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ALLOCATIVE EFFICIENCY AND QM FACTORS COVARIATE IN SERBIAN INDUSTRY

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Trends of allocative efficiency and covariate of firm size and efficiency of quality management(QM) factors in the Serbian industry were tested on the unbalanced panel sample of 48 industrial firms from 12 industrial sectors in the period 2004-2009. The obtained results show that 10 of 12 sectors have a positive covariate of participation in the output market and multi-factor productivity. Covariates of firm size and efficiency of all QM factors record the same direction in the chemicals sector (positive) and motor vehicles (negative), which means that in those two sectors larger companies had above-average and/or below-average efficient TQM. The same (positive) trend of allocative efficiency and covariates of all QM factors was recorded in manufacture of chemical industry.

Key words: Allocation, Allocative efficiency, Covariation, Industry, QM

INTRODUCTION

The more recent literature brings a limited number of studies which analyse the relationship between firm performances and quality management. [01], [05], [12]. Results are mixed and often do not support the hypothesis on positive correlation between productivity and efficiency of some critical QM factors [13]. Reallocation of resources significantly influences the level of aggregate productivity of industry from less productive to more productive firms.

In this type of studies, aggregate industry productivity is determined as weighted average of firm level total (multi-factor) productivity with market share in industry output as a weight. This method of defining productivity allows decomposition of industry productivity on average productivity and covariate part as sum of cross product of firm size and firm productivity. Such decomposition gives insight into correlation of firm size (market share) and firm level productivity. If the sum of cross product positive industry productivity is improved, the sector resources are allocated towards more productive firms and industry is allocative efficient.

Concurrently, deregulation and market liberalisation may have positive impact on QM practice as companies are trying, in the conditions of increased competition, to have more effective QM. Therefore, thanks to reallocation of resources, more productive firms can be expected to grow bigger and at the same time have more effective QM. Average QM efficiency may be, similarly to productivity, decomposed to average efficiency of critical QM factors and a sum of cross product of firm size and firm QM effectiveness (QM factors covariate). If a covariate is positive, QM effectiveness of the industry is improved. The aim of this research is to examine the trend of allocative efficiency and QM factors covariate.

METHODOLOGY

Allocative efficiency

Market reallocation of resources represents one of key channels for identifying the change in productivity at the level of an industry. [02],[07],[11]. Aggregate multi-factor productivity in industry is average weighted productivity of firms, whereby a weight is share of a firm in the output market:

$$MFP_{t,j} = \sum_{i}^{N} \theta_{i,j,t} * MFP_{i,j,t} \qquad (1)$$

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where $MFP_{t,j}$ represents aggregate productivity in industry (j) in time (t), $\theta_{i,j,t}$ is market share of plant (i), in industry (j) in time (t), $MFP_{i,j,t}$ firm level productivity and N represents a number of firms in the sector (j).

Industry productivity may vary through changes in allocation of productivity and market share reallocation between incumbent (surviving) firms, but also through contributions entering and exiting firms [10]. Contribution of resource reallocation to the change in aggregate productivity can be captured through decomposition of productivity of industry to the product of the deviation of market share of plant from the average market share and firm productivity from average unweighted productivity at the level of the industry:

$$MFP_{t,j} = \sum_{i}^{N} (\bar{\theta}_{j,t} + \Delta\theta_{i,j,t})(\overline{MFP}_{j,t} + \Delta MFP_{i,j,t}) \quad (2)$$

or

$$MFP_{t,j} = N_{t,j}\,\bar{\theta}_{j,t}\,\overline{MFP}_{j,t} + \sum_{i}^{N} \Delta\theta_{i,j,t}\Delta MFP_{i,j,t} = \overline{MFP}_{j,t} + \sum_{i}^{N} \Delta\theta_{i,j,t}\Delta MFP_{i,j,t} \quad (3)$$

where $\overline{MFP}_{j,t}$ represents average unweighted productivity, $\bar{\theta}_{j,t}$ average unweighted sales participation, $\Delta\theta_{i,j,t}$ difference between participation in company sales $\theta_{i,j,t}$ and average sales participation $\bar{\theta}_{j,t}$ and $\Delta MFP_{i,j,t}$ difference between company productivity $MFP_{i,j,t}$ and average productivity at the level of the industry $\overline{MFP}_{j,t}$. Sum of cross product $\sum_{i}^{N}\Delta\theta_{i,j,t}\Delta MFP_{i,j,t}$ represents productivity covariate (covprod) and contains contribution of resource reallocation to the change in aggregate productivity.

If it is positive, industry has a positive allocative efficiency where resources in the industry follow more productive incumbent (surviving) firms.

QM factors covariate

The covariate of efficiency of QM and firm size comes down to a question whether firms with above-average scale of dimensions of the specific critical QM factor have bigger output market participation.

QM efficiency is measured as an average value of the dimension scale for specific critical QM factor. Efficiency of the specific QM factor at the industry level is a weighted average of firm-level efficiency (scale of QM factor at firm level) with market share of industry as weights:

$$QM_{t,j}^{n} = \sum_{i}^{N} \theta_{i,j,t} * QM_{i,j,t}^{n} \quad (4)$$

where $QM_{i,j,t}^{n}$ represents a weighted scale of the factor (n), sector (j) in time (t), represents a market share of the firm (i), in the market of the sector (j) and time (t), $QM_{i,j,t}^{n}$ scale of the factor (n) of the firm (i) sector (j) in time (t) and N represents a number of firms in the sector (j).

Weighted efficiency of the specific QM factor in the sector (j) can be decomposed to average unweighted efficiency of factor (n) and the sum of cross product deviation of firm size (i) and efficiency (scale) of the factor (n) in a firm (i):

$$QM_{j,t}^{n} = \overline{QM}_{j,t}^{n} + \sum_{i}^{N} (\theta_{i,j,t} - \bar{\theta}_{j,t}) * (QM_{i,j,t}^{n} - \overline{QM}_{j,t}^{n}) \quad (5)$$

where $QM_{j,t}^{n}$ represents average unweighted efficiency of factor (n), sector (j) in time (t), whereas represents average unweighted market share as a measure of average size of a company in the sector (j) in time (t).

If covariate of QM factor (QM cov) and firm size is positive, efficiency of QM factor at the industry level increases. Companies with higher market share (larger companies) had in the observed time a more efficient QM factor.

Analysis procedure and results

The sample is a stratified random sample drawn from the population of Serbian industrial firms certified according to ISO 9000. The information referring to the determination of MFP and efficiency of QM factor cover the period 2004-2009. The information on company productivity comes from the official financial reports and information about QM practice comes from a questionnaire. Quality management elements or critical QM factors, as the components that will lead to the successful application of the QM concept, were considered for the first time by [03] and the number of available works reported to date is not negligible. Following an analysis of frequency incidence in available literature the QM critical factors shown in Table 1. can be segregated.

Table 1: The dimensions of critical QM factors after factor and reliability analysis [13]

CRITICAL QM FACTORS	DIMENSIONS FOR CRITICAL QM FACTORS
Leadership and management support for quality program (LID)	L2: Care of Department manager for quality L3: Efforts of company management to improve quality L4: Goal setting and quality policy L5: Establishing regulation for quality
Training and involvement of employees (OB)	OB2: Employees training as priority of the company OB3: Existence of financial resources for employees training OB4: Employees training to apply methods and techniques (tools) for quality improvement
Systemic approach and documentary evidence for quality system (SIST)	SIST1: Availability of data on quality to each employee SIST2: Analysis of collected data on quality in order to improve it SIST3: Existence of Department of quality SIST4: Possession of documents for quality system
Process approach (PROC)	PROC1: Differentiation and description of each process in the company PROC2: Continuous monitoring of key processes in the company and their improvement PROC3: Determination of quality measure for each process in the company PROC4: Participation of machine operator in maintenance
Beneficial interaction with suppliers (ISP)	ISP1: Relying upon a small number of reliable suppliers ISP2: Selection of certified suppliers ISP3: Participation of supplier in program development ISP4: Participation in employees training in quality field at supplier's firm
Permanent quality improvement (PK)	PK1: Permanent tendency to eliminate internal process leading to waste of time or money PK3: Application of advanced IT to better analyze data and determining priorities to improve quality PK4: Revision of documents for quality system if necessary PK5: Application of methods and techniques to improve quality
Product design according to user demands (PP)	PP1: Coordination of employees from different organizational units in product development process PP2: New product quality as priority in its design and manufacture PP3: Analysis of possibility for manufacture and cooperation in product development

The research instrument proposed initially contains 7 factors with 31 dimensions (Table 1.), which is substantially the lowest of all offered to date. Using recommendations by [13] to recode 25 – 50% of the questions (posed in reverse order relative to other questions), 45.88% of the questions were recorded. All questions had a five-level Likert scale. The majority of questions in the research instrument were taken from or designed using previous research (which is of critical importance in research of this kind as stated in [12, 14].

The information from financial statements is used for the determination of MFP at the industry level through neoclassical production function, whereby LP algorithm is applied in order to avoid simultaneity. [04]. The data due to QM practice were exposed to factorial analysis to ensure that they constituted reliable indicators of QM constructs. [13]. Based on the determined MFP and selected reliable QM factors by applying algorithms (2),(3),(4) and (5), allocative efficiency and QM covariate of all 12 industrial sectors were determined.

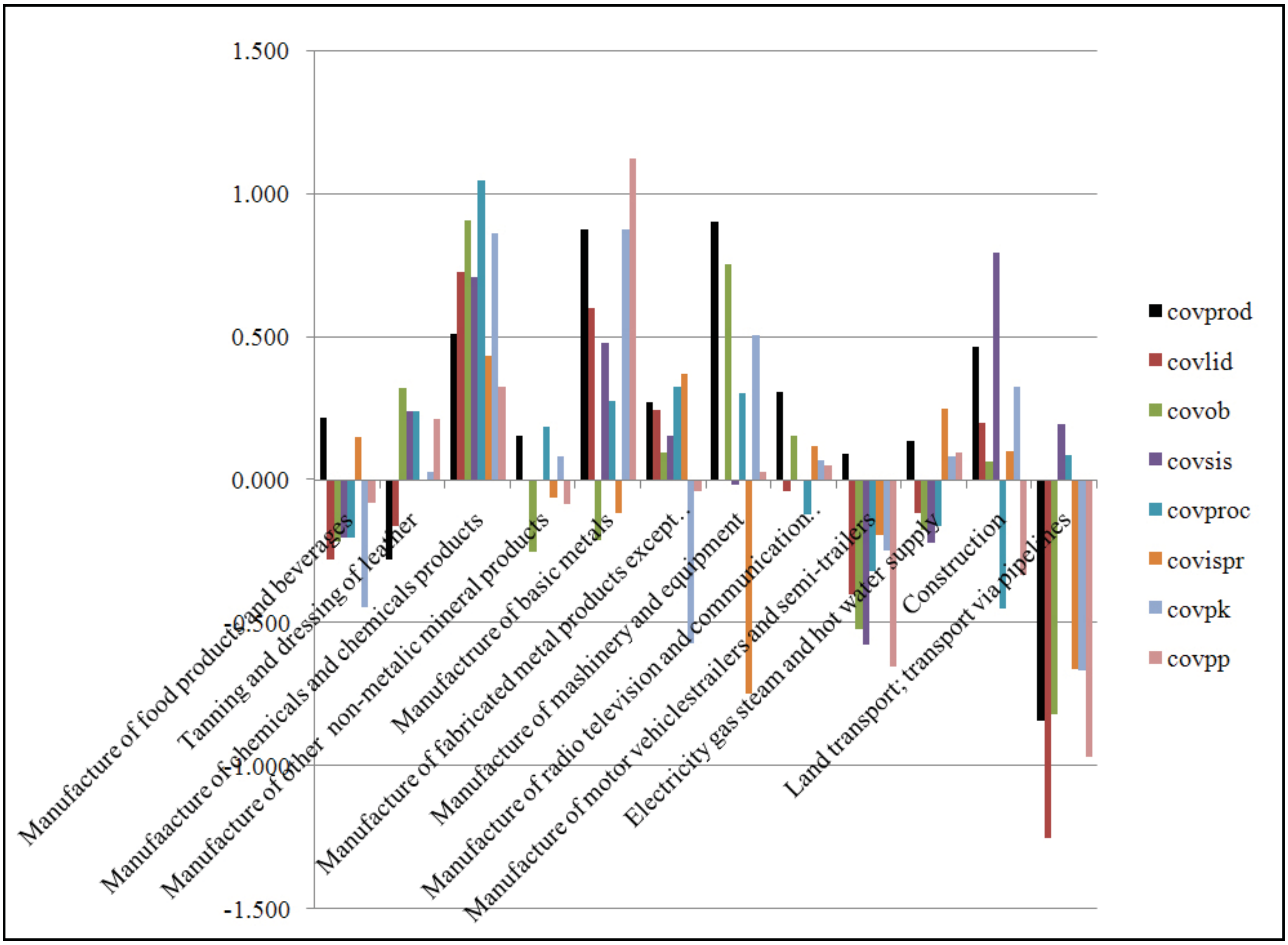

Figure 1: Allocative efficiency and QM factors covariate

The results show that 10 of 12 sectors have positive covariate of output market participation and multi-factor productivity and in those sectors market allocates most resources towards companies with factor productivity above average productivity of the sector. Allocative efficiency in these sectors is increasing in the observed period. Covariates of firm size and efficiency of all QM factors show the same trend in the sector of chemical industry (positive) and motor vehicles (negative), which means that in these two sectors larger companies had QM efficiency above average. In other sectors, the trends of covariate of firm size and scale of QM factor are different. In food-manufacturing industry, an increase of quality with negative covariate is visible, which means that larger companies had efficiency of quality increase below sector average. Training of employees has positive covariate in leather sector, while it is negative in non-metal industry. Metal sector shows a positive covariate of product design, while the sector of machine manufacturing has positive covariate of training and negative covariate of quality improvement. In the production of TV sets, values of covariate are very low. In the electrical sector, there is a positive covariate of suppliers, whereas in the construction sector a positive covariate of systemic approach should be noted. In the transport sector, there is a very negative covariate of leadership.

If a covariate of firm size and efficiency of all analysed QM factors and a covariate of firm size and MFP are observed only in the sector of manufacture of chemicals and chemical products, the same trends are recorded. It is only in that sector that larger firms record a higher factor productivity and more efficient TQM as well.

CONCLUSIONS

The chemical industry's predominant use of batch manufacturing processes is in sharp contrast to the use of assembly line production in automotive or computer industries, so it can be expected that these differences influence the relationship between QM implementation [6]. According to the same authors the strongest contributor to variation in total effects of QM across groups was industry type, followed by size and then QM duration. Typical risks associated with the work in chemical industry require high level of organisation, documented, transparent and effective management systems and therefore, greater attention is given to the standardisation of various management systems. On the other hand, motor vehicles industry in Serbia is in most cases only learning about ISO/TS 16949: 2009, whereby larger manufacturers are for many years in the phase of restructuring and production programme adjustment.

Therefore, our result is expected. Work thus offers managers the possibility to allocate available resources subject to the type of industry and size of the company. An important result of this research is also a fact that majority of the sectors have positive covariate of output market participation and multi-factor productivity so that in those sectors the market directs most of the resources towards companies that have factor productivity above average productivity of the relevant industrial sector.

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