship of markups and returns to scale, even from the macroeconomic viewpoint. This also facilitates the resolution of one rigid assumption incorporated in studies based on industry-level data, namely that the markups are either time-invariable or directly related to the business cycle. Using this type of data some studies have not only attempted to estimate markup ratios but have also tried to assess the impact of competitive pressure on their formation (Dobrinsky, Markov and Nikolov, 2001b; Halpern and Kőrösi, 2001a; Konings, Van Cayseele and Warzynski, 2005). In a similar vein, Konings, Van Cayseele and Warzynski (2001) seek to identify whether competition policy matters in shaping the firms' pricing behaviour.

Both the main theoretical results and most of the empirical studies refer to the case of a two-factor production technology with output defined as value added. However, Norrbin (1993) pointed out that defining the markup over value added may induce an upward bias in estimations. Basu and Fernald (1997) emphasize that value added can only be interpreted as an output measure under perfect competition, and its use suffers from omitted variable bias under imperfect competition. Noting this, Oliveira Martins, Scarpetta and Pilat (1996) proposed an extension of Roeger's model for a production function defined over sales and incorporating material inputs as well (but preserving the assumption of constant returns to scale). In this extension the main features remain intact while the data requirements only rise slightly to include nominal material costs.

Most related empirical studies so far have neglected one specific aspect of markup pricing, namely the existing link between the markup ratio and the returns to scale index in the case of non-constant returns to scale. We illustrate this link in the following simplified theoretical setup. Assume that the production technology of a representative firm is characterized by a production function $y = f(\mathbf{x})$, where $\mathbf{x}$ is the vector of inputs. Alternatively, it can also be defined by the dual cost function $C = C(y,\mathbf{p})$, where $\mathbf{p}$ is the vector of factor prices. It is assumed that both f and C possess all the conventional properties that validate the duality theorems. Let the production technology be characterized by a returns to scale index λ which in accordance with the theory of production duality (see, e.g. Fare and Primont, 1995) can be expressed as:

$$\lambda = [\Sigma\, x_i(\partial f/\partial x_i)]/f(\mathbf{x}) = (C/y)/\mu\,, \qquad (2)$$

where C/y is the average cost of producing one unit of output and μ, as before, denotes the marginal production cost $\mu = \partial C/\partial y$. From eq. (2) the marginal cost can be determined as $\mu = (C/y)/\lambda$. Substituting the latter in eq. (1) establishes a direct relationship between the markup and the returns to scale indices:

$$\theta/\lambda = p_y y/C\,. \qquad (3)$$

The right-hand side of this expression is nothing else than the firm's average profit margin. Hence eq. (3) suggests that a monopolist operating a production technology characterized by a returns to scale index λ will achieve an average profit margin which equals the markup over marginal costs θ divided by the returns to scale index. From a theoretical point of view eq. (3) establishes a direct structural relationship between (the unobservable) returns to scale and markup indices and the (observable) average profit margin.

It should be pointed out that while eq. (3) is established as a structural relationship, it does not imply anything as regards the direction of causality between the two structural parameters. Besides, the non-linear nature of this relationship prevents its direct use for empirical purposes: thus one and the same average profit margin may be consistent with an infinite number of combinations of λ and θ. Hence, while this relationship sets up an issue, it offers little help in resolving the problems associated with it.

Similarly to the measurement of the price markup, the actual quantification of the returns to scale index is essentially an empirical issue. The empirical literature dealing with returns to scale is very extensive (for a comprehensive overview of issues and problems see

Quinzii, 1992). The mainstream approach starts with an assumption about the functional form of the underlying production technology and seeks to estimate the resultant production function (characterized by a specific returns to scale index). Alternatively, the starting point can be the dual cost function: assuming a functional form of the cost function and estimating it also yields the returns to scale index on the basis of the duality property (2).

2.3 Estimation of monopolistic price markups in the case of market imperfections causing non-constant returns to scale

The returns to scale index is present (explicitly or implicitly) in all empirical estimations of price markups. However, most of these studies do not take into account the relationships between returns to scale and markups, often assuming constant returns to scale (including those based on Hall's and Roeger's models).[1] The assumption of constant returns to scale may be a rather restrictive assumption for empirical applications, especially as regards economies in transition. However, the departure from the assumption of constant returns to scale not only invalidates some of the widely used theoretical results but may involve an important estimation bias and may lead to erroneous empirical conclusions.

Note that assumption of constant returns to scale (i.e. equiproportional changes in factor inputs and output) is consistent with the neoclassical theoretical framework, implying perfect markets and instantaneous adjustment. Conversely, real life phenomena such as imperfect markets and adjustment lags make more likely the deviations from constant returns to scale. For example, firms equipped with excess production capacity are more likely to operate with increasing returns to scale, while firms experiencing production bottlenecks can be expected to operate with decreasing returns to scale. On the other hand, production shocks such as the sudden disruption of traditional supply chains may translate into decreasing returns to scale while x-efficiency gains may show up in the form of increasing returns to scale.

As discussed, theory suggests that the markup and the returns to scale index are two elements of a broader, structural relationship. Given the existing structural link between these two parameters, the most natural approach to their estimation would be their joint estimation

[1] Roberts and Supina (2000) estimate a cost function that is characterized by a returns to scale factor and the latter, in turn, is implicitly present in their estimates of price markups. Among the problems associated with this approach they note that unobserved efficiency differences may lead to upward biased estimates of returns to scale and hence may cause an upward bias in the markups.

in a system of structural equations where, on the one hand, the returns to scale index is treated as a parameter of the production technology and, on the other hand, the relation between markup and returns to scale is specified as a structural characteristic of the system.[2] Kee (2002) is among the few authors who address the structural nature of the relationship between returns to scale and markups. He proposes a framework for their joint simultaneous estimation using the derived log differences of the underlying production and cost functions (both of which contain the markup and the returns to scale index) by assuming a functional form for the technical progress term and by imposing cross-equation restrictions on the estimated parameters.

The main practical problem in the empirical application of Kee's approach is that it is rather data demanding: its implementation at the firm level would imply the use of firm-level price data which, as a rule, are very difficult to obtain.[3] For this purpose we suggest a simplified multi-step approach based on a reduced form of the structural relationship between the markup ratio and the returns to scale index (3).

The theoretical underpinning of this approach is the assumption that the structural relationship (3) does not necessarily imply simultaneous interdependence of the two characteristics that goes in the two directions. In particular, we assume that the returns to scale index is an autonomous feature of the production technology employed by the representative firm which is not affected by the firm's pricing policy and behaviour.[4] Under this assumption the returns to scale index can, without loss of generality, be estimated separately, in the context of the implied production technology (2). This is the first step of our estimation procedure. In a second step we estimate a markup equation of Roeger's type, without a prior conjecture regarding the returns to scale index. In a third step, we compute an adjusted markup ratio, by superimposing the computed returns to scale index onto the price

[2] In principle, it would seem appealing to use directly for this purpose the structural identity (3) which not only establishes a direct and straightforward link between the markup and the returns to scale index but also relies on easily observable firm performance variables. However, the specific non-linear character of this relationship precludes its direct practical use in estimations.

[3] Kee applies his approach at the industry level using sectoral price data.

[4] If adjustment is instantaneous, this may appear as a too strong assumption. Thus if firm chooses to charge a very high price markup, it may effectively price itself out of the market, resulting in excess capacity. In turn, this may show up in increasing returns to scale. However, in the presence of considerable adjustment lags, this causal link will not necessarily involve a simultaneous relationship. Also, the firm may meanwhile choose to correct its pricing policy.

markup. This three-step procedure is in fact equivalent to a reduced form solution of the structural relationship (3). Its details are illustrated below.

For example, assume that the production technology is defined by a Cobb-Douglas production function:

$$Z = AL^{\alpha_L} M^{\alpha_M} K^{\alpha_K}, \quad (4)$$

where *Z, L, M* and *K* stand for real sales, labour, material and capital inputs, respectively, and *A* is the measure of productive efficiency (technical progress). As well known, the returns to scale index $\lambda = \alpha_L + \alpha_M + \alpha_K$, so its value will be directly derived from the estimated production function.

For the estimation of price markups we apply Roeger's approach, which for the case of a three-factor production function of the type (4) comes to the estimation of the following simple regression:

$$v^* = B\, q^* + \varepsilon, \quad (5)$$

where

$$v^* = d\, z^* - \alpha_L\, (d\, l^*) - \alpha_M\, (d\, m^*) - (1 - \alpha_L - \alpha_M)\, (d\, k^*), \quad (6)$$

$$q^* = d\, z^* - d\, k^*. \quad (7)$$

In these notations, *d* denotes differences, lower case indicates the logarithm of the corresponding variable and asterisk (*) stands for nominal values. Thus dz^* is the logarithmic difference of nominal sales, dl^* is the logarithmic difference of labour costs, dk^* is the logarithmic difference of capital costs and dm^* is the logarithmic difference of material costs.

The estimable parameter *B* in eq. (5) is the so-called Lerner index, which in the case of constant returns to scale is linked to the markup ratio as follows:

$$B = 1 - 1/\theta \quad (8)$$

Hylleberg and Jørgensen (1998) and Oliveira Martins and Scarpetta (1999) showed that in the case of non-constant returns to scale, the estimable equation (5) retains its form but the estimated parameter B' has a different interpretation:

$$B' = 1 - \lambda / \theta, \quad (9)$$

where λ is the returns to scale index.

Accordingly, our estimation procedure, which seeks to quantify the firms' markup ratios in the case of non-constant returns to scale, is organized as follows:

1) First we estimate the production function (4) for groups of firms and compute their average returns to scale index λ.

2) As a second step we estimate Roeger's equation for the case of a three-factor production function: equations (5) to (7). From eq. (8) we also compute the implied average markup ratio θ for the same group of firms for the case of constant returns to scale.

3) In a third step, from eq. (9) we compute the implied markup ratio θ for the case of non-constant returns to scale. This corresponds to the introduction of a measurement adjustment to price markup, reflecting the value of the computed returns to scale index λ for the corresponding group of firms.

The structural relationship between the returns to scale index and the markup ratio (eq. (3)) suggests that they are related to each other through the firm's average profitability ratio. Obviously, profitability varies across firms and thus the structural equation does not establish a direct relationship between sectoral returns to scale and markup ratios at the firm level. However, if estimated at the level of industries, the sectoral returns to scale and markup ratios are averaged over time; thus we analyse their long-run relationship, irrespective of the actual phase of the business cycle. In the presence of arbitrage, average sectoral profitability over time will tend to equalize across sectors, unless substantial institutional constraints paralyse this arbitrage process.[5] Hence, if profitability in eq. (3) is kept constant, then the estimated values of the returns to scale and markup ratios should be linearly related. This is a testable hypothesis on the validity of our theoretical model.

2.4 Empirical application to firm-level data for Bulgarian and Hungarian manufacturing

We test our theoretical results on a sample of Bulgarian and Hungarian manufacturing firms. Given the market environment in these economies, discussed above, we subsume substantial market distortions, facilitating a meaningful test of our theoretical conclusions. In fact, as these distortions are considerably larger than in a well-functioning, mature market economy, it also provides us with the opportunity to test the robustness of our findings.

Earlier studies provide further hints with respect to some of our priors. Thus when studying the performance of manufacturing firms during the early to middle transition process in Hungary, Halpern and Kőrösi (1998) found that in the initial phase of transition the

[5] Our empirical analysis uses manufacturing sectors only, where such institutional constraints should normally be irrelevant. Other sectors, e.g, agriculture or finance may be subject to strong institutional and policy interventions inhibiting the arbitrage.

effect of market power substantially diminished, as the former socialist behemoths were exposed to competition. Their size and market power were frequently based on administrative decisions rather than on efficient use of resources, and initially many found difficult to adjust to the new realities of the emerging market. After the restructuring and privatisation phase market power again became an important determinant of corporate performance. Another relevant finding by Halpern and Kőrösi (2001b) was that returns to scale also characteristically varied with the progress of the transition: early transition was characterised by decreasing returns to scale. Later, as reorganisation increased the efficiency of the resource allocation, returns to scale first moved into the neighbourhood of 1, later to increasing returns to scale regime. Based on these findings we expect that the timing differences of the two transitions will show up as characteristic differences between returns to scale and markup indices estimated for Bulgaria and Hungary. We expect lower returns to scale for Bulgaria, as it was in an earlier transition phase in our sample period. Also, we may expect lower markups for Bulgaria, as dominant firms cannot utilise their market power effectively in extracting rents.

The Bulgarian dataset used in this study contains detailed enterprise balance sheets for all manufacturing firms that use the double entry accounting method and report to the National Statistical Institute (NSI), for the period 1994-2001.[6] The annual reports contain the balance sheet, the profit-and-loss statement and several supplements. The total number of manufacturing firms in the dataset ranges from some 4,000 in 1994 to almost 12,000 in 2001. All firms in the Bulgarian dataset are incorporated entities but the set also covers micro firms with less than 10 employees.

The Hungarian dataset is based on balance sheet information for Hungarian firms supplemented with sectoral data. The dataset consists of the profit and loss account and balance sheet data of a sample of Hungarian manufacturing firms for the same period, and covers manufacturing firms employing at least 10 people. The sample selection is, however, biased towards the large firms. The total number of manufacturing firms in the dataset ranges from some 3000 in 1994 to 5000 in 2001. This sample includes at least 15% of all Hungarian manufacturing firms in every year (usually more than 20%). However, the representation is

[6] In accordance with the Law on Statistics firms registered as corporate entities have to apply double entry accounting and must report their annual balance sheets to the NSI, for statistical purposes. Hence the NSI enterprise survey is in principle a full population census.

much larger with respect to sales volume: the sample accounts for least 70% of all manufacturing sales in Hungary every year.

The empirical exercise reported here follows the approach outlined above. Our preferred definition of output is gross revenue (sales) and, accordingly, we assume a three-factor production function of the type (4).[7] In estimating the production function we assume that the efficiency term *A* is time dependent and has the following functional form:

$$A(T) = A_0\, e^{\,aT}\, \varepsilon. \qquad (10)$$

A series of estimations of this standard markup model was performed including both single-year and panel estimates. As could be expected, the sectoral markups based on single year estimates tended to display some time variability, which could largely be attributed to cyclical factors but also to a changing level of competitive pressure within the sectors.[8] Thus we decided to proceed with using panel methods, but as these yield average markups for the estimation period, we also included in this specification of *A(T)* time dummies to take care of time-specific macroeconomic shocks and other time variable macroeconomic factors.

In the panel estimations we tried different estimation techniques (OLS, fixed and random effects) which produced rather similar results. As material inputs may be endogenous in the production functions, we also experimented with the instrumental variables G2SLS estimator proposed by Balestra and Varadharajan-Krishnakumar (1987), using several different sets of instrumental variables. Generally, the different estimation techniques produced rather similar results, which could also be taken as an evidence of their robustness. In tables 1 and 2 we report some of the panel estimation results[9] (for Bulgaria and Hungary, respectively) for the production functions and the markup equations performed at the NACE 2-digit sectoral level for the period 1995-2001, and the corresponding values for the sectoral price markups.[10] We apply a completely identical methodology to the data for the two

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[7] In our own experience, similarly to the observation by Oliveira Martins, Scarpetta and Pilat (1996), the markups estimated from the definition of output as value added were often excessively high, say in the order of 50% to 100% over marginal costs (mostly likely due to the inherent estimation bias), a range that seems implausible in terms of their interpretation as a real life phenomenon.

[8] Single year estimates for the markups are available from the authors upon request.

[9] Stata and TSP were used for estimation.

[10] In the case of Hungary, in several sectors the elasticity of capital was estimated with a negative sign which is in principle an implausible value as it does not have an adequate economic interpretation. However, the statistical significance of these coefficients (as well as of most capital elasticities in the case of Hungary) was also rather low suggesting that in the statistical sense they are not significantly different from zero. This may reflect the persistence of transition-related excess capacity in Hungarian manufacturing.

countries and thus these results are fully comparable: production functions were estimated by instrumental variables, assuming random effects, while the markup equation by OLS.[11]

(Tables 1 and 2 here)

As a first observation, these results suggest that while the returns to scale index in most sectors is close to one, the assumption of constant returns to scale in general cannot be taken for granted.[12]

In the middle panels of Tables 1 and 2 we present the computed sectoral markup ratios under the assumption of constant returns to scale (equation (8)). In the right-hand panel (the last two columns of the tables) we show the implied markup ratios in the case when we ease the assumption of constant returns to scale as well as the percentage difference between the two estimates of the price markup (equation (9)) which is in fact the estimation bias induced by the assumption of constant returns to scale. Generally, the bias is not very large (MAPE of 5.2% in the case of Bulgaria and 3.8% in Hungary). These results are in line with the simulation results in Hylleberg and Jørgensen (1998). However, the bias correction still has important theoretical consequences: the correlation between the estimated sectoral returns to scale and the biased markup ratio was statistically 0 (–0.17 for Bulgaria, and –0.01 for Hungary), while it is significantly positive with the correct one: 0.61 for Bulgaria, and 0.49 for Hungary. The relationship of the sectoral returns to scale and markup ratios is also clearly visible on the scatter plots of Figure 1.

(Figure 1 here)

[11] Instrumental variables were: indicators for state and foreign ownership, competitive pressure variables: Hirschman-Herfindhal index of sectoral concentration of output, and relative standard deviation of sectoral output, both at the NACE 4-digit level, import penetration, again at the NACE 4-digit sectoral level, and time dummies. We also experimented with alternative sets of instrumental variables, such as lagged differences of model variables, etc. We chose the above instrumental set on two grounds. First, it closely corresponds to the second equation of the model as these are the variables possibly influencing market power, and thus markup. Second, while various estimates usually gave qualitatively similar results, this set of instruments seemed to yield estimates with smaller noise.

[12] The constant returns to scale hypothesis (H0: $\alpha_L + \alpha_M + \alpha_K = 1$) was rejected for most manufacturing sectors in Bulgaria, and approximately for half of the cases for Hungary.

The two graphs in Figure 1 also highlight some dissimilarities in the two countries. Clearly, the estimated returns to scale indices have different tendencies: they are always below unity, if significantly different from the constant returns to scale for Bulgaria, while typically above one, if different from unity for Hungary. The average of the sectoral returns to scale is 0.95 for Bulgaria, and 1.03 for Hungary. This conforms to our assessment of the difference in transition phase of the two countries. However, we do not see such difference in the markup ratios. The average is slightly higher for Hungary, but the difference is negligible. And that small difference can fully be attributed to one single sector (NACE 16: tobacco products), which is highly concentrated in Hungary (much more so than in Bulgaria), and where government regulation plays an extraordinary role in price setting. Thus this extremely large markup may well reflect the very specific conditions of this sector in Hungary. But that also means that the empirical evidence did not support our expectation for higher average markups for Hungary.

At a first glance, the bias introduced by the assumption of constant returns to scale may appear as minor (within the acceptable margin of error in econometric estimation). However, one problem in this exercise is that we in fact assume that firms in each NACE 2-digit sector are characterized by the same returns to scale index. This in itself may be a too rigid assumption, potentially introducing its own estimation bias. To check this, we performed another series of estimations, which seek to reduce this distorting effect.

In principle, under the assumption of perfect markets, firms operating in the same market should employ very similar, qualitatively identical production technologies (hence identical returns to scale) and should be characterized by identical levels of productive efficiency as competitive pressure will drive out of the market less efficient firms. Obviously, as the output of firms is heterogeneous, and we use the rather aggregated 2 digit sectoral classification, sectors are not fully homogeneous by their technology, but still, sectoral heterogeneity should be much smaller than economy wide. Deviation from the assumption of perfect market implies a possible additional heterogeneity in production technologies and, respectively, varying returns to scale across the same markets. However, as noted, the identification of the returns to scale index is essentially an empirical issue and there are no clear priors as to the classification of firms into groups featuring the same (or at least similar) returns to scale.

We attempted several possible breakdowns of the firms in the samples for the two countries, and the one that did reveal differences in the returns to scale index was the breakdown by size.[13] In tables 3 and 4 we present a selection of some of the main results (for Bulgaria and Hungary, respectively) for three size categories of firms: 1) "small firms" (firms with less than 20 employees); 2) "medium-sized firms" (firms with more than 20 but less than 200 employees) and 3) "large firms" (firms with more than 200 employees).[14]

(Tables 3 and 4 here)

One of the important empirical outcomes of this exercise is the finding that small firms in many manufacturing sectors on average tend to display decreasing returns to scale.[15] This is especially pronounced in the case of Bulgaria where the sample includes a considerable number of small-sized firms in all manufacturing sectors (basically the full population of incorporated small firms). The same situation is not as straightforward in Hungary. This may be due to the fact that the Hungarian dataset excludes micro firms (those with less than 10 employees), which sometimes also leads to lower sample sizes. However, it may just be the consequence of faster Hungarian transition: Halpern and Kőrösi (2001b) found that small firms were characterised by strongly decreasing returns prior 1995 in Hungary, but it approached the constant returns to scale regime afterwards.

On the other hand, both medium-sized and large manufacturing firms (both in Bulgaria and in Hungary) were in most cases found to operate at close to constant returns to scale.[16] It is thus the category of small firms for which the non-adjusted estimation of the price markups will contain the biggest, upward measurement bias. To illustrate this we present in tables 3 and 4 both the markup ratios computed with constant returns to scale, and those with the adjustment for non-constant returns, as well as the corresponding percentage

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[13] In a mature market economy firm size reflects past performance, thus it may well be the outcome of the production decisions of the firm. However, that was certainly not true in the socialist economy. Thus, firm size can be treated as an exogenous characteristic feature of the firm, especially in a relatively early transition phase. As capital markets are strongly distorted in transition economies, successful firms cannot easily raise capital. This rigidity conserves the pre-existing size distribution during transition.

[14] The full estimation results by size categories are available from the authors upon request.

[15] This finding is in line with the empirical literature on small firms, which generally finds that such firms tend to operate with decreasing returns to scale. One of the reasons is that (in the conditions of imperfect markets and assuming adjustment lags) small firms willing to expand their output are likely to face production bottlenecks in the short run.

[16] Interestingly, as can be seen in Tables 3 and 4, medium-sized firms both in Bulgaria and in Hungary on average display slightly higher returns to scale than large firms, although that difference really is negligible.

difference (measurement bias). Indeed, in the case of Bulgarian small firms this difference is in most cases between 10 and 20%, sometimes even larger, which can already be considered as a strong bias. In the case of Hungary the difference is somewhat smaller, but there are a few cases of double-digit biases. But also among the size categories of medium-sized and large firms, firms in some manufacturing sectors were found to operate with returns to scale deviating substantially from 1, which also leads to a notable measurement bias in the corresponding price markups.

Average markups are somewhat smaller for Bulgaria than for Hungary for all size categories, and the difference actually is larger for the size categories than for the entire sample estimates. However, these differences still remain small: the Bulgarian average price markups are between 15-18% price markups for the size categories, while they all are around 20% for Hungary. However, the structure of sectoral markups is very different in the two countries, no matter whether we look at the overall picture or at size categories: the correlation between the Bulgarian and Hungarian markup structures was always found to be close to 0.

The three panels of Figures 2 and 3 display scatter diagrams illustrating the relationship between sectoral returns to scale and markups for the three size categories of firms (for Bulgaria and Hungary, respectively). These diagrams confirm the existence of a strong positive correlation between returns to scale index and price markups. Indeed, in the case of Bulgaria, the coefficient of correlation between returns to scale index and price markup ratio for small firms is 0.78, for medium-sized firms 0.63 and for large firms 0.82. In Hungary, the corresponding correlation coefficients are: 0.60, 0.61 and 0.86. The importance of correcting markup estimates by the returns to scale factor is highlighted by the fact that this positive relationship is not observable for the unadjusted markups: the correlation coefficients are close to zero for Hungary for all size categories, and they are negative for Bulgaria in all cases. Even though the differences between adjusted and non-adjusted markups seem to be small in many cases, the proposed correction restores the theoretically important relationship.

(Figures 2 and 3 here)

3. Cross-country analysis of firms' responses to competitive pressure, institutional interactions and change

3.1 Theoretical background and methodological framework for the analysis

The intensity of competitive pressure faced by the firms operating in a given market is the complex outcome of the interactions of numerous agents. While it arises from the direct interaction of firms with their competitors on the marketplace, these interactions also reflect the indirect effect of the actions of other stakeholders such as government bodies entrusted with the implementation of public policy (in particular, the institutions with delegated authority to implement competition policy), creditors and other financial institutions, suppliers and customers, organized labour unions, business associations, etc. Following the strand of literature that came to be known as institutional economics (or new institutional economics), the agents that exert such indirect influence on the level and intensity of competitive pressure, can be broadly associated with the notion of institutions and institutional environment (Williamson, 2000).

In the broader sense (North, 1990) institutions are the norms and rules, including the incentive systems that govern and structure the interactions of economic agents. In particular, they define a system of property rights, regulations that curb fraud and anti-competitive behaviour, the rule of law and socio-political arrangements that mitigate risk and manage social conflicts. Together, the rules form a hierarchic structure of mutually supporting directives that influence jointly and can impact the development of nations (Bhattacharya and Patel, 2004).

Furthermore, it is often argued that institutions function to protect society from two potential dangers that are at the two extremes of societal organization: disorder and dictatorship (Djankov, Glaeser, Lopez de Silanes and Shleifer, 2003). The main instruments of such institutional control are market discipline, private legal action through courts, public enforcement through regulation and state ownership. Depending on history and cultural traditions, different societies are characterised by a different institutional environment based on different combinations of these instruments of institutional control. Moreover, while some of these types of instruments are complementary, others may act as substitutes and, in a democracy, the choice of the mix of instruments will reflect the majority preference in a society. Thus, for example, governments may chose to internalise the requirement of regulatory oversight of private monopolies by assuming ownership of infrastructure utilities, or vice versa (Bhattacharya and Patel, 2004).

In a more narrow sense, the institutional environment refers to the system of public institutions that sets the “rules of the game” for the behaviour and performance of economic agents in the different markets. In our research exercise we shall mostly refer to the second, narrower interpretation of the institutional environment. We shall seek to identify and eventually quantify, the relationship(s) between the evolving formal rules and norms governing competition (which were analysed in detail during the first phase of the project) with the behaviour and performance of firms in the emerging markets of the east European countries.

The interactions between all stakeholders involved, including firms, shape the institutional dynamics and institutional change. Apart from “revolutionary” changes that involve a complete overhaul of the institutional order, institutional change is overwhelmingly incremental and path-dependent (North, 1991). The reason for this is that stakeholders interact within an existing “institutional matrix” which produces a bias in favour of choices that are consistent with the existing framework. In turn, institutional change does affect in a similar manner the behaviour and performance of stakeholders, including firms.

The observed behaviour of firms reflects, among other things, the reaction and adjustment of the firms to the acting rules and regulations and changes therein, including the credibility and enforcement of the latter (the degree to which firms abide by the rules and comply with regulations). If rules and regulations (or their credibility and enforcement) do not change, there will be no changes in firm behaviour and performance associated with them either. Conversely, changes in rules and regulations (or their credibility and enforcement) can be expected to provoke changes in firm behaviour and performance associated with the evolution in these institutional arrangements.

However, the identification of changes in firm behaviour and performance directly associated with changes in rules and regulations may be difficult as there exists no “pure” empirical evidence of such responses. In fact observed firm performance reflects the combination of numerous intertwined factors, of which institutional interactions and change only constitute a part. Hence, in investigating this type of firm level responses, utmost care must be taken to control for all factors that are not directly related to the institutional environment.

Apart from controlling for this type of “noise” one has to bear in mind the possible heterogeneity in firms’ responses. Thus for example rules and regulations dealing with the market environment (such as competition policy) seek to establish a level playing field not only among the firms competing in one and the same product market but also among firms in different industries. However, the reactions by firms in different market segments may be systematically affected by industry-specific factors. Hence in designing an empirical experiment it is necessary also to control for the possible interference of some industry-specific factors. Moreover, even firms within the same market segments may have different responses, depending on various idiosyncratic characteristics.

Finally, in cross-country comparative assessments (as is our case) we have to take into account that the same or similar rules and regulations (for example those dealing with competition) are applied in a different context and business environment. The observed behaviour and performance of firms in different countries may also reflect the effect of a myriad of other country-specific factors such as macroeconomic situation and prospects, different phase in the business cycle, political situation, etc. Consequently, the same or similar rules and regulations may have a different effect on the behaviour and performance of firms in different countries due to the influence of such country-specific factors. The empirical experiment should also carefully control for these factors; otherwise they may affect and distort the accurateness of the analysis.

A possible empirical methodology that would eliminate some of the technical difficulties outlined above is to apply a two-tier approach:

1) As a first step, we use firm level data for different countries to derive secondary, meso-level (e.g. at the level of NACE sectors) indicators, in which, in view of the arguments outlined above, we seek to eliminate – to the extent possible – the effect of firm-specific, time-varying factors that are not directly related to institutional interactions and change. By contrast, the time-varying, industry specific meso-indicators by design would incorporate the effects of institutional change (such as changing rules and regulations) at the level of the corresponding industries (sectors), averaged over the participating firms.

2) As a second step, we use these meso-level indicators to analyse the effect of institutional interactions and change on their formation and dynamics, in conjunction with other relevant factors. Moreover, if the meso-level indicators for different countries are compiled on the basis of identical methodology, we can also pool them together in order to undertake a cross-country analysis of the effect of institutional interactions and change.

In order to be usable for the purpose of this empirical experiment the meso-level indicators should incorporate both the effect of competitive pressure on the performance of representative firms (as reflected in the sectoral averages) and the effects of institutional change on average firm performance.

3.2 Empirical strategy

Step 1. Computing relevant secondary, meso-level variables

We apply the two-tier approach outlined above for two meso- (sectoral) level variables: average markups by NACE sectors and average productive efficiency by NACE sectors, both computed for different countries. As noted above, we construct these variables so that they incorporate the effects of both competitive pressure and institutional change on average firm performance.

A. Average sectoral markup ratios (annual ratios for individual countries).

We use annual estimates of the average sectoral markups (at NACE-2 level), applying a correction to adjust for the bias induced by non-constant returns to scale, as discussed in the first part of the paper. More specifically, we apply the procedure described in section 2.3 to firm level data for different countries. The main specificity is that in this case we modify the approach in order to compute annual values for the sectoral markup ratios (rather than period averages). The reason is that we shall seek to identify how the combined effect of competitive pressure and institutional change (such as changing rules and regulations) reflects in changes in the markups over time.

In principle, if one assumes that the production technology changes significantly over time, one could apply directly the approach described in section 2.3 to annual data. In this case we would get time variant values for the sectoral returns to scale λ_t. While this is probably a theoretically consistent approach, it suffers from some drawbacks when applied to actual empirical data. Thus, in the presence of economywide shocks in certain years, their effect may distort the estimated values for the sectoral returns to scale λ_t. By contrast, if we estimate the average sectoral returns to scale λ over a period of years, the effect of economywide shocks in certain years can be taken care of by time dummies during the estimation of the production function.

Due to this reason we use a slightly simplified approach based on the assumption that the production technology is relatively stable and the sectoral returns to scale index λ does not change significantly over the period of years that we estimate. In this case we just estimate the sectoral production functions once for the whole period to compute the sectoral returns to scale index λ.

As to the markups, we compute annual sectoral values θ_{it} using the procedure (5) to (9), on the basis of annual firm-level data. We thus compute annual values for B_{it}' from (5) and apply the average sectoral returns to scale index λ_i to the adjust the results for each year, as defined in (9).

This empirical procedure makes it possible to compute country sets of time variant sectoral (say, at the NACE 2-digit level) markup ratios θ_{it}, computed over a period of time. By their construction, these markups incorporate the effects of both competitive pressure and institutional change on average firm performance, as required.

B. Average (sectoral) efficiency level (annual values for individual countries).

The second suggested meso-variable is the average firm efficiency level computed at the sectoral level (for NACE 2-digit sectors) for different countries, annual estimates. These can be computed on the basis of production frontiers, as described below.

The underlying assumption of the production frontier approach (Aigner, Lovell and Schmidt, 1977) is that within a sample of firms, the frontier defines the maximum level of output, which is feasible at the given level of technological efficiency. The production frontier is stochastic and the "distance" from the frontier reflects the relative level of technical efficiency in individual firms:

$$q_j = f(\boldsymbol{X}_j, \boldsymbol{\beta}) \exp(v_j - u_j) \qquad (11)$$

where v_j is assumed to be a normal random variable with zero mean and u_j is an asymmetric non-negative random term which is assumed to be independently distributed (usually with a truncated normal distribution). The term $f(\boldsymbol{X}_j, \boldsymbol{\beta})$ defines the production frontier which reflects the "best practice" within the sample while the last term u_j represents the firm-specific (in)efficiencies vis-à-vis the production frontier.

Variables capturing competitive pressure, institutional interactions and other factors affecting productive efficiency can be incorporated by augmenting the corresponding functions. Thus for example the functional form of the production frontier can be augmented directly, by including additional variables to the main function:

$$q_j = f(\boldsymbol{X}_j, \boldsymbol{\beta}, \boldsymbol{Z}_j, \boldsymbol{\gamma}) \; exp\,(v_j - u_j). \qquad (12)$$

$\boldsymbol{Z}_j$ is a vector of factors that are assumed to determine or affect firm level efficiency (competition related variables and other exogenous factors). In this case they are assumed to determine or affect directly the level of the frontier but not the distance of the firm from this frontier (or inefficiency term) u_j. $\boldsymbol{\gamma}$ is a vector of estimable parameters.

For the purpose of our exercise, we compute and use the average sectoral inefficiency levels, as measured by u_{ij}.

The important detail here is that, in accordance with the theoretical background outlined above, the estimated (in)efficiency levels should only reflect industry-specific and economywide factors (incorporating the effects of competitive pressure and institutional change) but be net of firm-specific factors. To achieve this, we divide the two types of effects (firm-specific and industry-cum-economywide effects) by choosing an appropriate specification of the augmented production frontier. In doing so, by design only one type of effects will go directly into the specification, while the remaining effects will be reflected in the residual inefficiency level.

More specifically, we use an augmented production frontier of the type (12), incorporating only firm-level factors into the vector $\boldsymbol{Z}_j$. That is the vector that directly explains firm efficiency includes only time-varying, firm-specific factors, not directly related to external competitive pressure or institutional change, whereas the effects of the latter will be passed onto the residual (in)efficiency term.

A sample (obviously non exhaustive) list of such variables includes:

MS_{ij} – the firms' market share, within the firm's own market (the firm's share in total sales in the corresponding NACE sector, including imports).

FO_{ij} – a measure of foreign ownership in firm j (the share of foreign capital in the firm's statutory capital) (alternatively, dummy for foreign-controlled firms).

E_{ij} – a measure of the export activity of firm j (the share of exports in the firm's total sales) (alternatively, dummy for "actively exporting" firms).

IA_{ij} – a measure of the investment activity of firm j (the share of fixed investment in a given year to the firm's total fixed assets in the same year) (alternatively, dummy for "actively investing" firms).

D_{ij} – the firm's long-term debt ratio (the share of long-term debt in total assets).

The estimable form of the augmented production frontier, for the case of a three-factor Cobb-Douglas production function of the type specified in equation (4) and the above sample list of augmenting variables will take the form (in logarithms):

$$z_j = a_0 + a_1\, l_j + a_2\, m_j + a_3\, k_i + a_4\, mp_i + a_5\, ms_{ij} + a_6 fo_{ij} + a_7\, e_{ij} + a_8\, ia_{ij} + a_9\, d_{ij} + \varepsilon_j, \qquad (13)$$

where lower case indicates the logarithm of the corresponding variables.

By construction, in this case the effect of industry specific and economywide factors of competitive pressure and institutional change will be incorporated in the measured firm inefficiency level u_{ij}, as required. These inefficiency levels, possessing the necessary properties, will be directly derived in the estimation of the production frontier as specified in (13). As a result of this estimation we obtain time-varying values of the inefficiency levels u_{ijt} for individual firms in individual countries.

To derive average sector-level, time-varying inefficiencies u_{it}, we then compute averages (unweighted or weighted by firm size) by NACE 2-digit sectors. As in the case of the markups, in accordance with the goals of our exercise, we need annual values for the average sectoral inefficiencies u_{it}, in order to analyse how the combined effect of competitive pressure and institutional change is reflected in changes in efficiency over time. For this purpose we either estimate the production frontier by sectors for every year of the available data period, or estimate it for the whole period and use that to "predict" annual values.

The final outcome of this exercise are country sets of time variant sectoral (at the NACE 2-digit level) inefficiency levels u_{it}, computed over a period of time.

Step 2. Cross-country analysis of firms' responses to competitive pressure, institutional interactions and change

In this second step, we shall mix the country data sets in an attempt to analyze the effect of the institutional environment itself on competition-related firm performance.

Let Ω_{it} denote a sectoral level, time-varying meso-variable which is net of firm-level effects. We assume that it reflects, among other things, the effects of industry level competitive pressure and of nationwide competition policy, and, possibly, country-specific, time-variant economywide shocks. In our case Ω_{it} denotes either the sectoral markup ratios θ_{it}, or the sectoral inefficiency levels u_{it}, computed in accordance to the procedures described above at the NACE 2-digit level.

Assume also that we have pooled Ω_{ikt} data for several countries, where k is the country index. In accordance with these conjectures, we could try to identify, in statistical terms, the effects of industry level competitive pressure and of nationwide competition policy by regressing the pooled Ω_{ikt} data on data of these determinants. The estimation results concerning these regressors based on pooled cross-country data can be expected to highlight, and generate new results, concerning both behaviour of institutional agents and competition-related interactions of firms and institutions.

As to the actual variables, for the first set of regressors we can use the time-varying, industry-specific measure of competitive pressure.

A sample list of such variables includes:

MP_{ik} – the import penetration ratio in sector i of country k.

E_{ik} – export ratio in sector i of country k. It is defined as the share of exports in the sector's total sales.

C_{ik} – a measure of the concentration of firms in sector i of country k. It can be defined in various ways as: a) the Herfindhal index measured at different sectoral levels; b) the combined share of the several largest firms in the sector or c) the relative standards deviation of firms' sales in the sector.

F_{ik} – a measure of foreign presence in sector i of country k (the share of foreign-controlled firms in the sector's total sales).

D_{ik} – average long-term debt ratio in sector i of country k. It is defined as the share of total long-term debt in the sector's total assets.

SD_{ik} – sectoral dummy for sector i of country k.

For the second set of regressors, we can use the following:

PT_k – the EBRD indicator on progress in transition in country k (the average overall measure, also compiled on an annual basis by EBRD using identical methodology for all countries). The EBRD index of progress in transition is a composite measure of institutional change and progress in market reforms, and is comprised, *inter alia*, of core indicators such as enterprise governance and restructuring, competition policy, banking reforms and financial markets, progress in privatization, price liberalization. As such a composite measure of institutional change, the EBRD index captures exactly the types of institutional interactions that we seek to investigate.

PE_k – an indicator of policy enforcement indicator in country k. It should reflect the credibility of the enforcement threat with respect to competition policy. This could be defined, e.g. as the share of enforcement decisions taken by the National Body for the protection of competition in a particular year relative to the number of cases brought to it in that year.

We shall also include time dummies for years (TD_t) and country dummies (CD_k) in the specification; alternatively, we can use country-specific time dummies (TD_{tk}).

Accordingly, we estimate the following equation (the time subscript is omitted):

$$\Omega_{ik} = a_0 + a_1 MP_{ik} + a_2 E_{ik} + a_3 C_{ik} + a_4 F_{ik} + a_5 D_{ik} + a_6 PT_k + a_7 PE_k + a_8 TD_k + a_9 CD_k + \varepsilon_i \quad (14)$$

The specification can be enriched further by including interaction variables. Obvious candidate for interacting are the sectoral and country dummy(s). As in the previous case, we could interact the sectoral dummies with all, of some of the, variables of competitive pressure. In this way, we could differentiate the effect of competitive pressure on firm-level efficiency across sectors. In addition, we could interact the country dummies with the time dummy, with all or some of the country-specific variables and with all or some of the sector-specific variables.

3.2 Results

The model specified above was estimated on empirical data for Bulgaria and Hungary. For the source data we use the same enterprise datasets as described in section 2. The Bulgarian dataset contains enterprise balance sheets for all manufacturing firms that use the double entry accounting method and report to the National Statistical Institute (NSI) period 1994-2001 (covers micro firms with less than 10 employees). The Hungarian dataset is based on balance sheet information and covers manufacturing firms employing at least 10 people.

The empirical procedure contains two steps. In the first step we estimate the two sectoral level variables: the average markups by NACE sectors and the average productive efficiency by NACE sectors for the two countries. For the same time periods we also compute the values of the relevant regressors as specified above. Due to data constraints, we had to exclude from the empirical testing some of the variables described in the theoretical specification (14). In table 5 we report the corresponding descriptive statistics for the model variables for the two countries.

(Table 5 here)

In this second step, we pool the data for the two countries and perform panel regressions of the cross-country model separately for the two sectoral level variables. Given the limited number of countries, and the absence of lagged dependent variables in the specification, we used OLS techniques on pooled data rather than panel estimation techniques proper. In tables 6 and 7 we report some of the estimation results for the technical efficiency equation and for the markup equation, accordingly.

These estimation results highlight some of the important determinants and driving mechanisms of firm's adjustment to competitive pressure, institutional interactions and change in a cross-country perspective. Moreover, the two different equations that we use to analyze these adjustments suggest important differences in the driving factors of the two variables.

(Table 6 here)

First, the effect of competitive pressure, institutional interactions and change on technical efficiency (table 6). The theoretical literature generally maintains that when markets are imperfect, higher competitive pressure enhance productive efficiency, through different channels (see, e.g. Nickell, 1996 and Djankov and Murrell, 2002). One of these channels is x-efficiency gains associated with competitive pressure. When competitive pressure is low, managerial and worker effort if undersupplied which shifts the firm's production schedule away from the production frontier expressing the maximum amount of output obtainable with a given technology from a given mix of input quantities. Competitive pressure increases incentives for better performance, including through the threat of exit. Higher efficiency in individual firms will then translate into higher productivity within the whole industry. Another strand in the literature asserts that high competition within an industry brings about high overall productivity due to rationalization of the industry entailing reallocation of resources across firms: when firms compete for market share, resources move from less efficient to more efficient firms which grow faster and increase their market share.

At the same time, it can be pointed out that empirical research does not fully support these conjectures. Thus Carlin, Schaffer and Seabright (2004) and Carlin, Fries, Schaffer and Seabright (2001) find evidence that firms in the transition economies may still be not fully prepared to face the full power of transboundary competitive pressure: due to the weakness of local firms too strong a competitive pressure may even possibly have a destructive impact on local markets (drain on firm performance). They also emphasize the danger of the incidence of unchallenged monopoly of single firms in these nascent markets.

Our results, which also incorporate the effects of institutional interactions and change, are more or less in line with the theoretical arguments with respect to the direction of the effect of competitive pressure on industry level efficiency but at the same time highlight some specificities. We use two different indicators of market concentration to represent competitive pressure: the Herfindhal index of concentration by NACE 2-digit and the share of the three largest firms by NACE 2-digit sectors. These reflect different facets of market concentration: the Herfindhal index is based on the whole family of firms within a sector and measures overall concentration, whereas the second one is an indicators of the level of monopolization or oligopolization of the market. Thus, in line with theory, one would expect positive coefficients for the first variable and negative for the second one. The results presented in the first column of table 6 are in line with the theoretical arguments outlined above: they indicate a strong positive statistical association between overall market concentration (which also stands for higher overall competitive pressure) and technical efficiency. At the same time, the results in the second column of the table show that there is no statistically significant association between monopolization/oligopolization and technical efficiency.

The coefficients on the variable measuring the level of foreign control of the markets are positive but weakly statistically significant. This confirms that the degree of foreign penetration in the ownership structure is generally associated with higher efficiency; however at the level of average sectoral indicators this links is not strongly manifested.

Two of the regressors, the import penetration ratio and the debt ratio, were systematically estimated with negative coefficients and these coefficients are always statistically significant. The first result is in fact at odds with the theoretical argument: the higher import penetration signifies more competition on local markets exercised by foreign competitors and, according to theory, that should translate into higher efficiency. At the same time, this result is consistent with the results with the empirical studies quoted above (Carlin, Schaffer and Seabright, 2004, and Carlin, Fries, Schaffer and Seabright, 2001), which argue that due to the weakness of local firms too strong a competitive pressure (in this case from foreign firms) may act as a drain on local firm performance. As to the debt ratio, we consider that this indicator mirrors financial pressure on heavily indebted firms and, possibly, the incidence of soft budget constraints reducing competitive pressure. Thus the negative coefficient of the debt ratio is in line with the prior.

The estimated coefficients of the EBRD index of "progress in transition", which is a composite measure of institutional change and progress in market reforms, were not statistically significant. One possible interpretation of this somewhat puzzling outcome is that the institutional environment in these countries is still immature and the policy and institutional changes that are being introduced nominally do not actually translate into motivational driving forces for the firms. It may also be a sign of weak enforcement of policy and regulation by the public bodies and other regulatory institutions entrusted with the implementation of policy and regulation.

Second, the effect of competitive pressure, institutional interactions and change on average sectoral markup ratios (table 7). In this table we present the results for two versions of the markup model: based on the unadjusted values of the estimated markup ratios (the first two columns) and based on their adjusted values (the last two columns). Our priors are that the higher the level of competitive pressure, the lower the chances for firms to extract rents through monopolistic pricing (higher markup ratios). Institutional interactions and market reforms should facilitate the working of these mechanisms.

(Table 7 here)

In general, the estimation results indicate that the explanatory power of the model is not very strong suggesting that there are also other factors that play a role for the shaping of the firms' pricing policy. In any case, the coefficients of two of the explanatory variables were estimated to be strongly statistically associated with the markup ratios: the intensity of export activity of the firms – the export ratio (in the case of adjusted markups), and the level of monopolization or oligopolization of the market (the share of the three largest firms by NACE 2-digit sectors). The coefficients of both these variables are positive which in the case of the concentration variable is fully in line with the prior: the higher the degree of monopolization or oligopolization of the market, the more likely it is that the firms occupying such a dominant position would tend to extract monopolistic rents through higher prices. The fact that the export ratio is also estimated with a positive coefficient could have a dual interpretation. In the first place, it can be interpreted in terms of the existing global market imperfections which prevent trans-boundary marginal cost equalization in the international markets even if prices do equalize. In this case firms that are competitive in terms of quality but originating in low-cost countries enjoy higher monopolistic markups over marginal costs compared to their competitors originating in high-cost countries. Secondly, this outcome can be interpreted in terms of quality differentials. At a given level of marginal costs, exporting firms are capable of producing goods of superior quality compared to their counterparts that can only sell on the domestic market and this quality differential is reflected in higher markup ratios.

Both the import penetration ratio and the Herfindhal index were always estimated with negative coefficients (in line with the priors) but their coefficients are not statistically significant. In the case of the variables of foreign participation and indebtedness the signs of the coefficients varied in different estimations and the coefficients are not statistically significant.

Finally, as in the first equation, the estimated coefficients of the EBRD index of “progress in transition” were not statistically significant. The interpretation of this outcome should be the same as the one suggested above.

6. Conclusions and policy implications

Within the COMPPRESS project, WP1 focuses on the effect of the growing competitive pressure faced by firms in the new EU members and acceding countries from Central and Eastern Europe on their behaviour and performance. In this final, third stage of our research we take a more in-depth look on two important aspects of enterprise adjustment: 1) the changes in firm’s pricing behaviour against the background of a combination of growing competitive pressure and immature markets that are still marred by numerous imperfections; 2) the firms’ responses to a combination of growing competitive pressure and institutional interactions and change. The empirical results presented in this report develop further our research in this area highlighting the specificities of the ongoing restructuring of the corporate sectors in the emerging market economies of Central and Eastern Europe.

In the first part of the report devoted to the effect of competitive pressure in imperfect markets and the effect of market imperfections on firms’ pricing behaviour and performance we discuss the relationship between price markups and returns to scale in imperfect markets and the implications of this relationship for the empirical estimation of these two parameters.

We propose an approach for the empirical estimation of markup ratios with an adjustment for the case of non-constant returns to scale. The idea of this approach is first to determine the average returns to scale index for a group of firms and then to use it in order to make an adjustment to the markup ratio for the same category of firms.

The suggested approach was tested on balance sheet data for Bulgarian and Hungarian manufacturing firms. The use of identical methodology allows us to produce fully comparable results for the two countries. Using the suggested approach, we estimate for both countries sectoral markups and returns to scale indexes with and without the adjustment for non-constant returns.

We show that adjusting for non-constant returns to scale is essential in the presence of considerable market distortions, as is the case in these transition economies. The application of standard procedures for estimating average price markups based on the assumption of constant returns to scale may lead to serious biases. This may occur if the markup is estimated for a group of firms, which is heterogeneous with respect to the actual returns to scale index at which different firms operate. In particular, we find in our empirical analysis that small manufacturing firms tend to operate with decreasing returns to scale. Ignoring this fact in the estimation of their markup ratios will result in a considerable upward measurement bias in their estimated price markups. Moreover, this will also be the case when markups are estimated for groups of firms, which lump together small and larger firms. One of the general practical conclusions of our exercise is that empirical research in this area should devote special attention to the relationship between returns to scale and price markups and the related implications.

We also analyse empirically the relationship between returns to scale and their price markups. We find the existence of a strong positive correlation between the estimated sectoral returns to scale and price markups indices, which is in line with the theoretical prior. The importance of correcting markup estimates by the returns to scale factor is highlighted by the fact that this positive relationship is not observable for the unadjusted markups. The proposed correction in the markups helps to restore this theoretically important relationship.

We found a characteristic difference between the returns to scale estimates for the two economies, which corresponds to our prior knowledge on the transition path the two countries took. On average, returns to scale in Hungarian manufacturing sectors were found to be higher than those in Bulgaria; besides, Bulgarian manufacturing firms were found to operate at decreasing returns to scale much more often than Hungarian firms, which typically operated at increasing returns to scale. These outcomes are consistent with the fact that

Hungary is more advanced in the process of establishing a functioning market economy. This result reinforces our previous finding that the actual enterprise responses to competitive pressure may differ in the stages of economic transformation in these countries. Indeed, the in-depth empirical analysis based on micro data is a valuable (and probably remains unique) source of information in investigating these specificities of the adjustment process in these emerging market economies.

While the differences in average markup estimates are negligible, the sectoral structures of markup ratios are very different, reflecting differences in the market structure of the two economies. This means that after the strongly concentrated socialist market structures were dismantled through liberalisation and corporate restructuring in the early phases of transition, the subsequent evolution of concentration and market power in the two countries followed different paths. Note that we apply identical methodology to firm level data for two countries with some important differences in the market conditions, and come up with qualitatively similar empirical results. We consider this as further evidence of the robustness of the results and of the conclusions that we draw from them.

In the second part of the report we develop a methodology for cross-country analysis of firms' responses to competitive pressure, institutional interactions and change and apply this methodology to empirical data for the countries concerned. The proposed methodology is a two-step approach: in the first step, we derive meso-level, sectoral indicators, in which we eliminate the effect of firm-specific, time-varying factors that are not directly related to institutional interactions and change; in the second step, we use these meso-level indicators for a cross-country analysis of the firms' responses to competitive pressure, institutional interactions and change, in conjunction with other relevant factors. We apply this two-tier approach for two meso- (sectoral) level variables: the average markups by NACE sectors and the average productive efficiency by NACE sectors computed for different countries.

The estimation results based on firm-level data for two countries, Bulgaria and Hungary, make it possible to gain further insights into the effects of competitive pressure on firm behaviour and performance and highlight some of its transmission mechanisms, taking into account institutional interactions and change.

Most of our empirical results are consistent with the theoretical priors. Thus our results presented indicate a strong positive statistical association between higher overall competitive pressure in the corresponding market and the average technical efficiency of the firms operating in this market. We also find that a higher degree of monopolization or oligopolization of the market is associated with higher markup ratios, suggesting that firms with a dominant position are more likely to extract rents through higher monopolistic prices. The degree of foreign penetration in the local ownership structure is generally associated with higher average efficiency in these sectors. In turn, financial pressure (related to high indebtedness and, possibly, soft budget constraints reducing competitive pressure) tends to be negatively associated with firm efficiency.

At the same time some of our findings suggest that excessive competition on the local markets can be detrimental to the domestic firms of these immature market economies, possibly due to the weakness of local firms to withstand competitive pressure. This is especially the case with competitive pressure generated by high import penetration in the domestic markets. Our empirical results indicate some destructive effect of excessive import penetration: it tends to be associated with lower average productive efficiency of domestic firms in the same sector.

Finally, we did not find a statistically significant association between the indicator of institutional change and progress in market reforms used in the model (the EBRD index of "progress in transition") and the meso-level variables measuring firms' responses. On the one hand, this outcome may suggest that the policy and institutional changes that are being introduced nominally do not actually translate into motivational driving forces for the firms. It may also be a sign of weak enforcement of policy and regulation by the public bodies and other regulatory institutions entrusted with the implementation of policy and regulation. On the other hand, this outcome may be due to impreciseness in our data, calling for further research into the refinement of the methodology and its empirical application.

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Table 1. Estimation results for production functions and markup equations for Bulgarian manufacturing sectors (panel estimations, 1995-2001)

Dependent variable in production function (eq. (4)): total revenue (net sales); estimation in logarithms of levels.
Markup equation: Roeger type estimation of the Lerner index.
Estimation methods: instrumental variables and random effects for the production function (G2SLS); OLS for the markup equation.

NACE 2-digit sectors	Estimated production function								Estimated markup equation (constant RS)		Markup adjusted for non-constant RS	
	Const A_0	Time *T*	*L*	*M*	*K*	R^2	N obs.	Returns to scale λ	Markup *θ*	R^2	Markup *θ*	% bias
15 Food products and beverages	1.051	0.001	0.012	0.878 ***	0.049 ***	0.960	5861	0.939 ***	1.306 ***	0.502	1.226	6.5
16 Tobacco products	6.099 *	-0.029	0.236	0.571 ***	0.139 ***	0.959	149	0.946	1.337 ***	0.572	1.265	5.7
17 Textiles	-1.494	0.032 ***	0.053	0.854 ***	0.022	0.974	933	0.930 ***	1.252 ***	0.470	1.164	7.6
18 Wearing apparel, fur	2.849 ***	-0.008	0.216 ***	0.676 ***	0.083 ***	0.951	2766	0.975 *	1.261 ***	0.481	1.230	2.5
19 Leather, luggage and footwear	1.598	0.000	0.109 ***	0.821 ***	0.040	0.964	590	0.970 *	1.234 ***	0.489	1.196	3.1
20 Wood and wood products except furniture	-0.616	0.024 ***	0.100 ***	0.797 ***	0.039 **	0.954	1214	0.936 ***	1.227 ***	0.401	1.148	6.9
21 Pulp, paper and paper products	-5.183	0.063 **	0.044	0.930 ***	0.014	0.972	540	0.987	1.243 ***	0.462	1.227	1.3
22 Publishing, printing, recorded media	15.570 ***	-0.139 ***	0.188 ***	0.645 ***	0.109 ***	0.945	1334	0.942 ***	1.252 ***	0.475	1.180	6.1
23 Coke, refined petroleum and nuclear fuel	13.578 ***	-0.115 ***	0.201	0.731 ***	0.024	0.993	30	0.957	1.280 ***	0.641	1.224	4.5
24 Chemicals	4.576 ***	-0.030 ***	0.073	0.773 ***	0.090 ***	0.981	1004	0.936 ***	1.265 ***	0.478	1.184	6.8
25 Rubber and plastic products	-0.233	0.017	0.054	0.851 ***	0.041	0.961	1144	0.947 ***	1.315 ***	0.488	1.245	5.6
26 Other non-metallic mineral products	5.233 ***	-0.040 ***	0.058	0.839 ***	0.051 ***	0.977	985	0.949 ***	1.218 ***	0.460	1.156	5.4
27 Basic metals	-0.717	0.023 ***	0.077 *	0.854 ***	0.033	0.983	396	0.964 ***	1.262 ***	0.476	1.216	3.8
28 Fabricated metal products exc. machinery	3.552 ***	-0.018 ***	0.119 ***	0.747 ***	0.080 ***	0.949	2060	0.946 ***	1.229 ***	0.419	1.162	5.7
29 Machinery and equipment n.e.c.	1.553 **	-0.002	0.099 ***	0.838 ***	0.047 ***	0.963	2428	0.984	1.230 ***	0.460	1.210	1.6
30 Office machinery and computers	-3.599	0.074 ***	0.327 ***	0.554 ***	0.032	0.940	187	0.913 ***	1.237 ***	0.367	1.129	9.5
31 Electrical machinery and apparatus n.e.c.	2.123 *	-0.007	0.035	0.836 ***	0.070 ***	0.963	912	0.941 ***	1.237 ***	0.409	1.164	6.3
32 Radio, television and communication	5.768 ***	-0.039 **	0.091	0.705 ***	0.143 ***	0.941	267	0.939 *	1.224 ***	0.379	1.149	6.5
33 Medical, precision and optical instruments	4.910 ***	-0.023 **	0.168 ***	0.633 ***	0.102 ***	0.927	516	0.903 ***	1.243 ***	0.399	1.122	10.7
34 Motor vehicles, trailers and semi-trailers	3.435 **	-0.024 *	0.129	0.797 ***	0.090 ***	0.973	217	1.016	1.255 ***	0.441	1.276	-1.6
35 Other transport equipment	0.804	0.009	0.153 **	0.782 ***	0.053	0.981	199	0.989	1.164 ***	0.487	1.151	1.1
36 Furniture; manufacturing n.e.c.	0.263	0.019 **	0.170 ***	0.711 ***	0.071 ***	0.959	1295	0.951 ***	1.226 ***	0.464	1.166	5.1
MAPE												5.2

Notes:
(i) The symbols *, ** and *** refer to significance levels of 10%, 5% and 1%, respectively.
(ii) The hypotheses regarding returns to scale are as follows: H0: λ=1; markup: H0: θ=1.
(iii) Time dummies (not reported in this table) were also included in the estimation of the production function.
(iv) The reported % measurement bias is calculated as the % difference between the estimated and adjusted values of the price markups.
(v) The abbreviation "n.e.c." stands for "not elsewhere classified" and the abbreviation "MAPE" stands for "mean absolute percentage error".

Table 2. Estimation results for production functions and markup equations for Hungarian manufacturing sectors (panel estimations, 1995-2001)

Dependent variable in production function (eq. (4)): total revenue (net sales); estimation in logarithms of levels.
Markup equation: Roeger type estimation of the Lerner index.
Estimation methods: instrumental variables and random effects for the production function (G2SLS); OLS for the markup equation.

NACE 2-digit sectors	Estimated production function								Estimated markup equation (constant RS)		Markup adjusted for non-constant RS	
	Const A_0	Time T	L	M	K	R^2	N obs.	Returns to scale λ	Markup θ	R^2	Markup θ	% bias
15 Food products and beverages	-0.221	0.003 **	0.054 *	0.992 ***	-0.022 **	0.984	5218	1.024 ***	1.083 ***	0.120	1.109	-2.3
16 Tobacco products	-4.156 *	0.043 **	0.318 **	0.616 ***	0.194 ***	0.992	44	1.129 *	1.319 ***	0.630	1.489	-11.4
17 Textiles	0.640	-0.001	0.393 ***	0.437 ***	0.139 ***	0.934	1355	0.969 **	1.176 ***	0.190	1.140	3.2
18 Wearing apparel, fur	1.092 ***	-0.008 ***	0.208 ***	0.888 ***	-0.016	0.911	2606	1.081 ***	1.137 ***	0.210	1.229	-7.5
19 Leather, luggage and footwear	1.322 ***	-0.012 ***	0.346 ***	0.711 ***	0.012	0.919	1055	1.069 ***	1.117 ***	0.170	1.194	-6.4
20 Wood and wood products except furniture	0.635 **	-0.004	0.068	0.942 ***	0.024	0.973	1579	1.034 ***	1.113 ***	0.140	1.150	-3.3
21 Pulp, paper and paper products	-0.024	0.004	0.100 **	0.874 ***	0.038 **	0.986	463	1.013	1.228 ***	0.540	1.243	-1.2
22 Publishing, printing, recorded media	0.791 ***	-0.005 **	0.060 **	0.934 ***	0.028 ***	0.972	1904	1.022 **	1.139 ***	0.330	1.164	-2.2
23 Coke, refined petroleum and nuclear fuel	4.197 ***	-0.046 ***	0.169	1.008 ***	-0.094	0.999	16	1.084	1.162 ***	0.880	1.260	-7.7
24 Chemicals	1.427 ***	-0.009 ***	0.203 ***	0.685 ***	0.118 ***	0.978	1004	1.006	1.232 ***	0.370	1.240	-0.6
25 Rubber and plastic products	0.246	0.003	0.149 ***	0.783 ***	0.066 ***	0.979	1813	0.999	1.161 ***	0.330	1.160	0.1
26 Other non-metallic mineral products	0.237	0.000	0.165 ***	0.862 ***	0.022	0.976	1339	1.049 ***	1.317 ***	0.550	1.381	-4.7
27 Basic metals	-0.392	0.008 *	0.233 ***	0.751 ***	0.045	0.987	564	1.029 **	1.112 ***	0.240	1.144	-2.8
28 Fabricated metal products exc. machinery	0.047	0.003	0.162 ***	0.853 ***	0.020	0.964	4270	1.035 ***	1.177 ***	0.310	1.219	-3.4
29 Machinery and equipment n.e.c.	0.983 ***	-0.007 ***	0.087 ***	0.969 ***	-0.015	0.960	3139	1.042 ***	1.141 ***	0.290	1.189	-4.0
30 Office machinery and computers	-0.452	0.009	0.051	0.942 ***	0.009	0.983	148	1.002	1.336 ***	0.340	1.338	-0.2
31 Electrical machinery and apparatus n.e.c.	-0.041	0.006	0.156 ***	0.837 ***	0.022	0.976	1254	1.016	1.221 ***	0.320	1.240	-1.6
32 Radio, television and communication	0.364	0.001	0.201 ***	0.821 ***	0.008	0.967	773	1.031 **	1.234 ***	0.220	1.272	-3.0
33 Medical, precision and optical instruments	1.995 ***	-0.016 ***	0.148 ***	0.894 ***	0.006	0.950	908	1.048 ***	1.222 ***	0.340	1.280	-4.6
34 Motor vehicles, trailers and semi-trailers	0.718 *	-0.004	0.128 ***	0.871 ***	0.028 *	0.988	650	1.027 **	1.168 ***	0.270	1.199	-2.6
35 Other transport equipment	0.407	0.002	0.174 *	0.741 ***	0.054	0.982	210	0.969 *	1.130 ***	0.350	1.095	3.2
36 Furniture; manufacturing n.e.c.	0.696 **	-0.004	0.183 ***	0.801 ***	0.038 *	0.967	1502	1.022	1.145 ***	0.220	1.170	-2.2
37 Recycling	1.888	-0.023	0.063	1.133 ***	-0.101 *	0.954	112	1.095 *	1.033 **	0.220	1.131	-8.7
MAPE												3.8

Notes:
(i) The symbols *, ** and *** refer to significance levels of 10%, 5% and 1%, respectively.
(ii) The hypotheses regarding returns to scale are as follows: H0: $\lambda=1$; markup: H0: $\theta=1$.
(iii) Time dummies (not reported in this table) were also included in the estimation of the production function.
(iv) The reported % measurement bias is calculated as the % difference between the estimated and adjusted values of the price markups.
(v) The abbreviation “n.e.c.” stands for “not elsewhere classified” and the abbreviation “MAPE” stands for “mean absolute percentage error”.

Table 3. Returns to scale and price markups (estimated and corrected) for Bulgarian manufacturing firms grouped by size

NACE 2-digit sectors	Firms with less than 20 employees				Firms with more than 20 but less than 200 employees				Firms with more than 200 employees			
	Returns to scale (RS)	Estimated markup	Markup adjusted for RS	% bias	Returns to scale (RS)	Estimated markup	Markup adjusted for RS	% bias	Returns to scale (RS)	Estimated markup	Markup adjusted for RS	% bias
15	0.884	1.359	1.201	13.1	0.989	1.259	1.246	1.1	0.997	1.268	1.264	0.3
16					0.926	1.362	1.262	7.9	0.879	1.300	1.143	13.7
17	0.768	1.407	1.080	30.3	0.966	1.187	1.147	3.5	0.969	1.172	1.135	3.2
18	0.949	1.410	1.338	5.4	0.955	1.224	1.169	4.7	1.060	1.149	1.217	-5.6
19	0.863	1.378	1.189	15.9	1.019	1.177	1.199	-1.8	0.996	1.157	1.153	0.4
20	0.847	1.283	1.087	18.0	1.006	1.129	1.136	-0.6	0.811	1.161	0.941	23.4
21	0.900	1.281	1.153	11.1	1.019	1.233	1.257	-1.9	0.956	1.110	1.061	4.6
22	0.871	1.268	1.105	14.8	1.014	1.214	1.231	-1.4	0.959	1.219	1.169	4.2
24	0.839	1.361	1.142	19.1	0.953	1.158	1.103	5.0	1.043	1.235	1.288	-4.1
25	0.832	1.378	1.146	20.2	1.011	1.215	1.228	-1.0	0.952	1.149	1.094	5.0
26	0.868	1.349	1.171	15.2	1.000	1.141	1.140	0.0	0.975	1.185	1.156	2.5
27	0.806	1.333	1.074	24.1	0.887	1.255	1.113	12.8	1.001	1.105	1.106	-0.1
28	0.872	1.262	1.100	14.7	1.001	1.177	1.178	-0.1	1.028	1.194	1.228	-2.7
29	0.962	1.284	1.235	4.0	0.999	1.193	1.192	0.1	1.049	1.157	1.213	-4.6
30	0.897	1.338	1.201	11.4	0.953	1.125	1.072	4.9	1.032	1.088	1.123	-3.1
31	0.822	1.315	1.081	21.7	1.009	1.143	1.153	-0.9	0.955	1.161	1.109	4.7
32	0.970	1.242	1.204	3.1	1.034	1.200	1.241	-3.3	0.858	1.177	1.010	16.6
33	0.875	1.305	1.142	14.3	0.951	1.125	1.070	5.2	0.936	1.108	1.037	6.8
34	0.884	1.279	1.130	13.2	1.028	1.255	1.291	-2.8	0.996	1.155	1.151	0.4
35	1.037	1.207	1.251	-3.5	1.159	1.130	1.309	-13.7	1.124	1.123	1.262	-11.0
36	0.883	1.289	1.138	13.3	1.008	1.172	1.181	-0.8	0.963	1.160	1.117	3.9
MAPE				14.3				3.5				5.8

Notes:
(i) The reported % measurement bias is calculated as the % difference between the estimated and adjusted values of the price markups.
(ii) The abbreviation “MAPE” stands for “mean absolute percentage error”.

Table 4. Returns to scale and price markups (estimated and corrected) for Hungarian manufacturing firms grouped by size

NACE 2-digit sectors	Firms with less than 20 employees				Firms with more than 20 but less than 200 employees				Firms with more than 200 employees			
	Returns to scale (RS)	Estimated markup	Markup adjusted for RS	% bias	Returns to scale (RS)	Estimated markup	Markup adjusted for RS	% bias	Returns to scale (RS)	Estimated markup	Markup adjusted for RS	% bias
15	1.043	1.094	1.141	-4.1	1.012	1.081	1.094	-1.2	0.974	1.094	1.066	2.7
16									1.521	1.277	1.942	-34.2
17	0.981	1.597	1.567	1.9	0.980	1.152	1.129	2.0	1.014	1.063	1.078	-1.4
18	1.257	1.128	1.418	-20.4	1.078	1.135	1.224	-7.3	0.993	1.127	1.119	0.7
19	0.884	1.268	1.121	13.1	1.067	1.119	1.194	-6.3	0.977	1.146	1.119	2.4
20	1.011	1.060	1.072	-1.1	1.022	1.105	1.129	-2.1	1.005	1.137	1.142	-0.5
21	0.907	1.165	1.057	10.2	1.017	1.219	1.239	-1.6	1.031	1.292	1.332	-3.0
22	1.056	1.167	1.232	-5.3	0.994	1.127	1.121	0.6	1.023	1.119	1.145	-2.3
24	1.201	1.171	1.407	-16.7	1.017	1.170	1.190	-1.7	1.042	1.059	1.103	-4.0
25	0.971	1.080	1.048	3.0	1.057	1.184	1.252	-5.4	0.967	1.122	1.085	3.4
26	0.989	1.133	1.121	1.1	1.069	1.250	1.336	-6.4	1.075	1.404	1.509	-7.0
27	1.018	1.186	1.207	-1.7	1.035	1.159	1.199	-3.4	0.984	1.098	1.081	1.6
28	0.986	1.186	1.170	1.4	1.045	1.167	1.219	-4.3	0.975	1.339	1.305	2.6
29	1.124	1.154	1.297	-11.0	1.015	1.167	1.184	-1.4	0.986	1.124	1.109	1.4
30	1.026	1.211	1.243	-2.5	1.039	1.123	1.167	-3.7				
31	1.035	1.267	1.311	-3.4	0.957	1.206	1.155	4.4	0.992	1.266	1.256	0.8
32	1.018	1.170	1.191	-1.8	1.030	1.269	1.307	-2.9	0.952	1.390	1.324	5.0
33	1.017	1.223	1.244	-1.7	1.057	1.226	1.296	-5.4	0.800	1.191	0.953	24.9
34	1.053	1.221	1.285	-5.0	1.021	1.256	1.283	-2.1	0.988	1.180	1.165	1.2
35	1.076	0.954	1.027	-7.1	0.914	1.128	1.031	9.4	1.083	1.101	1.192	-7.6
36	0.983	1.085	1.067	1.7	1.104	1.176	1.298	-9.4	1.036	1.097	1.137	-3.5
37	0.867	1.052	0.912	15.4	1.098	1.027	1.127	-8.9				
MAPE				6.2				4.3				5.5

Notes:
(i) The reported % measurement bias is calculated as the % difference between the estimated and adjusted values of the price markups.
(ii) The abbreviation "MAPE" stands for "mean absolute percentage error".

Table 5. Descriptive statistics for the model variables of the cross-country model

Variable	*Bulgaria*			*Hungary*		
	N obs	Mean	St.dev.	N obs	Mean	St.dev.
Mean efficiency level	147	0.798	0.053	78	0.781	0.093
Average markup ratio (unadjusted)	159	1.314	0.573	145	1.178	0.120
Average markup ratio (adjusted)	154	1.240	0.325	145	1.185	0.117
Import penetration ratio, %	159	0.211	0.250	67	0.478	0.238
Export ratio, %	159	0.239	0.180	161	0.418	0.227
Herfindhal index by NACE 2-digit sectors	159	0.121	0.169	161	0.304	0.212
Share of three largest firms by NACE 2-digit sectors, %	159	0.049	0.114	161	0.396	0.091
Share of foreign-controlled firms in total sales (NACE2), %	159	0.117	0.146	161	0.539	0.170
Share of long-term debt in the firms' total assets (NACE2), %	159	0.167	0.132	161	0.233	0.113

Table 6. Estimation results (OLS) for the equation of the technical efficiency level, pooled data for Bulgaria and Hungary

Variable		
Period	1995-2002	1995-2002
No. observations	181	181
Constant	0.794 ***	0.878 ***
	(9.95)	(7.35)
Import penetration ratio	-0.089 ***	-0.081 ***
	(-5.87)	(-4.95)
Herfindhal index by NACE 2-digit sectors	0.167 ***	
	(4.10)	
Share of three largest firms by NACE 2-digit sectors		-0.003
		(-0.04)
Share of foreign-controlled firms in total sales (by NACE 2-digit sectors)	0.052 *	0.061 *
	(1.62)	(1.71)
Share of long-term debt in the firms' total assets (by NACE 2-digit sectors)	-0.120 ***	-0.121 ***
	(-3.57)	(-3.44)
EBRD index of "progress in transition"	0.004	-0.011
	(0.17)	(-0.41)
Country dummy	0.011	-0.019
	(0.61)	(-0.30)
R2	0.273	0.203
Root MSE	0.048	0.050

Notes:
(i) The symbols *, ** and *** refer to significance levels of 10%, 5% and 1%, respectively.

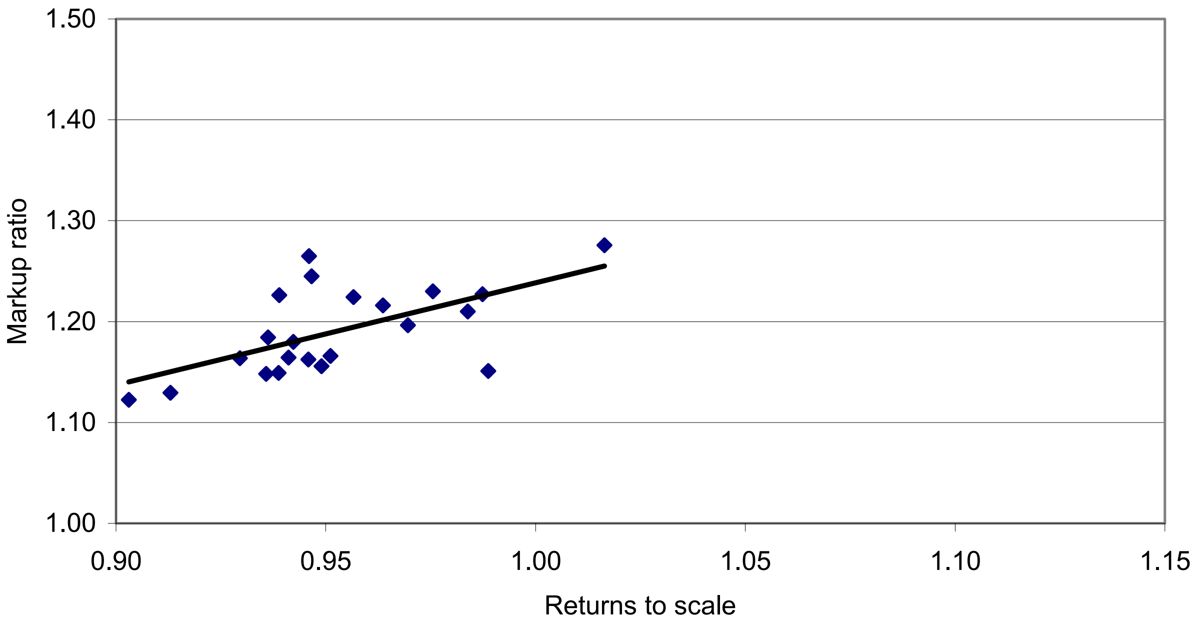
Table 7. Estimation results (OLS) for the markup equation, pooled data for Bulgaria and Hungary

	Markups not adjusted for returns to scale		Markups adjusted for returns to scale	
Period	1995-2002	1995-2002	1995-2002	1995-2002
No. observations	219	219	214	214
Constant	1.847 ***	0.923	1.060 ***	0.372
	(2.65)	(1.22)	(2.56)	(0.76)
Import penetration ratio	-0.013	-0.022	-0.021	-0.048
	(-0.09)	(-0.15)	(-0.24)	(-0.57)
Export ratio	0.180	0.166	0.272 ***	0.237 **
	(0.94)	(0.89)	(2.48)	(2.17)
Herfindhal index by NACE 2-digit	-0.046		-0.067	
	(-0.23)		(-0.52)	
Share of three largest firms by NACE 2-digit sectors		0.886 ***		0.565 **
		(2.79)		(2.32)
Share of foreign-controlled firms in total sales (by NACE 2-digit sectors)	0.046	0.025	-0.020	-0.076
	(0.17)	(0.10)	(-0.13)	(-.50)
Share of long-term debt in the firms' total assets (by NACE 2-digit sectors)	0.048	-0.056	0.084	0.050
	(0.17)	(-0.20)	(0.46)	(0.28)
EBRD index of "progress in transition"	-0.216	-0.172	-0.011	0.075
	(-1.00)	(-0.81)	(0.09)	(0.59)
Country dummy	0.022	0.800 ***	0.084	0.590 ***
	(0.15)	(2.56)	(0.96)	(2.57)
R2	0.022	0.056	0.039	0.062
Root MSE	0.500	0.491	0.284	0.280

Notes:
(i) The symbols *, ** and *** refer to significance levels of 10%, 5% and 1%, respectively.

Figure 1. Returns to scale and markup ratios by NACE-2 digit manufacturing sectors

A. Bulgaria



B. Hungary

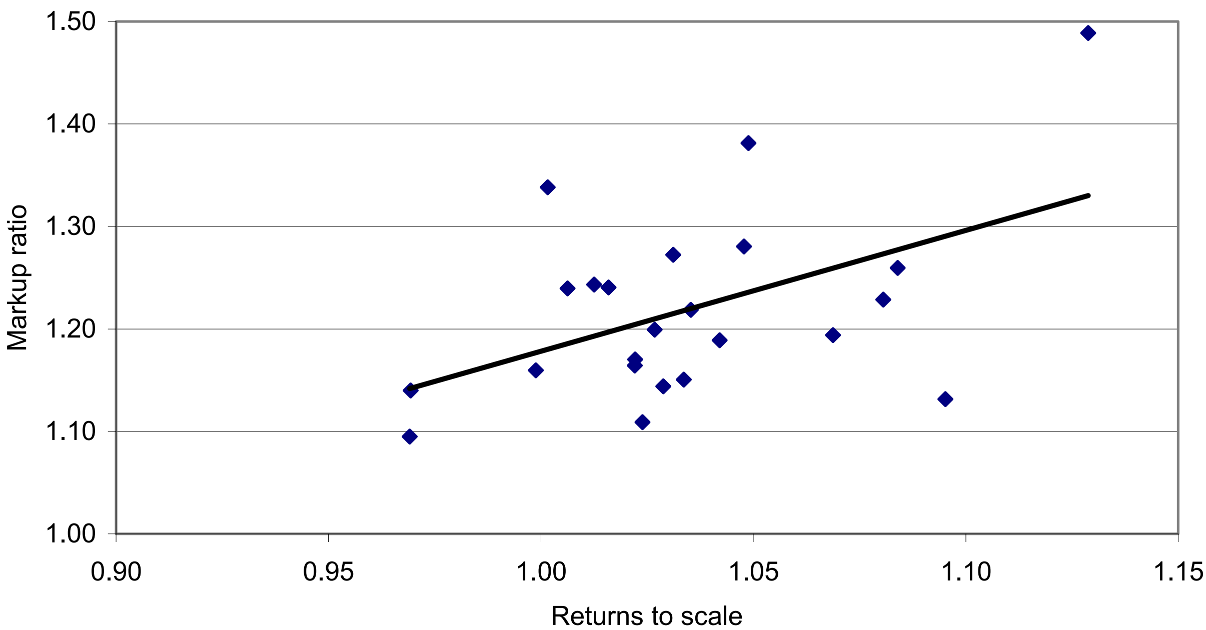
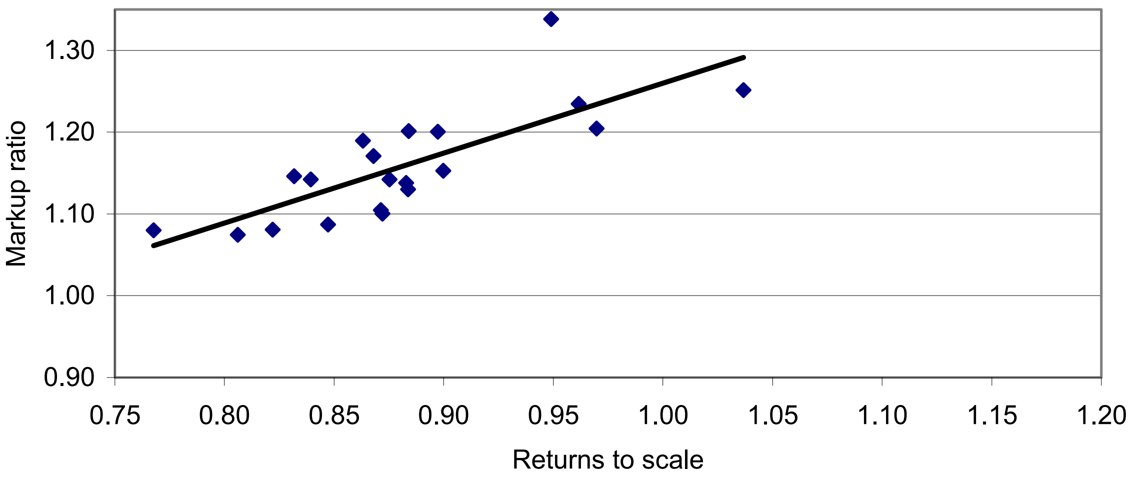
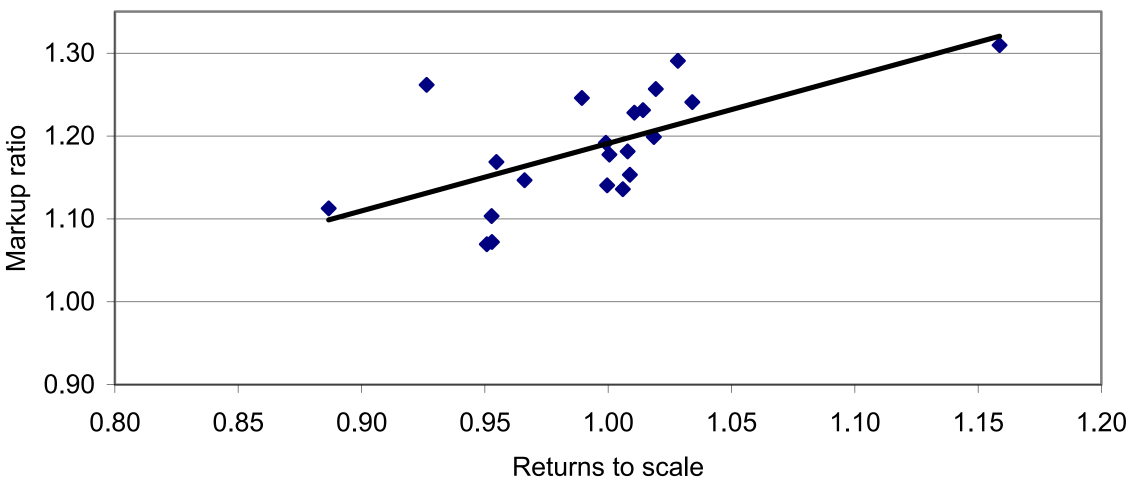


Figure 2. Returns to scale and markup ratios in Bulgarian manufacturing by NACE-2 digit sectors and size of firms

A. Firms with less than 20 employees



B. Firms with more than 20 but less than 200 employees



C. Firms with more than 200 employees

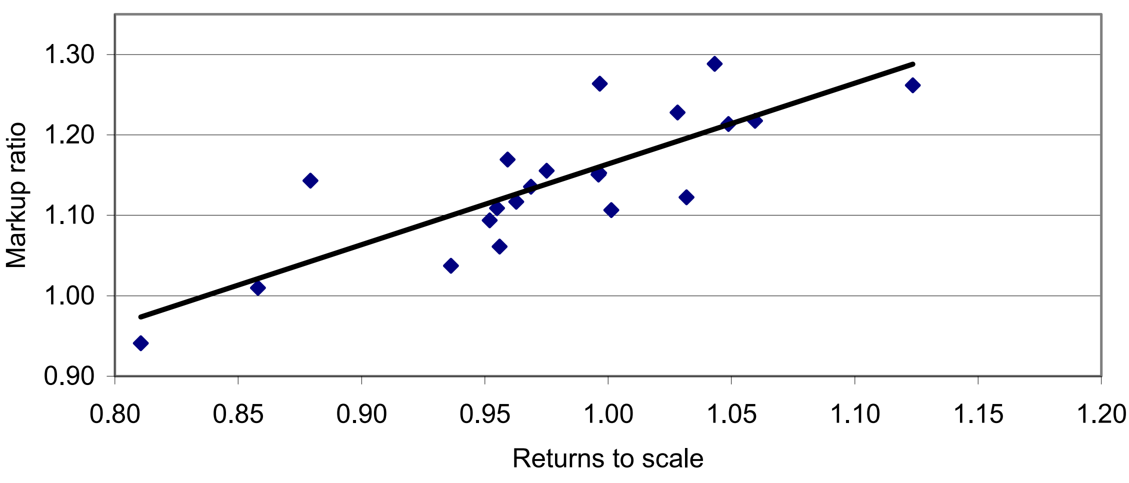
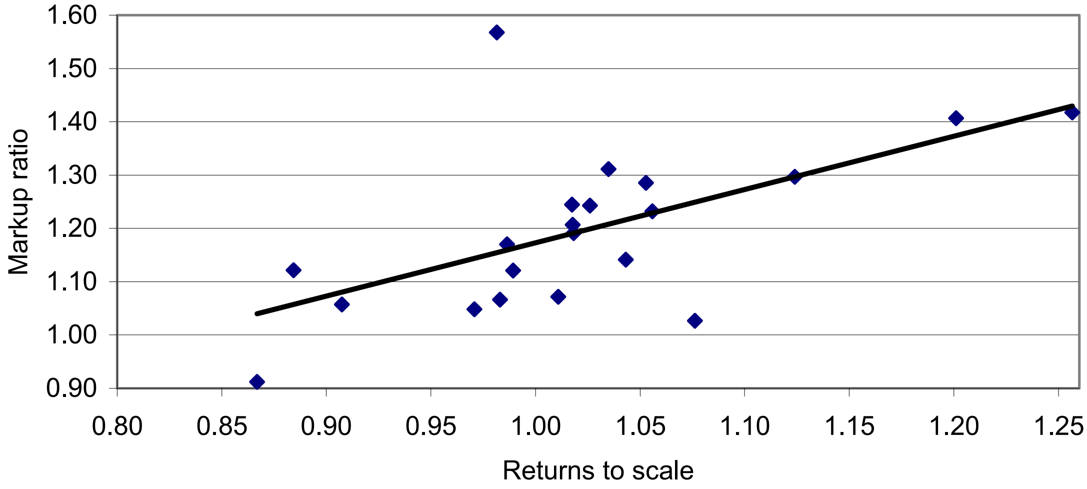
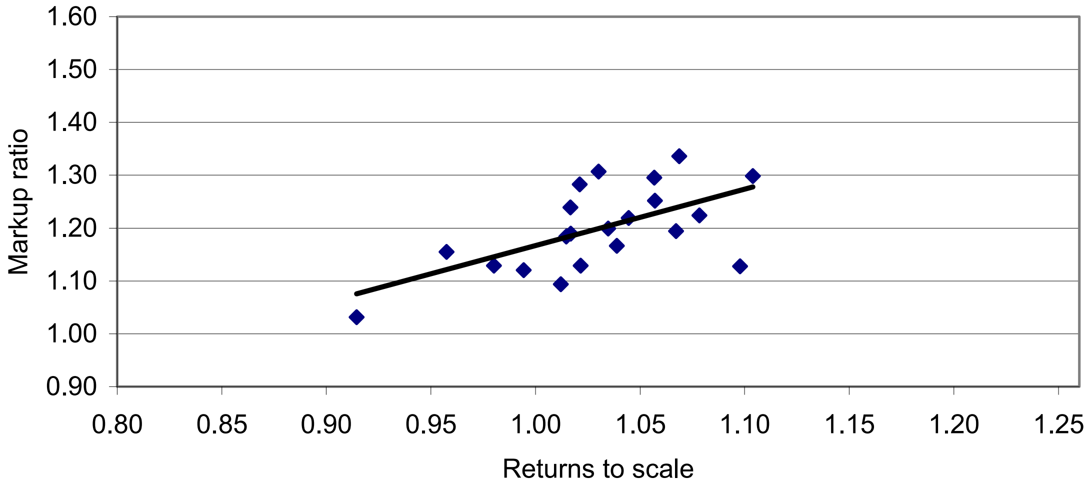


Figure 3. Returns to scale and markup ratios in Hungarian manufacturing by NACE-2 digit sectors and size of firms

A. Firms with less than 20 employees



B. Firms with more than 20 but less than 200 employees



C. Firms with more than 200 employees