Estimation of weighted average cost of capital in transmission and distribution: case of Croatia

IVONA ŠTRITOF
Croatian Energy Regulatory Agency
Ulica grada Vukovara 14, Zagreb
CROATIA
istritof@hera.hr

TOMISLAV GELO
University of Zagreb
Faculty of Economics and Business
Trg. J F. Kennedya 6, Zagreb
CROATIA
tgelo@efzg.hr   http://www.efzg.hr/tgelo

SLAVKO KRAJCAR
University of Zagreb
Faculty of Electrical Engineering and Computing
Unska 3, Zagreb
CROATIA
slavko.krajcar@fer.hr   http://www.fer.hr/slavko.krajcar

Abstract: - A regulatory method chosen for setting allowed revenue in transmission and distribution of electricity in Croatia is a traditional Rate of Return method. The main feature and, at the same time, the main drawback of this method is that a price is in a direct relationship with the costs of regulated company. A parameter used in this method, which does not solely depend on the costs and management decisions, is the rate of return. The rate of return is usually calculated using the weighted average cost of capital formula (WACC). The WACC reflects two types of finance used to fund investments, debt and equity respectively. The cost of equity is calculated using the Capital Asset Pricing Model (CAPM). This Paper provides the WACC calculation based on the estimates of particular parameters which could be applied in the case of electricity transmission and distribution in Croatia.

Key-Words: - Distribution, Transmission, Rate of return, WACC and CAPM

1 Introduction

The regulatory experience and practice in electricity sector in Croatia are of newer date, especially in respect to the economic regulation and implementation of its methods. Although the regulatory authority was established in 2001, the actual implementation of economic regulation happened in the first half of 2008. Such development is partially a consequence of the fact that in Croatia there is only one vertically integrated company (HEP Group), which carries out all electricity activities. The process of legal unbundling has been gradually carried out since the first reform steps taken in 2001.

The regulatory authority (the Croatian Energy Regulatory Agency, CERA) in December 2006 passed the bylaws on tariff systems for all electricity activities, generation for tariff customers, transmission, distribution and supply for tariff customers [1,2,3,4]. All tariff systems define a traditional method of Rate of Return (RoR) as the initial method of economic regulation. A notion tariff customer nowadays refers to households and small entrepreneurs. From July 2009 only households will be considered as tariff customers and will have regulated final price.

The European regulatory theory and practice [5] recognizes the RoR method as a method of regulation of monopoly activities, transmission and distribution of electricity accordingly, whereas generation and supply are considered to be market activities. Therefore, the Croatian case of applying RoR to generation and supply could be considered as a peculiarity within the European regulatory context. The experience shows that in some

cases defining a regulatory method and amount of network charges is left to regulatory authorities while the government is in charge of setting all inclusive tariffs for customers who are eligible to be priced by these tariffs and not to buy electricity at the market [6]. Such practice is also in line with provisions of the Directive 2003/54/EC [7].

Since the role of economic regulation is to mimic the market forces in activities where competition is not economically justified, it is reasonable to analyze the use of RoR method and its parameters in natural monopolies, transmission and distribution of electricity respectively [8].

The paper provides analysis of the RoR method applied in transmission and distribution of electricity in Croatia, special emphasis is given to the analysis of its particular element, the rate of return. This element is essential for sustaining a financial stability of the power system through securing prudential and justified new investments. It also has the impact on the level of network fees. Estimation of the rate of return is quite important in countries where not much work has been done in this respect so far. Additionally, it is particularly important if analysed in a framework of the global financial crisis and its impact on Croatia. Having in mind that the CERA has not carried out empirical analysis of the rate of return, the paper presents results of the estimates carried out independently by the authors and not as a part of regulatory process.

2 Rate of return method

A specific feature of applying RoR method is that the allowed revenues are set by analyzing the costs of the particular regulated company. The efficiency level is not questioned nor is the comparison of costs and performance of regulated company with similar companies carried out. Performing such regulatory exercise is characteristic of more developed and advanced methods of incentive regulation, very often accompanied with a quality regulation.

The RoR standard formula which is used for calculating the allowed revenue on yearly basis for all electricity activities is as follows [1,2,3,4]:

$$R_t = OPEX_t + RAB_t \times WACC_t + D_t \qquad (1)$$

where
R_t is the allowed revenue in year t;
$OPEX_t$ are operating costs in year t;
RAB_t is the average value of regulated asset base in year t;

$WACC_t$ is the weighted average cost of capital in year t and
D_t is depreciation in year t.

The element of RoR method which does not depend only on regulated company costs and management decisions, but also heavily depends on national and international socio-economic environment, is the rate of return. In many cases the regulatory authorities estimate the rate of return using the weighted average cost of capital (WACC). Such approach is also used in the Croatian case. The analysis of WACC estimates is a real regulatory challenge. The methodological basis for determination of the WACC has been rooted in modern finance theory and the asset pricing models that have been developed as that theory has evolved. In the Croatian case, especially in respect to the allowed revenue setting, the regulatory authority did not carry a thorough analysis of the WACC estimates so far.

3 Weighted Average Cost of Capital

A Croatian methodology defines the post tax WACC. It reflects two types of finance, debt and equity:

$$WACC_{post\text{-}tax} = g \times r_d \times (1\text{-}T) + (1\text{-}g) \times r_e \qquad (2)$$

where
g is a proportion of finance that is debt;
r_d is the cost of debt;
r_e is the cost of equity and
T is the corporate tax rate.

The cost of debt is defined as the average interest rate on liabilities [1,2,3,4]. However, a very common approach in estimating the cost of debt is estimating the risk free rate on which country specific debt premium is added [8].

The most widely used approach for estimating the cost of equity is the Capital Asset Pricing Model (CAPM) [9]:

$$r_e = r_f + \beta \times (r_m - r_f) \qquad (3)$$

where:
r_f is the risk free rate;
β is the measure of relative (or non-diversifiable) risk of the company or industry
r_m is the expected return on the market and
$(r_m - r_f)$ is the market risk premium.

The risk free investments and the return obtained from them exist only as a theoretical abstraction. In practice, such investments with minimum risks are investments in government securities.

Market risk premium is implied that any additional risk taken by an investor should be rewarded with an interest rate higher than the risk-free rate. The difference between the market return and the risk free rate of return is a risk premium. Risk premiums may be calculated for a particular security, a class of securities, or a market.

The equity β (beta) coefficient is essentially a measure of price volatility of company's shares in comparison to the market index. In the case of high beta the company's shares' prices will tend to move more than the market index (β is greater than 1) and in a case of low beta the company's shares' prices will tend to move less than the market index (β is lower than 1). A standard procedure for estimating betas is to regress stock returns against market returns. The slope of the regression corresponds to the beta of the stock, and measures the riskiness of the stock. The beta is very often estimated by using relatively straightforward statistical parameters:

$$\beta = (\text{cov}_{s,m})/(\text{var}_m) \qquad (4)$$

where
$\text{cov}_{s,m}$ is the covariance of the company's share prices with the market prices and
var_m is the variance of the market prices.

4 Estimation of WACC parameters in the Croatian case

A theoretical assumption that was followed as a basis for the WACC estimation was that the WACC should not be the same for transmission and distribution activity and that the WACC for transmission should be lesser than in the case of distribution activity. Namely, a distribution activity is supposed to be more risky business. Such assumption was founded on two grounds, firstly on the experience of other regulatory authorities [11,12,13] and secondly, on the financial statements of companies that carry out analyzed activities, HEP-Operator prijenosnog sustava ltd. (HEP-OPS) and HEP- Operator distribucijskog sustava ltd. (HEP-ODS) [14,15]. An overview of nominal pre-tax WACC estimates in several countries is shown in Table 1.

Previously explained WACC parameters in case of Croatia were estimated using three different versions, as shown in Table 2. Having in mind the environment in which respective activities are carried out, six parameters (risk free rate, market risk premium, beta, tax rate, cost of debt and cost of equity) are the same for all three versions, while a difference could be seen in capital structure (gearing). However, this difference

significantly influences the range of results and the level of optimal WACC.

Table 1 Overview of the nominal pre-tax WACC [10,11,12]

Country	T[1] (%)	D[2] (%)
Czech Republic	7.479	8.114
Northern Ireland	6.41	6.91
France	7.25	7.25
Hungary	7,1	7,1
Slovenia	4.13	4.13

Legend: [1]Transmission; [2] Distribution

The first parameter, the risk free rate (r_f) was estimated using two different sources. The first source was the Croatian Ministry of Finance and the return on government bonds issued in the past few years [16] as shown in Table 3.

The second source used for confirmation of the results, was Aswath Damodaran's estimates of default free government bond rate for Croatia [17]. Based on these two sources as the risk free rates for both activities the value of 5 per cent was set.

Table 2 Estimation of WACC

Parameters	Version 1		Version 2		Version 3	
	T[1]	D[2]	T	D	T	D
Risk free rate (r_f)	5.00%					
Market risk premium ($r_m - r_f$)	3.28%					
Beta (β)	0.839					
Cost of equity (r_e)	7.67%					
Share Equity (E)	0%		76%		40%	50%
Share of debt (D)	100%		24%		60%	50%
Cost of debt (r_d)	5.5%					
Tax rate (T)	20%					
WACC (%)	4.40		7.01		5.77	6.12

Notation: [1]Transmission; [2] Distribution

The second parameter, market risk premium ($r_m - r_f$) was estimated according to country rating, which is Baa2 (Moody's) [18]. Additionally, according to [17] market risk premium for Croatia in January 2009 was 3.38 per cent. This percentage is used in calculations.

The third parameter, the equity beta (β) was calculated using both mentioned approaches for the beta calculation. However, in the Croatian case there are many obstacles in using such approaches in calculation of the equity beta. One of the main obstacles lies in the

fact that only one energy company is listed on the Zagreb Stock Exchange and that is INA, privatizes oil and gas company. The second obstacle is a degree of the financial market development. The assumption on which the beta calculation was based was that the beta of INA is similar to beta of the HEP Group (proxy variable). Therefore, the beta was estimated by comparing the price of INA's shares against the national stock index Crobex. The Beta was based on historical data of 112 weeks (1st December 2006 to 3rd February 2009) [19]. Dynamics of the price of INA's shares and the national stock index Crobex are shown in Fig.1.

Table 3 Croatian Ministry of Finance Bonds – Series and interest rate [15]

Bonds - Series	Currency	Maturity	Interest rate
Bonds-Series 07 D-	EUR	2019	5.375%
Bonds-Series 12 D-	HRK	2017	4.75%
Bond Series 09 D-	EUR	2015	4.25%
Bonds-Series 05 D-	EUR	2014	5.50%

The result of such calculation is the value for INA's beta of 0.839, as shown in Fig.2. The stock beta is the slope of the straight line.
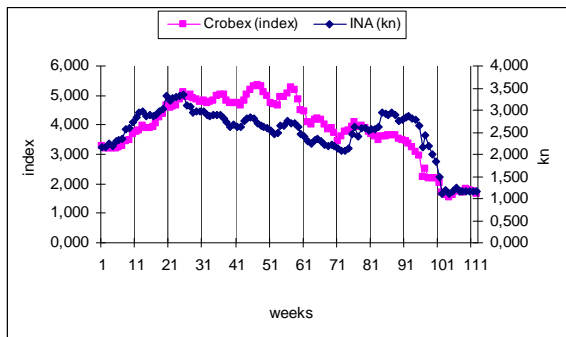

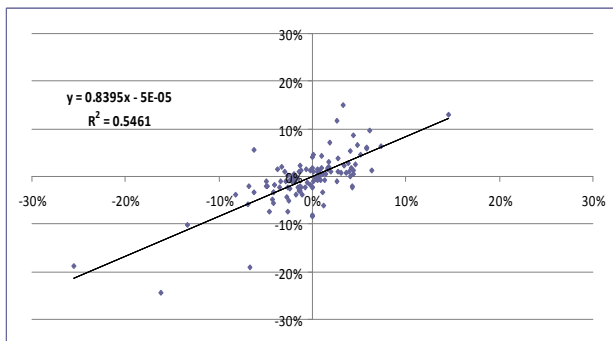Fig.1 Price of INA's shares and the national stock index Crobex

Fig.2 INA's stock beta

This result was further challenged and confirmed by comparing it with the betas of the electricity utility companies from Europe and the United States [17] as shown in Table 4. The betas of the respective companies are in between 0.75 and 0.89.

The fourth parameter, the cost of debt (r_d) is a result of two elements taken from the financial statement of HEP Group for 2007 [20]: the weighted average structure of long-term and short-term liabilities, and calculation of interest rate for every liability (debt). The weighted average cost of debt for the HEP Group is approximately 5.5 per cent. This analysis is quite superficial since the calculation is not carried out independently for each activity. However, the prerequisite for further more thorough analysis of the cost of debt for each activity is unbundling of liabilities within the HEP Group. Monitoring of such exercise is within the competences of the CERA.

Table 4 The betas of the electricity utility companies in Europe and the United States [16]

Industry	Number of firms	Average Beta
USA		
Electric Util. (Central)	24	0.82
Electric Util. (East)	26	0.74
Electric Util. (west)	16	0.79
Europe		
Electric Utilities	35	0.89

The CERA's monitoring should be two-folded. On one hand, past debts should be rationally allocated between activities in order to prevent subventions enabling thus a development of a fair playing field for completion. On the other hand, the CERA is in charge of approving a three-year development and construction plans of HEP-OPS and HEP-ODS. One of the essential components of this procedure is giving approval for future financial resources needed for realization of planned investments. A level of indebtedness for each daughter company is decided by the management board of the HEP Group and not by the managers of daughter companies although the investment plans and tariffs are set separately for each of the activities. This gives, however, the space for unfair allocation of debts.

The fifth parameter, the capital structure or the gearing (*g*), it showed to be the most challenging and interesting parameter of the WACC estimation. Three different versions of the gearing were used:

1. Version 1 – a gearing equals 1 (a share of capital is 0 per cent and a share of debt is 100 per cent) for both activities is 48 percent, a share of transmission is 10 per cent, while a share of distribution is 42 per cent;

Table 5 Structure of planned and realised investments of HEP-ODS in period 2005-2007 [15]

Type of investments	2005			2006			2007			2005-2007		
	Planned mil. kunas	Invested mil.kunas	Realisa-tion	Planned mil. kunas	Invested mil.kunas	Realisa-tion	Planned mil. kunas	Invested mil.kunas	Realisa-tion	Planned mil. kunas	Invested mil.kunas	Realisa-tion
Investments' preparation	23.79	25.19	106%	24.25	13.17	54%	37.60	19.60	52%	28.55	19.32	68%
Replacements	230.22	251.24	109%	269.21	218.05	81%	97.50	225.30	231%	198.97	231.53	116%
Revitalization	15.56	13.43	86%	5.40	4.58	85%	3.10	4.30	139%	8.02	7.44	93%
War demages	83.29	73.38	88%	126.10	72.40	57%	25.00	101.80	407%	78.13	82.53	106%
New facilities	251.23	252.31	100%	283.78	231.43	82%	217.10	267.20	123%	250.70	250.31	100%
Other investments	188.75	212.81	113%	124.53	163.48	131%	180.50	157.10	87%	164.59	177.80	108%
Connections	719.55	427.88	59%	781.40	560.67	72%	445.00	597.00	134%	648.65	528.52	81%
R&D	3.09	2.22	72%	3.51	0.00	0%	20.00	0.00	0%	8.87	0.74	8%
Total	**1,515.47**	**1,258.46**	**83%**	**1,618.18**	**1,263.78**	**78%**	**1,025.80**	**1,372.30**	**134%**	**1,386.48**	**1,298.18**	**94%**

activities. Such ratio results from the data in annual reports of HEP-OPS and HEP- ODS [14, 15]. Namely, the owner of all assets of the HEP Group is a mother company. The daughter companies have signed a contract with the mother company with which they were granted a right to operate the assets, but are not the owners of the assets. The contracts *per see* have a form of the financial leasing contracts;
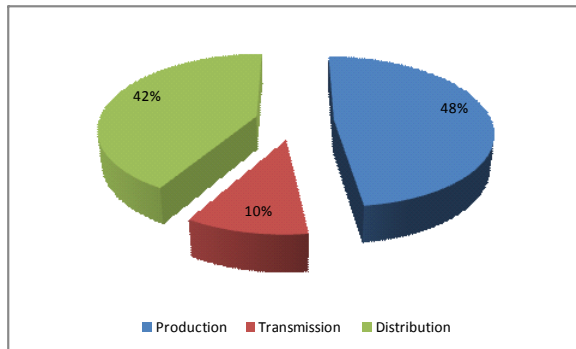

Fig.3 Structure of operating income from electricity activities

2. Version 2 – a share of capital is 76% and share of debt is 24%, for both. In this case capital structure was taken form the consolidated balance sheet of HEP Group [20]. HEP Group is a 100% state-owned energy company which has been active in electricity production, transmission and distribution and in district heating and natural gas supply. Operating income of the Group was 10,815.5 million kunas in 2007. Income from electricity sales (including electricity production, transmission and distribution) was 80.8 per cent of the total operating income. The income from the heat and gas sales was 4.2 per cent and 2.2 per cent respectively. Other operating income was 12.8 per cent.

Structure of operating income from electricity activities is show in Fig.3. A share of electricity production in total operating income from electricity

3. Version 3 - has two options, one for a transmission and the other for a distribution activity. A share of equity for transmission is 40 per cent, while for distribution is 50 per cent. On the other hand, a share of debt for transmission is 60 per cent and for distribution 50 per cent. This diversification in structure of capital results significantly from the fact that the in Croatia a deep approach toward connection fees has been adopted. Table 5 shows the structure of planned and realized investments in HEP ODS for a three year period 2005-2007 [15]. From Table 5 it could be seen that in this period on average roughly 40 per cent (a creation of conditions in the network for new connections) of all realized investments were financed from the connection fees. On the other hand, in case of HEP-OPS no investments have been financed from the connection fees so far [14].

The values of gearing in this version are result of the author's analysis based on three grounds. Firstly, the estimates carried out by other authors were analyzed [9]. Secondly, the authors' judgment and estimates were based on the capital structure resulting from the thorough analysis of the HEP Group's consolidated balance sheet, HEP-ODS's and HEP-OPS's balance sheets [14, 15, 20]. Finally, gearing was defined according to future investment plans and financial resources planned for them respectively.

As the sixth parameter, lastly, a tax rate is used to calculate tax liability. In Croatia tax rate is 20 per cent.

A range of the post tax WACC for both activities, transmission and distribution, is from 4.4 per cent to 7.01 per cent. According to the authors' opinion the Version 3 is the most realistic and applicable version. The post tax WACC for transmission operator should be approximately 5.77 per cent and for distribution operator approximately 6.12 per cent. This result at the same time proves the previously stated assumptions.

The WACC estimates and its implementation should

be analyzed in wider context, as a part of regulatory costs' review. However, it is important to emphasis that the values of WACC used in tariff setting procedure carried out in 2008 are not publically available. Therefore, the values that were used by the CERA could not be challenged against the values obtained though the author's analysis. This fact additionally opens space for a further, deeper academic analysis and a dialogue between the regulatory authority and regulated entities.

5 Conclusion

Implementation of the RoR method in the monopolies, such as electricity transmission and distribution, implies that regulated prices are directly related to the costs of a particular company. A parameter of the RoR method, which to a certain extent depends on a wider socio-economic framework and not solely on company's costs, is a cost of capital. The experience shows that cost of capital is usually calculated using the WACC approach. Estimating the WACC and its parameters is a real challenge for the regulatory authorities, especially in the countries where the financial market is in its initial phase of development (e.g. in case of Croatia). In such cases, estimation of the WACC requires additional evaluations and argumentation concerning past values and future trends.

Estimating the WACC in the Croatian case and deciding on its justified level has not been performed by the regulatory authority *per see,* so far. Therefore, the authors have carried out their independent analysis which was not an integral part of a tariff setting process. The input data used in calculation is publically available. Using such data the results obtained show that the post tax WACC for both activities should range between 4.4, and 7.01 per cent. The authors suggest that the post tax WACC for transmission activity should be around 5.77 per cent and for a distribution activity should be higher, around 6.12 per cent. This difference results primarily from different gearing (a capital structure). In case of transmission indebtedness is higher. Additionally, a trend of future indebtedness is positive, while a distribution activity shows a constant level indebtedness, primarily due to deep connection fees.

However, there is still space for further analysis of the WAAC and their improvements. Primarily, due to the fact that a complete and thorough unbundling of liabilities between different activities within the HEP Group has not been carried out and that the Croatian financial market is still not in its mature phase.

References:
[1] Tariff System for Electricity Supply, with the Exception of Eligible Customers, without the Amounts of Tariff Items, *Official Gazette*, 143, 2006

[2] Tariff System for Electricity Distribution, without the Amounts of Tariff Items, *Official Gazette*, 143, 2006

[3] Tariff System for Electricity Transmission, without the Amounts of Tariff Items, *Official Gazette*, 143, 2006

[4] Tariff System for Electricity Generation, with the Exception of Eligible Customers, without the Amounts of Tariff Items, *Official Gazette*, 143, 2006

[5] I. Štritof, Preconditions for implementation a model of incentive regulation in transmission of electricity, *Master thesis* (Faculty of Electrical Engineering and Computing, University of Zagreb, 2005)

[6] European Regulators Group for Electricity and Gas, *Status Review of End-User prices Regulation as of 1 July 2008*, Bruxelles, March 2009

[7] Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC, *OJ* L176/37, 2003

[8] V.S. Ajodhia, A. Hakvoort, Economic regulation of quality in electricity distribution networks, *Utilities Policy*, Vol.13, No.3, 2005, pp. 211-221

[9] Frontier Economics, The cost of capital for Regional Distribution Networks*, A Report for DTE*, December 2005

[10] D. Brounen, A. De Jong, K. Koedijk, Corporate Finance in Europe – Confronting Theory with Practice*, Working Paper*, Erasmus Research Institute of Management (ERIM), Erasmus Universiteit Rotterdam, Jan. 2004

[11] Energy Regulatory Office, www.eru.cz (January 2008)

[12] Utility regulator, www.niaur.gov.uk, (January 1008)

[13] HRO CIGRÉ, *Round Table, The role of regulatory body in setting tariff systems*, Zagreb, 15th May 2007

[14] HEP-Operator prijenosnog sustava, *Annual report 2007*, Zagreb 2008

[15] HEP-Operator distribucijskog sustava, *Annual report 2007*, Zagreb 2008

[16] Ministry of finance, www.mfin.hr (22nd March 2009)

[17] A. Damodaran, pages.stern.nyu.edu/ ~adamodar (22nd March 2009)

[18] Moody's, www.moodys.com (22nd March 2009)

[19] Zagreb Stock Exchange, www.zse.hr (22nd March 2009)

[20] HEP, *Annual Report 2007*, Zagreb 2008