Ondrej Machek[1], **Jiri Hnilica**[2]

IMPLEMENTING BENCHMARKING FOR INCENTIVE REGULATION OF PUBLIC UTILITIES IN POST-COMMUNIST COUNTRIES

Regulatory benchmarking has become a modern instrument to improve efficiency of network utilities which, however, requires large data sets. In the case of post-communist countries, efficiency analyses result in a downward bias even if regulated companies are not able to affect all their costs. This article provides a productivity study of selected network utilities in Czech Republic. It has been proved that no reliable long-term time series are available for a solid efficiency analysis of regulated companies due to specific events which occurred during the transition from centrally planned to market economies and liberalization of the public utilities sector.

Keywords: *network utilities; regulation; benchmarking; total factor productivity; Czech Republic.*

Ондрей Мачек, Іржі Хніліца

ВИКОРИСТАННЯ БЕНЧМАРКИНГУ В РЕГУЛЮВАННІ СЕКТОРА КОМУНАЛЬНИХ ПОСЛУГ: ЗА ДАНИМИ ПОСТРАДЯНСЬКИХ КРАЇН

У статті продемонстровано, яким чином регулятивний бенчмаркинг допомагає підвищити ефективність комунальних послуг за умови наявності значних обсягів даних. У випадку з пострадянськими країнами результати такого аналізу можуть бути доволі неоднозначні, оскільки компанії даного сектору економіки не завжди можуть впливати на власне ціноутворення. Аналіз продуктивності роботи компаній, що надають комунальні послуги, проведено на прикладі кількох чеських комунальних підприємств. Доведено, що для якісного аналізу у даному випадку не вистачає даних щодо довготермінових часових рядів, що пов'язано з переходом від централізованого управління економікою до ринкової економіки та лібералізації роботи сектору комунальних послуг.

Ключові слова: *комунальні мережі; регулювання; бенчмаркинг; загальна продуктивність; Чеська Республіка.*

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Ондрей Мачек, Иржи Хнилица

ИСПОЛЬЗОВАНИЕ БЕНЧМАРКИНГА В РЕГУЛИРОВАНИИ СЕКТОРА КОММУНАЛЬНЫХ УСЛУГ: ПО ДАННЫМ ПОСТСОВЕТСКИХ СТРАН

В статье показано, каким образом регулятивный бенчмаркинг помогает повысить эффективность коммунальных услуг при условии наличия больших объёмов данных. В случае с постсоветскими странами результаты такого анализа могут быть довольно противоречивы, так как компании данного сектора экономики не всегда могут влиять на собственное ценообразование. Анализ продуктивности работы компаний, предоставляющих коммунальные услуги, проведён на примере нескольких чешских предприятий. Доказано, что для качественного анализа в данном случае не хватает данных по долгосрочным временным рядам в связи с переходом от централизированного управления экономикой к рыночной экономике и либерализации работы сектора коммунальных услуг.

Ключевые слова: *коммунальные сети; регулирование; бенчмаркинг; общая продуктивность; Чешская Республика.*

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1. Introduction

The term "network utilities" usually refers to the energy, water and sewerage industries, transportation and telecommunications. These industries are often characterised by natural monopoly and are affected by public interest. The protection and stability of such industries are promoted by governments through regulation. Regulation of network utilities concerns not only services prices, but also market entry and exit conditions, the scope and quality of services etc. In this article, we discuss the issues of regulatory benchmarking, which has become a modern approach to improve regulated business efficiency, from the Central European perspective. We demonstrate the issues by a productivity analysis of selected network utilities: gas distribution, energy distribution and transportation, and water and sewerage operators.

2. Essentials of economic regulation

The basic economic goal of regulation is to achieve competitive outcomes in an environment where competition is not feasible. The basic model of competitive markets is the perfect competition model where technical and allocative efficiency is achieved. However, perfect competition is not always desirable; consumers may require a differentiation of products and services, a lower number of producers may benefit from economies of scale and scope, or, for instance, monopoly profits may represent a suitable stimulus for innovations. If serious market imperfections prevail at a market, then perfect competition can't be efficient (Kahn, 1988). Eventually, more realistic and less demanding theories of efficient competition emerged. We may cite the contestable markets theory or workable competition concepts (Clark, 1940; Stigler, 1942).

Perhaps the most general market model on which public utilities regulation is based is the natural monopoly concept. We refer to natural monopoly when one firm can satisfy market demand with lower average costs than if multiple firms were operating at the same market. Natural monopolies are characterized by barriers of entry to the market, information asymmetries, externalities, and fixation of customers to a single firm. Another market model on which public utilities regulation is based is the destructive competition, which refers to the situation when competition may result in an undesirable deterioration of quality and stability of services provided. However, if such services are important for national security, the government may want to monitor and regulate their quality.

The economic goal of regulatory bodies is to ensure an optimal technical and allocative efficiency, while it is necessary to allow regulated companies recover their costs and earn a reasonable return on their investments. In connection with the regulation goals, it is important to mention the tendencies to liberalise network industries arising from the EU legislation. Liberalisation has multiple goals, for instance, long-term security of energy markets, the reduction of energy prices and improvement of service quality (for a comprehensive discussion of all the aspects of the liberalisation of EU energy markets see Balaz et al., 2011). One of the requirements arising from the EU legislation is to separate regulated and non-regulated activities of vertically integrated companies. This process is called "unbundling". The goal of unbundling was to introduce competition and increase transparency within the regulated sectors. In Czech Republic, the legal unbundling of energy industries took place in 2005–2006, which led to a considerable reorganisation of market structure and

relationships among firms. However, despite the ambitious goals of unbundling, the prices for energy did not decrease and the benefits of unbundling are not clear-cut (Vondracek, Skucek, 2010).

3. Methods of tariff regulation

All methods of economic regulation are based on the principle that a company should be allowed to recover its costs and earn a reasonable return on its investments (Lesser and Giacchino, 2007). Allowed revenues, often referred to as revenue requirements (RR), can be calculated as:

$$RR = O\&M + D + T + (RB \times RoR), \quad (1)$$

where $O\&M$ are operating, administrative and maintenance costs, D denotes depreciation, T denotes taxes, RB is the regulatory asset base (assets used in providing regulated services) and RoR is the rate of return (usually approximated using the weighted average cost of capital, WACC).

Cost-of-service regulation is a classical method based on summing eligible expenses and calculating a required rate of return. This approach has several disadvantages – information asymmetries between regulatory bodies and regulated companies, incentive to overinvest (A-J-W effect, see Averch and Johnson, 1962) or to invest imprudently (gold plating) and last but not least, the tariff level has to be reviewed frequently, typically every year, which makes this method expensive.

The purpose of incentive regulation (performance-based regulation) is to reduce the negative impact of information asymmetries and to induce a company behave efficiently, i. e. reduce its costs in order to increase earnings. In general, we distinguish two basic alternatives of incentive regulation: price-cap and revenue-cap. The price-cap method is based on setting maximum tariffs for the services provided. The general formula for that is

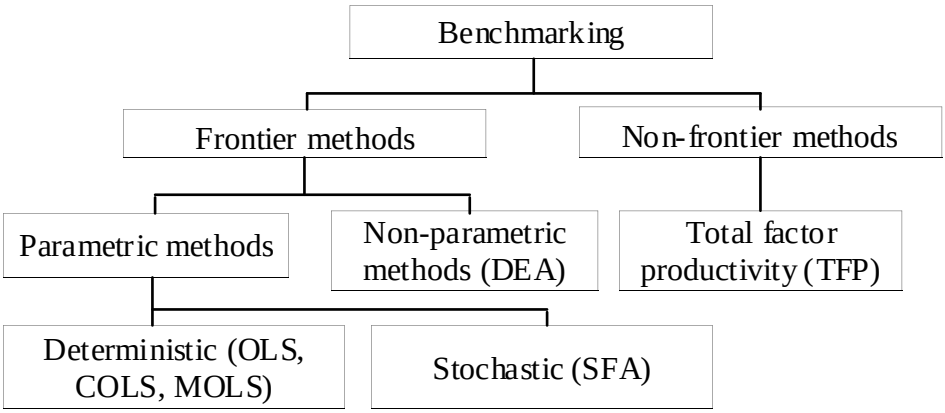
$$P(t) = (1 + RPI - X).\ P(t - 1), \quad (2)$$

where $P(t)$ is the tariff in time t, RPI is the inflation rate, X is the efficiency factor and $P(t - 1)$ denotes tariff in time $t - 1$. The revenue-cap method is based on the same principle, but it sets a cap on total revenues. Since tariffs or revenues are capped according to the inflation rate (RPI-factor) and required efficiency growth (X-factor), the incentive regulation is also often referred to as RPI-X regulation.

The idea that revenue requirements should not be entirely based on regulated firm's own costs is the main principle of regulatory benchmarking. Benchmarking means comparing performance of a firm against a relative performance measurement. If properly applied, benchmarking strengthens the incentives for regulated firms to act efficiently. If a regulated firm achieves to improve its efficiency more than other firms, it is rewarded by the possibility of earning a positive profit. Basic methods of regulatory benchmarking are illustrated on Figure 1. They may be divided into frontier and non-frontier methods. Frontier methods can be divided into parametric methods (econometric methods such as OLS, COLS, MOLS, SFA) and non-parametric methods (mathematical programming methods such as data envelopment analysis, DEA). Among the methods which are not based on the efficiency frontier, we may cite the total factor productivity method (TFP).

A modern complement to traditional approaches is the consulting process, also referred to as a negotiated settlement (Robinson, 2007). The process covers all the

parties involved (including representatives of consumers and service users) into the regulatory process. The aim is to reduce costs of regulation and its time requirements, and to increase the utility of all parties. We may conclude that the current trend is to implement incentive regulation schemes into regulatory regimes. The pioneers of incentive regulation were Northern states (United Kingdom, Ireland and Norway), later this method was spread in other countries and currently it is being used in the majority of the European Union states.



Source: Machek (2011).

Figure 1. **Methods of regulatory benchmarking**

4. The use of regulatory benchmarking in Central Europe

In this section, we will describe in short the regulatory practice in the selected Central European countries: Czech Republic, Slovakia, Hungary, Poland, Germany and Austria. For a more detailed overview, see e.g. Machek (2011b) or Haney and Politt (2009).

The Czech energy regulatory agency (Energeticky regulacni urad, ERU) is currently employing a classical RPI-X regulatory formula in which some parameters (the rate of return, debt-to-equity ratio, beta coefficient) have been set with respect to "foreign experience" (ERU, 2009) but without specifying a precise and transparent methodology. However, no true benchmarking has been used in Czech Republic. Revenue requirements are based on proper costs of regulated companies and the negative aspects of traditional regulatory methods (for instance, imprudent investment) are not eliminated. During the preparation of the fourth regulatory period, ERU has made an attempt to benchmark distribution operators using the DEA method. However, this efficiency analysis has been subject to considerable criticism due to incomparableness of the firms included in the sample. Also, benchmarking is not likely to be implemented in the following regulatory period.

Slovak energy market is regulated by the URSO (Urad pre regulaciu sietovych odvetvi) regulatory agency. Tariff regulation is based upon the price-cap method and the regulatory formula, as well as the way of setting its parameters, are very similar to Czech ones. Currently, no true regulatory benchmarking is being used in practice. Price caps in the area of gas storage and transportation are set with regard to the comparison of Slovak prices against the prices of other EU countries (URSO, 2009), while only "similar" firms have to be taken into account.

The Hungarian energy regulatory agency MEH (Magyar Energia Hivatal) is currently employing the price-cap method in energy tariffs regulation. However, unlike in the two previously mentioned countries, some of the regulatory formula parameters (such as the beta coefficient, the rate of return etc.) are being set with respect to local (domestic) conditions such as the Hungarian price stock index BUX (MEH, 2009). Operating cost analysis makes use of data normalization in order to mitigate regional differences such as wages, consumer characteristics etc.

Polish energy market is regulated by the URE (Urzad Regulacji Energetyki) agency. However, the price setting rules are determined by the Ministry of Economics (Ministerstwo Gospodarki). In practice, the price-cap method is being employed. Polish energy market is relatively large which potentially facilitates the use of benchmarking in practice. However, this market is rather concentrated, with respect to the total country area and population, a relatively low number of firms are currently operating on it. Benchmarking has been used in the field of electricity distribution (SFA method). For the next regulatory period, other benchmarking methods (DEA, COLS) are under consideration.

German energy market is considerably larger than the markets of the previously mentioned countries, both in terms of the number of customers and the number of operators. It is regulated by BNetzA (Bundesnetz-agentur). Since 2009, the RPI-X regulation scheme is being employed. BNetzA is currently employing benchmarking methods in the way that an individual X-factor of efficiency is calculated for every regulated company, DEA and SFA methods are applied to two cost bases and consequently, a best-of-four approach is applied; out of 4 possible results, the one which is the most favourable for regulated firms is chosen. However, due to a certain non-transparency, a number of operators made legal steps to review the results of benchmarking.

Austrian energy regulatory agency Energie-Control (E-Control) is currently using benchmarking methods both in the field of electricity and natural gas distribution and transmission. Despite similar country area and population, Austrian energy market is not as concentrated as Czech or Slovak ones. Within the regulatory benchmarking framework, both domestic and international data have been used. E-Control is employing DEA and MOLS methods, while a weak-of-method is subsequently applied; the more favourable result is attributed the weight of 60%, while the less favourable result is weighted by 40%. Unlike in Germany, the benchmarking outcomes have generally been accepted by regulated firms.

5. Measuring the performance of network utilities in Czech Republic

In this section, we will describe the assessment of performance of selected companies operating in Czech network. It is important to emphasize that the calculations are based on the annual reports of the companies and may be affected by certain errors. However, the availability and accuracy of data is one of the main issues in performance benchmarking. To assess performance, we employed the total factor productivity (TFP) method based on price and quantities aggregation. For a more detailed description of TFP measurement using productivity indices, see e.g. Coelli et al. (2005), Lawrence (2006), or Machek (2013). We measured productivity using the Fisher index of productivity (Fisher, 1922).

The Laspeyres index weights quantities by the prices of the base period. The Laspeyres output quantity index (Y_L) and the Laspeyres input quantity index (X_L) can be specified as

$$Y_L = \frac{\sum_{n=1}^{N} p_{n,t} y_{n,t+1}}{\sum_{n=1}^{N} p_{n,t} y_{n,t}}, \quad \text{resp.} \quad X_L = \frac{\sum_{m=1}^{M} w_{m,t} x_{m,t+1}}{\sum_{m=1}^{M} w_{m,t} x_{m,t}} \tag{3}$$

Paasche index weights quantities by the prices of the current period. The Paasche output quantity index (YP) and the Paasche input quantity index (XP) can be specified as

$$Y_P = \frac{\sum_{n=1}^{N} p_{n,t+1} y_{n,t+1}}{\sum_{n=1}^{N} p_{n,t+1} y_{n,t}}, \quad \text{resp.} \quad X_P = \frac{\sum_{m=1}^{M} w_{m,t+1} x_{m,t+1}}{\sum_{m=1}^{M} w_{m,t+1} x_{m,t}} \tag{4}$$

The Fisher (chain) index is defined as the ratio of geometric averages of Laspeyres and Paasche iindexes for output and input:

$$\Pi_F = \frac{Y_F}{X_F} = \frac{\sqrt{Y_L Y_P}}{\sqrt{X_L X_P}}, \tag{5}$$

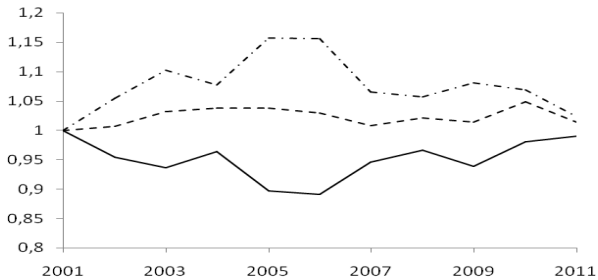
where Y denotes the aggregated outputs and X denotes the aggregated inputs (F denotes Fisher index, L – Laspeyres index, and P – Paasche index).

5.1. PP Distribuce – natural gas distribution

Prazska plynarenska distribuce (PP Distribuce) is one of the 3 regional distributors of natural gas in Czech Republic. The company came into existence by 2007 as a result of legal unbundling from the company "Prazska plynarenska". The company is specific due to the fact that it operates on the densely populated area of the capital city Prague, which is on the one hand beneficial, since this area is very profitable, but on the other hand, facilities have to pass through densely settled areas and premises which makes the construction and maintenance of the assets costly. We measured the productivity development from 2001 to 2011. Among the output variables, we consider the throughput, i.e. the volume of distributed natural gas (MWh), the number of customers and the grid length (km). Further, 2 input variables were considered: operating costs (OPEX) which capture the consumption of materials, energy and services, and tangible assets which are the measure of capital consumption. The weights of outputs have been set to 33% for each output, while the weights of inputs have been set as follows: the OPEX weight was determined as the ratio of OPEX over revenue, and the remaining portion (1 – OPEX/revenue) was attributed to tangible assets. OPEX and revenue were deflated by the consumer price index (CPI) and reported in constant prices of 2000. As we needed to evaluate productivity development before and after legal unbudling which took place in 2006, we subtracted the costs of natural gas purchase from 2001 to 2006 and further, we subtracted 18.5% of operating expenses since a comparable part of costs represented the costs of sale and delivery of natural gas[3].

The productivity development can be summarized using Figure 2 where fixed-base indices are illustrated. Since productivity is actually the ratio of aggregated output over aggregated input, it follows that the output index growth will result in an increase of TFP, while the growth of input index will be followed by a decrease of TFP.

[3] This number is a result of expert interviews with RWE company technicians carried out in 2011-2012.



Source: Authors' development.

Figure 2. **PP Distribuce – TFP development (fixed-based Fisher indexes)**

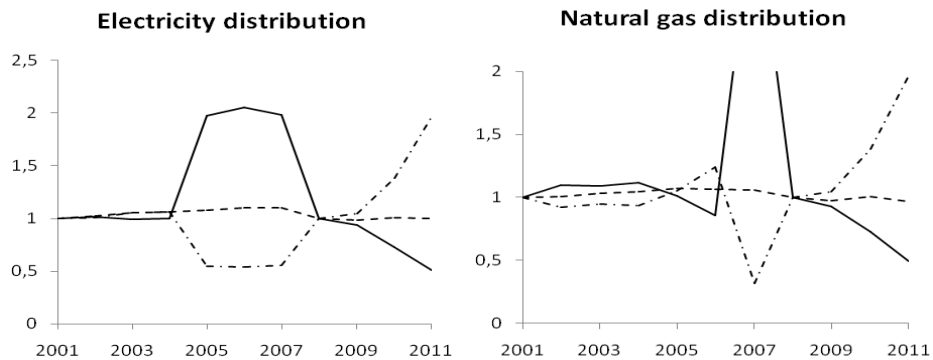
In 2001, a state of emergency has been declared due to large floods in Prague which affected the company's revenues as well as the demand for natural gas. The emergency state lasted until spring 2002. On the other hand, due to lower sales of natural gas, operating expenses have been reduced. In 2003, new customers have been connected to the distribution grid, and due to favourable weather conditions, the total volume of distributed has increased, as well as the total sales. At the same time, the total assets were increasing due to an intense development of the network size in developing districts of the city. In 2005, the company has begun its preparation of legal unbundling. In the same year, operating expenses increased substantially since new tariff corrections have been set by the regulator which increased the price of purchased natural gas. In 2006, OPEX grew again due to an increased purchase of natural gas whose price increased by 5%. However, the volume of distributed natural gas decreased, especially because of unfavourable weather conditions by the end of the year and economy measures taken by customers such as thermal insulation due to the price inflation of natural gas. Since 2007, we measured the productivity of the unbundled company "PP Distribuce", a.s. In the first year of its existence, the company has been affected by a decrease of distributed gas volume which has probably been due to high temperatures in winter 2007. In the following year, the distribution volume and the total sales increased, but operating expenses experienced a higher growth rate (due to material, energy and services consumption) so the total TFP decreased. In 2009, the costs associated with services continued growing. In the following years, the costs have been managed more successfully, so eventually the TFP development has become more favourable.

5.2. "E.ON Distribuce" – electricity and natural gas distribution

The second analysed company was "E.ON Distribuce" established in 2005 as the result of legal unbundling. This company is the only regional electricity and natural gas distributor in southern Bohemia and Moravia. "E.ON Distribuce" is a specific company since it deals with both electricity and natural gas distribution. However, the legal unbundling of electricity and natural gas distribution operators took place in different years (electricity has been legally unbundled one year earlier). In electricity distribution, we had to analyse data of "Jihoceska energetika" and "Jihomoravska energetika" for the period 2001–2004, since these companies merged in 2005 into "E.ON Distribuce", while in the field of natural gas distribution, we analysed the data of "Jihoceska plynarenska" (2001–2006), which was included into "E.ON Distribuce" in 2007. Futher, it is necessary to note that since 2008, we are unable to separate cost

data for electricity and natural gas distribution; we don't know which operating expenses are associated with the distribution of electricity and natural gas. "E.ON Distribuce" has also been affected by the review of depreciation rates of the company's assets and an artificial prolongation of assets' lifetime (Order 404/2005 of the Energy Regulatory Agency). In the annual reports of "E.ON Distribuce", this regulatory act is provided as a reason for a considerable increase of the salvage value of the company's assets.

We analysed the productivity development from 2001 to 2011. We defined the following output variables: grid length (km), distributed volume of energy (GWh for electricity, MWh for natural gas) and the number of customers. We also used the company's OPEX (CZK) and tangible assets (CZK) as input variables. The weights of outputs and inputs have been set in the same manner as in the case of PP Distribuce.



Source: Authors' development.

Figure 3. **E.ON Distribuce – TFP development (fixed-based Fisher indices)**

The output indices remained relatively stable since they are invariant to accounting rules. However, input indices experienced considerable changes. Due to the integration of natural gas and electricity distribution on 2008, we had to set the year 2008 as the new base for the purpose of fixed-index calculation. That is to say, since 2008, the development is identical for electricity and natural gas distribution activities.

5.2.1. TFP Development of electricity distribution

It is evident from Figure 3 that the TFP development experienced a jump in 2004–2005. During this period, two regional operators merged into one, and at the same time, the distribution has been legally separated from other activities (unbundling). After these events, OPEX decreased by 50% in 2004–2005, which has probably been due to a considerable reduction of the headcount in the separated company, as well by the decrease of personnel, material and other costs associated with non-distribution activities. Further, the salvage value of tangible assets increased substantially (by 18% in 2005–2006), which has been caused by the changes of depreciation rates, by investment activities of the company and connection of new energy sources, probably due to the development of renewables support. In 2007, the hurricane Kyrill has hit the company's distribution area which resulted in a state of emergency and a temporary black-out. This resulted in a negative development of the output index in this year. In 2008, several assets have been damaged by the windstorm

Emma. From 2009 to 2010, operating expenses of the company increased significantly (by 40% in 2009 and 50% in 2010). According to the annual reports of the company, this has been due to the government policy of support for renewable energy sources which resulted in a distortion of company's earnings.

5.2.2. TFP Development of natural gas distribution

Likewise, in the field of natural gas distribution, the output index was relatively stable which corresponds to its invariance to modification of accounting and legal rules, but the input index experienced more important year-to-year changes. Since 2008, when the original company "Jihoceska plynarenska" has been integrated and rebranded into "E.ON Distribuce", the changes were so important that we had to set 2008 as the new base for TFP calculations. The year 2007 was a transitional one and is associated with the fusion of companies and the creation of a new company which has been followed by a substantial decrease of the company's operating expenses and assets. As a consequence, the year 2007 is irrelevant for productivity analysis. In 2008, a partial decrease of the output index was probably caused by a gas stoppage in Ukraine, which resulted in an increased need for import from Norway and extraction of natural gas from underground storage reservoirs. A similar unfavourable situation occurred at the beginning of 2009 when the natural gas from Russia has been totally stopped. Moreover, the economic crisis affected the overall company performance.

5.2.3. Summary

The productivity analysis of "E.ON Distribuce" is difficult due to multiple factors such as legal and accounting changes. Another important issue is the fact that electricity and natural gas distribution are carried out by the same company and the costs are not disclosed separately. Moreover, productivity has been affected by many factors beyond the control of the company, such as temperature fluctuations, windstorms and hurricanes, as well as gas stoppages from Russia, economic crisis and lower purchasing power of customers. The available data are impracticable in tariff regulation and benchmarking.

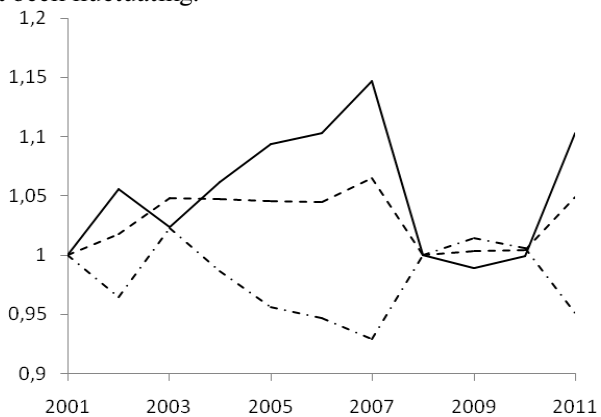
5.3. CEPS – electricity transmission

CEPS is a state-owned monopoly company which operates the Czech electricity transmission grid. Until 2003, the sole stockholder was the CEZ company, since April 2003, an important part of shares is owned by the government (National Property Fund and Ministry of Labour and Social Affairs). This company is also regulated by ERU but the regulatory formula's parameters are different from those set for distribution operators.

The productivity development has been surveyed for the period 2001–2011. We identified the followind outputs: total transmission grid length (km), volume of transported electricity (GWh) and installed performance of tranformers (MVA). We did not include the number of customers among the outputs since such indicator is not relevant for the national transmission grid operator. As to the inputs, we used the company's operating expenses and tangible assets, both disclosed in CZK.

Until 2007, the company has been performing well in terms of TFP. However, productivity has also been affected by extraordinary events such as snow calamity and electricity blackouts in winter 2006. However, CEPS has also been affected by the economic recession which decreased the company's productivity from 2008 to 2010, especially in terms of an overall decrease of revenue and transported electricity

volume and an increase of operating costs. In 2010, Czech Republic experienced a boom of solar energy sources which was eligible to jeopardize the reliability of the national electricity transmission grid and was mentioned, together with wind power plants and other unstable sources of energy, as a potential threat in 2009. The year 2011 was favourable since the volume of transported electricity increased (partly due to the development of renewables). The increase of assets base was associated with investment activities which resulted in the increase of transformers performance (one of the outputs). Generally, TFP development of CEPS can be classified as stable because no important deviations from the base-year productivity level occurred. This observation may be justified by the important role of the firm in Czech economy, and a stable organizational and ownership structure, due to which the accounting variables have not been fluctuating.



Source: Authors' development.

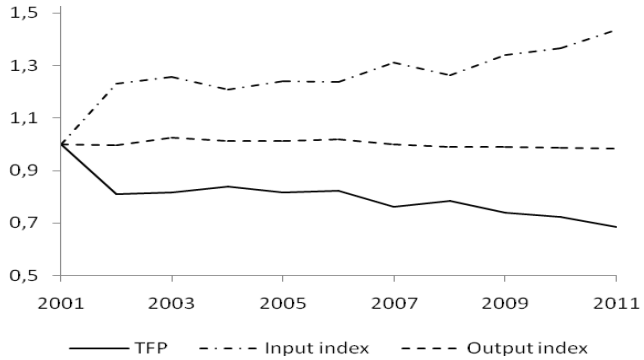
Figure 4. **CEPS – TFP development (fixed-based Fisher indices)**

5.4. Severoceska vodarenska spolecnost – water and sewerage

Severoceska vodarenska spolecnost belongs to the largest water and sewerage utilities in Czech Republic. This company deals with the maintenance and construction of facilities such as water supply and sewerage system. The water price is regulated using the classical cost-of-service regulation set by the Ministry of Finance. Besides the reconstruction and development of assets, the company's main goals include the preservation of a socially acceptable price level of water. Ii is clear that in the case of water and sewerage industries, a different set of outputs and input has to be used. With regard to available information, we used the following set of output variables: water system length (km), invoiced volume of water (1000 m3), number of customers (water system), sewerage system length (km), volume of cleaned water (1000 m3), and the number of customers (sewerage system). As to the inputs, we used operating expenses and tangible assets again. Output weights have been set to 16% for each output, input weight have been set following OFGEM (2003). OPEX and revenue have been deflated by the Czech consumer price index (CPI) and disclosed in fixed prices of 2000.

We may observe that the total length of the water and sewerage systems keeps growing as well as the number of customers connected to these networks. On the other hand, the volume of distributed water is constantly decreasing. Large floods in

August 2010 resulted in a considerable damage on assets (in total value of 143 mln CZK) while the sanation of these damages costed 50.1 mln CZK. Both these effects resulted in operating costs decrease. However, the most important component of operating costs was depreciation; however, depreciation tends to increase with the value of total assets which have been increasing due to investment activities (reconstruction and construction of new facilities). The increase of total assets and depreciation resulted in an increase of the aggregate input index which, eventually, made the TFP index decrease.



Source: Authors' development.

Figure 5. **Severoceska vodarenska spolecnost – TFP development (fixed-based Fisher indices)**

All these findings suggest that the use of TFP to regulate water and sewerage prices would be absolutely inappropriate, since the efforts to reduce costs would lead to a decrease of investment activity which is against the basic goals of this company. On the other hand, it is important to note that investment should lead to a proportional increase of output, which, according to the available data, was not achieved.

6. Conclusion

The modern regulation of public utilities in Czech Republic begins in 2002 when the first incentive-based regulatory period began. Since that time, 3 regulatory periods elapsed. It follows that time series is not long enough for solid productivity or efficiency analyses. Moreover, the number of operators at the market is small, which is a general problem in all post-communist countries. The evolution in post-communist countries has been affected by fundamental events which resulted in a distortion of available data which disallow their efficient use in tariff regulation. The available data cause a bias in productivity change which could not be affected by regulated firms themselves. In particular, we should mention the legal unbundling of electricity and natural gas utilities, reorganization of market, mergers, fusions and acquisitions of companies by others. Moreover, it is necessary to mention other non-typical events, such as unfavourable weather conditions, gas shortages from Russia, a continuous support of unstable energy sources (in particular, solar and wind power plants), and last but not least, a reconstruction of networks which were built up centrally planned during the communism era.

All these factors imply that the possibilities for using benchmarking methods are limited. However, it is possible to extend these possibilities to a certain extent. We

would suggest collecting data for a possible use of benchmarking in the future if the costs of collecting and maintaining such data weren't too high. If the use of benchmarking methods abroad proves good and if there is a sufficient data base, it is possible to initiate a negotiated settlement process with all the parties involved, ideally in cooperation with reputable consultancy firms or academic sites. Within the settlement process, as well as in the eventual regulatory regime, the regulated firms should be allowed to propose suggestions and remarks. The regulator itself should be bound by unambiguous rules.

To sum up, it is possible to recommend benchmarking rather as an underlying method for further analysis, not as a pure regulatory method. An example of such a successful use is the building-block approach used in the United Kingdom. An interesting alternative is to use productivity analysis in threshold settings, i.e. setting the moment when regulation and negotiation takes place, as it is used in New Zealand.

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