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Determining the cost of capital for Turkish electricity distribution utilities: Analysis and recommendations*

Mustafa Gözen[1]
Electricity Market Department
Energy Market Regulatory Authority
Ankara, Turkey

Abstract

Turkey has been transforming her electricity market to a competitive one since the electricity market law was approved by the parliament in 2001. As part of the new regime, electricity distribution activities are subject to incentive-based regulation by the energy regulator - EMRA. At the beginning of each implementation period, initial revenue is allowed by EMRA for a distribution utility in which a rate of return for investments in the utility is added. Setting a fair rate is relatively easy for mature markets; however, it is rather difficult for countries like Turkey. The models applicable to Turkey take the perspective of a global investor, provide different results and thus are not helpful as they do not even guide EMRA in accomplishing its tasks. As a result, EMRA is applying the same rate to all utilities. This would be logical when the state or the same private group owns all utilities in the country. However, the Turkish government is now privatizing distribution utilities. Currently, different distribution utilities have different shareholders with different return expectations. Therefore, each utility must be allowed different rates of return. Unfortunately, the models applicable to Turkey provide either countrywide or industry specific cost of capital figures.

Keywords: *Cost of Capital, Electricity Distribution, Electricity Market, WACC, Turkey*

Türkiye'de elektrik dağıtım şirketleri için sermaye maliyetinin belirlenmesi: analiz ve öneriler

Özet

Türkiye, Elektrik Piyasası Kanunu'nun 2001 yılında TBMM'de kabul edilmesiyle birlikte elektrik piyasasını rekabete dayalı hale dönüştürmektedir. Yeni piyasa yapısının parçası olarak, elektrik dağıtım şirketleri enerji düzenleme kurumu olan EMRA'nın teşvik esaslı düzenlemesine tabidir. Herbir uygulama döneminin başında, dağıtım şirketine yaptığı yatırımlara karşılık olarak bir getiriyi de içeren başlangıç gelir tavanı EMRA tarafından belirlenmektedir. Gelişmiş ülkeler için makul bir getiri oranının belirlenmesi göreceli olarak kolay olmasına rağmen bu işlem Türkiye gibi ülkeler için oldukça zordur. Türkiye için uygulanabilir modeller küresel yatırımcı perspektifini benimsemekte, farklı sonuçlar üretmekte, EMRA'ya görevlerini yerine getirmede kılavuzluk görevi yapmamakta ve yardımcı olamamaktadır. Bu itibarla, EMRA tüm şebeke şirketlerine aynı getiri oranını uygulamaktadır. Bu şekildeki bir uygulama, kamunun veya aynı özel şirketin ülkedeki tüm şebeke şirketlerine sahip olması halinde tutarlı olacaktır. Ancak, Türkiye'deki hükümet halen dağıtım şirketlerini özelleştirmektedir. Mevcut durum itibarıyla, farklı

[1] *mgozen@epdk.org.tr (M. Gözen).*

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dağıtım şirketleri farklı getiri beklentilerine sahip ortaklık yapısına sahiptir. Sonuç olarak, herbir dağıtım şirketine farklı getiri oranı verilmesi gerekmektedir. Ancak, Türkiye'de uygulanabilir modeller ya ülke bazında ya da endüstri bazında sermaye maliyeti değerleri üretmektedir.

Anahtar Sözcükler: *Sermaye Maliyeti, Elektrik Dağıtımı, Elektrik Piyasası, WACC, Türkiye*

1. Introduction

As an emerging economy that seeks to become a full member of the European Union, Turkey took the initiative to open her electricity market to competition in 2001. In this regard, Electricity Market Law (the law) regulating electricity market was passed by the Turkish Grand National Assembly to start a new era in the market [1]. The design and legal framework of the new market is adapted from that of the European Union.

Although the legal framework and market design are in place and mainly comply with that of the European Union, Turkey is facing some difficulties in applying the legislation. Consequently, policy makers in Turkey have opted for a transitional period in the market before the market structure as outlined in the law is fully applied. With regard to the difficulties, the major ones are the dominant position of the state enterprises in the market, the incompletion of privatization, high level of technical and commercial losses in the network, and the stranded liabilities of the previous period due to agreements of built-operate-own (BOO), built-operate-transfer (BOT), and transfer of operating rights (ToOR) signed between the government and private investors.

As part of the transitional period in electricity sales, a national tariff system supported by a price equalization mechanism is applied all over Turkey, and this will end at the close of 2012 [1]. That is to say that the same customer group is charged with the same tariff, no matter where the customer group is located. By using the price equalization mechanism, cash flow deficiencies of some utilities due to high level of losses are balanced through TETAS from the utilities with excess cash flows. TETAS is the state owned electricity trading company.

For distribution networks, the full implementation of incentive-based tariff regulation with efficiency and quality parameters added to the tariff formula has started since the beginning of 2011 [1]. One of the main difficulties in the existing and future periods is expected to be the estimation of an acceptable cost of capital for utilities for their spending on investments. On the assumption that setting an acceptable rate causes some debates even in matured markets, determining a reasonable rate will be much more difficult in Turkey as an emerging market. The legal duty of allowing a rate of return for utilities is given by the law to the energy regulator of Turkey- EMRA. Certainly, EMRA needs powerful and reliable tools to accomplish this specific task.

There are some models for estimating the cost of capital. But theoretically, they are developed for investors in matured markets entering the international market. Thus, the main purpose of this article is to review the models developed for the international market and, if possible, apply them to Turkish electricity distribution utilities, discuss the results, and make some recommendations to EMRA.

Therefore, this article is organized as follows. The second section gives a short summary and application of the legislation regarding network tariff regulation for electricity distribution utilities in Turkey and then discusses the legislation and its implementation. The third section reviews the literature about the cost of capital estimation in the international setting, calculates cost of capital for distribution utilities in Turkey using various models, and discusses the results. The fourth section makes some recommendations to EMRA. The final section evaluates what has been covered, provides some comments on the critical issues and concludes the article.

2. Distribution Utilities and Tariff Regulation

2.1. Review of the Existing Legislation

In Turkey, as stated earlier, distribution utilities are subject to incentive-based regulation and the first period with full implementation commenced in 2011.

The distribution utilities have two main revenue components. The first one is the distribution use of system price, aiming to recover costs arising from construction, operation and maintenance of distribution assets, and the second is the distribution system connection charge, aiming to recover costs arising from the connection of users to the system. The connection charges aim to recover the costs arising due to system connection requests. They are determined in a manner that reflects the expenditures related to the connection assets constructed in the name of a real person or legal entity connected to the system as well as the expenditures related to the construction of such assets.

In the Regulatory Accounting Guidelines (RAG) [2], the term *'opportunity cost'* is used and defined as "*the cost of financial resources that is calculated with due regard to (a) the return that could have been earned if the same resources were used in alternative investments and (b) considering the risks specific to the related business.*" According to the legislation, the weighted average of opportunity cost is determined with due regard to the borrowing rates and rate of return on investment in the market. RAG includes provisions regarding the cost of capital allowed for non-amortized investments [2]. The cost of capital on non-amortized investments is calculated by multiplying non-amortized investments and WACC.

Within the context of RAG, the calculation of regulatory asset base is clearly explained, detailed tables are annexed to RAG for utilities to complete and submit to EMRA. EMRA is authorized to determine the rate of return within the framework of the capital asset pricing model and other available models, in consultation with investors and financial institutions. EMRA uses the WACC methodology when setting rates for utilities. Although the same rate is applied to all utilities, there is no WACC calculation methodology or guidelines explaining how to pursue a consultation process in writing and open to the public via the internet.

2.2. The Current Implementation

The law was amended by the law no. 5496 in 2006. According to the amending law, distribution companies were not required to apply cost-based tariffs for electricity retail sales during the transitional period until the end of 2012. During that period, the price equalization mechanism will be implemented. For tariffs of distribution network services, there was also a transition period, which ended on December 31, 2010.

Following this transitional period, in 2011 and later, a hybrid of revenue/price cap will be implemented as stated in the law. That means that, in real terms, incentive-based tariffs prepared by 21 regional distribution utilities will be submitted for the approval of EMRA. In this regard, investment and operating expenditures of the utilities will be monitored in the new implementation period. In addition, in the new period, as part of the incentive-based regulation, technical and quality parameters will be reflected in revenue caps determined by EMRA for the utilities.

3. Cost of Capital Calculations

3.1. Literature Review

According to many authors like Grout [3], Alexander and Irwin [4], Whittington [5], and Rocha et al. [6], not only rate of return regulation, but also incentive-based regulation requires a careful determination of an acceptable rate and, thus rate setting still remains a key issue for the regulator. This is a challenging task for regulators in emerging countries like Turkey. The models suggested for the international setting are summarized in Table 1. It is important to note that these models are developed to help investors in developed markets. That is one aspect that the reader should remember when evaluating the models. Indeed, emerging countries need foreign sources to develop the infrastructure and new power investments to meet growing demands for energy, and then rate setting plays a critical role to attract the necessary investment to the country.

The models could be classified from different perspectives. For example, Sabal initially classifies them as practical and academic models [7]. Practical models are those that consider the addition of a country risk premium, but lack any theoretical justification. Then Sabal divides academic models as conceptual and empirical models [7]. On the other hand, Pereiro classifies the models as CAPM based and non-CAPM models [8].

As seen from Table 1, in a large number of the models, such as the Godfrey and Espinosa Model, the Goldman Sachs Model, the local CAPM, the SalomonSmithBarney Model, the Beta Approach, the Lambda Approach, the Bludgeon Approach, and the risk premium approach, country risk premium is considered as an undiversifiable risk factor and added to the models in response to a reward for this risk. This is questionable from the viewpoint of finance theory because the CAPM model assumes that investors have diversified portfolios and could only expect rewards for the market risk, which is undiversifiable by any means. Since most academicians accept that the country risk is diversifiable and no allowance is needed for it, it could be said that the allowance of any reward for country risk in regulatory decisions means transferring wealth from consumers to investors, namely well-diversified ones [7, 9, 10, 11].

lrisk free rate in the CAPM formula. Furthermore, the Goldman Model 2 uses the relative volatility of the local market with regard to the U.S. market instead of beta of the CAPM. Similar volatility is also used in the models such as the Godfrey and Espinosa Model and the Goldman Sachs Model. These models will likely result in higher cost of capital in countries where the relative volatility is high.

The Implied Cost of Capital Model is based on finding the discount rate or cost of equity by discounting cash flows to equity holders. It is obvious that this model could only be applicable in efficient and mature markets, not in developing markets with relatively illiquid markets. This model assumes a correct pricing of the underlying stock, which is lacking in most developing countries.

The Bekaert and Harvey Model attempts to include the evolution of the financial integration between countries in the model. In this regard, their suggestion has a time-varying methodology. Nevertheless, the difficulty remains as to how to calculate the degree of integration and include it in the formula. Since the incentive-based tariff regime sets the cost of capital allowed in advance, how the changes in the cost of capital is adjusted in tariff formula remains a question for regulators. Bekaert and Harvey's dynamic model does not match the requirement of the incentive-based regulation because this tariff regime does not envision any adjustment in the tariff formula during the implementation period.

Definitions of symbols and parameters used in Table 1

Symbol/Parameter	Definition
R_e	The cost of equity
R_f , R_{fl} , R_{fu} , R_{fw} , R_s	The risk free rate, the local risk free rate, the U.S. risk free rate, the global risk free rate, and the sovereign spread respectively
R_{ml} , R_{mu} , R_{mw}	The local market return, the U.S. market return, and the global market return respectively
β_l	The beta of the local company computed against the local market index
β_u	The beta of the U.S. company computed against the U.S. market index
β_w	The beta of the local company computed against the global market index
R_c	The country risk premium
R_a	Additional risk premium depending on the country where the investment is made
β_p	The beta of the relevant industry with respect to the world market. This parameter refers to the industry beta in the SalomonSmithBarney Model. On the other hand, it refers to the beta of a U.S. based project that is a proxy for a foreign project in the Lessard Model.
β_c	The beta of the relevant country with respect to the world/U.S. market. This refers to the relative sensitivity of the returns of the local stock market to the U.S. market returns in the Lessard model. It refers to the slope of the regression between the local equity market index and the global market index in the Adjusted Hybrid Model.
β_{gu}	The average unlevered beta of comparable companies listed in the global market. It requires relevering with the target leverage.
β_n	The sensitivity to factor *n*
B_{wp}	The weighted beta of projects in different locations (See Sabal [7])
ρ_{sb}	The correlation between the stock and bond markets of the country
σ_c	The standard deviation of returns in the local equity market
σ_u	The standard deviation of returns in the U.S. equity market
γ_1	A firm related score indicating access to capital markets, $0 \leq \gamma_1 \leq 10$, and a score of *0* indicates the best access.
γ_2	The susceptibility of the industry to political intervention, $0 \leq \gamma_2 \leq 10$, a score of *0* indicates the least susceptibility.
γ_3	The portion of the firm's total assets at the local level, $0 \leq \gamma_3 \leq 10$, a score of *0* indicates that the investment at the local level constitutes only a small portion.
CR	Country credit rating of the relevant country
λ	Measures the degree of integration and $0<\lambda<1$. If $\lambda=1$, it means that markets are fully integrated. If $\lambda=0$, it means a fully segmented market.
RM	A downside risk measure, the ratio between the semi-standard deviation of returns with respect to the mean in the market concerned and the semi-standard deviation of returns with respect to the mean in the world market
CF_t	Expected cash flows to equity holders in time *t*
P_t	Market price of the equity traded in an organized stock exchange
f_n	Factors affecting expected return
R_i^2	The amount of variance in the equity volatility of the target company that is explained by the country risk
R^2	The coefficient of determination of the regression between the equity volatility of the local equity market against the variation in country risk

Table 1 List of the Models for the International Setting

Models	Source	Cost of equity formula and short description
The Goldman Sovereign Spread Model (The Goldman Model 1)	Mariscal and Lee [12], Harvey [13],	$R_e=R_s+\beta_w(R_{mw}-R_{fw})$
Country risk premium (R_c) is added to the CAPM formula instead of the U.S. market risk premium of ($R_{mu}-R_{fu}$)	Sabal [7]	$R_e=R_{fu}+\beta_u R_c$
The Beta Approach	Damodaran [14], [15, 16]	$R_e=R_{fu}+\beta_u(R_{mu}-R_{fu}+R_c)$
The Bludgeon Approach		$R_e=R_{fu}+\beta_u(R_{mu}-R_{fu})+R_c$
The Lambda Approach		$R_e=R_{fu}+\beta_u(R_{mu}-R_{fu})+\lambda R_c$
Risk Premium Approach	Voll et al. [17]	The cost of equity is calculated by adding the country long-term debt rate and the global market risk premium.
		The cost of equity is calculated by adding the cost of equity for a U.S. utility and the country risk premium.
The Goldman Sovereign Spread Volatility Ratio Model (The Goldman Model 2)	Harvey [13]	$R_e=R_s+(\sigma_c/\sigma_u)(R_{mw}-R_{fw})$
The Godfrey and Espinosa Model	Godfrey and Espinosa [18], Pereiro [8]	$R_e=R_{fu}+R_c+0.60(\sigma_c/\sigma_u)(R_{mu}-R_{fu})$
The Goldman Sachs Model	Pereiro [8], Mariscal and Hargis [19]	$R_e=R_{fu}+R_c+\beta_l(R_{mu}-R_{fu})(1-\rho_{sb})(\sigma_c/\sigma_u)$ where $0<\rho_{sb}<1$
The Adjusted Hybrid CAPM	Pereiro [20]	$R_e=R_{fw}+R_c+\{\beta_c[\beta_{gu}(R_{mw}-R_{fw})]\}(1-R^2)$
The Lessard Model	Pereiro [8], Lessard [21]	$R_e=R_{fu}+R_c+(\beta_p\beta_c)(R_{mu}-R_{fu})$
The SalomonSmithBarney Model	Pereiro [8], Zenner and Akaydin [22]	$R_e=R_{fw}+\{(\gamma_1+\gamma_2+\gamma_3)/30)\}R_c+\beta_p(R_{mw}-R_{fw})$ where $0\leq\gamma_n\leq 10$
The Adjusted Local CAPM	Pereiro [20]	$R_e=R_{fw}+\beta_l(R_{ml}-R_{fl})(1-R_i^2)$
The Local CAPM	Pereiro [8]	$R_e=R_{fw}+R_c+\beta_l(R_{ml}-R_{fl})$
The Modified International CAPM	Sabal [7]	$R_e=R_{fu}+\beta_{wp}(R_{mw}-R_{fw})$
Estrada's Downside Risk Model	Estrada [23]	$R_e=R_{fu}+RM(R_{mw}-R_{fw})$
Arbitrage Pricing Theory	Ross [24]	$R_e=R_f+\beta_1 f_1+\beta_2 f_2+\ldots+\beta_n f_n$
The Erb, Harvey, and Viskanta Model	Erb et al. [25, 26]	$R_e=\varepsilon_0+\varepsilon_1 lnCR$, where ε_0 and ε_1 are regression parameters.
The Implied Cost of Capital Model	Damodaran [14], Lee et al. [27, 28]	$P_t=\sum_{t=1}^{\infty}\frac{CF_t}{(1+R_e)^t}$
The Bekaert and Harvey Model	Bekaert and Harvey [29]	$R_e=R_{fl}+(1-\lambda)\beta_l(R_{ml}-R_{fl})+\lambda\beta_w(R_{mw}-R_{fw})$
The Ibbotson Bayesian Model	Harvey [13]	It is a hybrid of the global CAPM. First, world market risk premium is calculated. Second, the country equity return minus the risk free rate is regressed on the global market portfolio return minus the risk free rate. Third, this country beta is multiplied by world market risk premium. Finally, an additional factor of '0.5 times the intercept from the initial regression' is also included to the result of the multiplication.

In addition, the Modified International CAPM deals with the adjusted beta for activities in different locations, namely in different countries. This model would not help regulators because they are responsible for only the domestic market. In the case of the Arbitrage Pricing Theory, the regulator will likely be in a difficult situation in deciding what inputs to use because the model allows the user complete freedom in this respect.

The Erb, Harvey, and Viskanta Model attempts to establish a relation between cost of equity and the country credit rating. This would be an alternative model for countries with no stock exchange.

From the models suggested, one can conclude that there are no accepted models among academicians and practitioners in the international setting. Pereiro [8, 20], Sabal [7], Harvey [13], and Estrada [30] would be worth reading to have more insights into the discussion of the models, including their weaknesses.

3.2. Calculation Methodology for WACC

In this article, the real pre-tax WACC approach (Eq.1) is used to estimate the cost of capital for electricity distribution utilities in Turkey. The reason for selecting a real WACC is that incentive-based tariff regulation allows the adjustment of changes in the inflation rate in subsequent years. This approach eliminates dealing with, and spending time on tax issues as long as the statutory tax rate is stable and the effective tax rate varies within reasonable limits.

$$WACC_{pre-tax} = \left[\left(\frac{E}{D+E}\right) * R_e (1-T)^{-1}\right] + \left[\left(\frac{D}{D+E}\right) * R_d\right] \qquad (1)$$

In Eq.1, R_e is the cost of equity capital, R_d is the cost of debt, T is statutory tax rate, and D and E are target debt and equity ratios for the utility.

To estimate the cost of equity, the applicable models to Turkey are selected among the available models in the international setting. The cost of debt is calculated by adding a margin over the risk free rate for Turkey. For example, 10-year Turkish Eurobonds issued in U.S. dollars is taken as a reference and a certain debt premium is added to the average rate of this debt instrument to arrive at a cost of debt figure for the electricity distribution utility.

In general, the rate of a government issued debt instrument is accepted as a risk free rate. It is, however, helpful to follow the recommendation of Copeland et al. [31] to calculate the risk free rate because the international debt instrument implicitly includes a sovereign premium. Therefore, the sovereign premium is subtracted from the rate of the Turkey's Eurobond and the long-term future inflation differential between Turkey and the U.S. is added to arrive at a risk free rate for Turkey.

The benchmark beta is relevered using the Hamada conversion method (Eq.2) used before in the selected cost of equity models. In Eq.2, β_e is the levered beta (equity beta) and β_a is the unlevered beta (asset beta). Therefore, the beta applied to utilities reflects the target gearing.

$$\beta_e = \beta_a * \left[1 + (1-T)\frac{D}{E}\right] \qquad (2)$$

It is assumed that the U.S. risk free rate represents the world risk free rate and the U.S. market risk premium represents the world market risk premium.

In calculations, first nominal pre-tax WACC is calculated by using Eq.1. Then this value is converted to real pre-tax WACC by using the adjusted Fisher Formula, which is written as *(1+nominal-pre tax WACC)=(1+real pre-tax WACC value)*(1+expected inflation)*.

3.3. Selection of Applicable Models

There are many models, but some of them given below are not considered as suitable for application to Turkey because there is no listed electricity distribution utility in the Istanbul Stock Exchange (ISE) or in other stock exchanges. These models are the Adjusted Local CAPM, Estrada's Downside Risk Model, the Erb, Harvey, and Viskanta Model, the Implied Cost of Capital Model, the Ibbotson Bayesian Model, the Goldman Sachs Model, and the Local CAPM.

In addition, The Bekaert and Harvey Model and the Adjusted Hybrid CAPM are not used because the inputs required for these two models could only be calculated using data obtained by a subscription to the relevant data provider. The input data needed are biannual country risk ratings for the Bekaert and Harvey Model and J.P. Morgan emerging markets bond index (EMBI) for the Adjusted Hybrid CAPM.

Pereiro recommends to calculate ($1-R^2$) by regressing local equity market volatility against country risk variation using Emerging Markets Bond Index (EMBI) [20]. The Modified International CAPM deals with the adjusted beta for activities in different locations. However, there is no clear guideline for inputs to the Arbitrage Pricing Theory. Hence, they are not applied for tariff setting purposes by regulators.

Beta and relative volatility values between Turkish and other markets are given in Table 2. As seen from Table 2, correlation coefficient and beta values between 2001 January and 2010 June are quite volatile, therefore the application of models using the relative volatility and/or country beta as inputs is subject to questioning.

Table 2 Beta Values Between Turkish, the U.S. and World Markets

Period	Beta		Relative volatility
	ISE vs. S&P 500	ISE vs. MSCI World	(σ_c/σ_u)
2001 January - 2010 June	0.39	0.70	2.30
2005 January - 2010 June	0.66	0.73	2.64
2007 January - 2010 June	0.72	0.77	2.38
2008 January - 2010 June	0.75	0.79	2.34
2009 January - 2010 June	0.73	0.80	1.93
2009 July - 2010 June	0.55	0.66	2.16
2010 January - 2010 June	0.53	0.63	2.06

Notes: For Turkish equity market, ISE 100 index (called as IMKB 100 Index in Turkish), for the U.S. equity market, S&P 500 Index, and for the global equity market, MSCI World Index is used.

The remaining models appropriate for Turkey are mainly those that foresee the addition of a country risk premium and/or adjusting/modifying beta by multiplying relative volatility in the local equity market versus the local debt market or the matured equity market (namely the U.S. market). Since electricity distribution utilities only serve the domestic market in Turkey, the Lambda Approach is identical to the Bludgeon Approach when λ is set to 1.

3.4 Input Data for the Models

One of the main inputs for the models is the risk free rate. For this purpose, the changes in rates and spreads of Eurobonds issued by the Turkish government in US Dollars with a maturity date of March 11, 2019 are given in Figure 1.

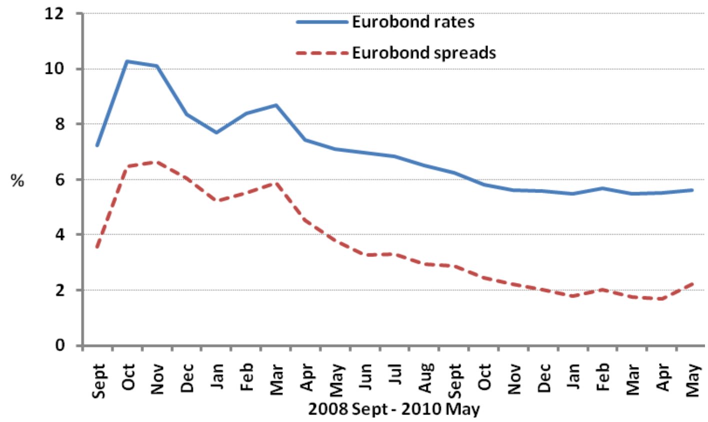

Figure 1 Eurobond Spreads since 2008 September

Source: Undersecretariat of Treasury of Republic of Turkey [32].

While the arithmetic average of the spreads for 2008 September to 2010 May is 3.62%, the same value for 2009 June to 2010 May is 2.37%, which is taken as the sovereign spread in the calculations. On the other hand, the arithmetic average of Eurobonds rates for 2008 September to 2010 May is 6.98% and the same value for 2009 June to 2010 May is 5.95%, which is taken as a reference Eurobond rate in the calculations.

The sovereign rate of 2.37% is subtracted from the rate of the Turkey's Eurobond and the long-term future inflation differential between Turkey and the U.S. is added to arrive at a risk free rate for Turkey. Then a risk free rate of 5.58% (5.95-2.37+2.00) for Turkey is calculated [10, 33, 34].

The long-term future inflation rate differential between Turkey and the U.S. is assumed to be 2.0, considering the inflation performance of both countries in the last 10 years and the inflation rate forecasts. The inflation data for Turkey is obtained from the internet site of Central Bank of the Republic of Turkey [33] and the U.S. inflation data is obtained from InflationData.com [34].

As an alternative, Pereiro calculates local risk free rate by adding the U.S. risk free rate and country risk premium [20]. This alternative also gives a risk free rate of 5.87% (3.50+2.37), which is very close to the value calculated by the methodology of Copeland et al. [31].

While the volatility of Turkey's equity market for that period is 14.90%, the volatility of the debt market is 7.14%. Then the relative standard deviation of the Turkish equity market with regard to the Turkish debt market for the period of 2001 January to 2010 June is calculated as 2.09. For the same period, the relative volatility of the Turkish equity market with regard to the U.S. market is 2.30.

Except for the Beta Approach and the Bludgeon Approach, country risk premium and sovereign spread are taken as 2.37%. In addition, country risk premiums for the Beta Approach and the Bludgeon Approach are calculated by using the following methodologies reported by Damodaran [14, 35].

1) Country risk premium depending on the country credit rating (4.50%) [36, 37]. Turkey's credit rating is Ba2 assigned by Moody's. This rating is used to calculate the corresponding country risk premium for Turkey using Damodaran`s methodology [36]. Damodaran multiplies the basis point for credit rating assigned by a rating agency by 1.5 to calculate the country risk premium. In the case of Turkey, the basis

point for a credit rating of Ba2 is 300 points, this is multiplied by 1.5, and the result is 4.5%.

2) Credit default swap spread (CDS) (2.10%) [38]. Arithmetic average of 5-year credit default swap spreads for Turkey for the period of August 26, 2009 - August 23, 2010 is 1.76%. Daily data is used. Furthermore, Deutsche Bank Research reports annual CDS of 2.10% for Turkey at 20% probability of default as of August 23, 2010 [38]. The same value is 1.80% at 10% probability of default and 3.70% at 60% probability of default. The 20% probability of default is taken as a reference [38]. But, CDS value depends on one's perception of probability of default.

3) Sovereign spread (2.37%)

4) Sovereign spread multiplied by the volatility in the Turkish stock market with regard to the Turkish debt market. Country risk premium could be formulated as (2.37*2.09) = 4.95%.

5) The U.S. equity risk premium multiplied by the volatility in the Turkish stock market with regard to the U.S. stock market. Then the U.S. equity risk premium is subtracted from the result. Country risk premium could be formulated as $2.30*(R_{mu}-R_{fu}) - (R_{mu}-R_{fu}) = 1.30*(R_{mu}-R_{fu})$. Depending on the value of the U.S. market risk premium (4%, 5%, and 6%), the corresponding country risk premium will be 5.20%, 6.50%, and 7.80%.

The SalomonSmithBarney Model requires the input of utility-specific subjective parameters. The parameters, γ_1 and γ_2 are set to zero because all utilities have equal access to financing opportunities and are exempt equally from the political intervention while γ_3 is set to 10 because utilities operate in the domestic market.

The cost of debt is calculated by adding debt premium to the risk free rate for Turkey. Debt premium is assumed as 1.50%, considering corporate bond spreads over U.S. Treasury Bonds. Furthermore, in practice, a debt premium of 1.5% has widespread acceptance [39].

From the studies and comments in Koller et al. [40] and Welch [41], market risk premium ranges from 4% to 6%. The Federal Reserve Bank of Cleveland reports that its latest estimate of 10-year expected inflation is 1.69% [42].

In general, asset beta for electricity utilities ranges between 0.35-0.50. For example, Independent Pricing and Regulatory Tribunal of New South Wales reports an asset beta of 0.35-0.50 for Australian electricity distribution utilities [43] and Damodaran calculates asset beta of 0.48-0.49 for electricity utilities in different regions of the U.S [44]. Since electricity distribution utilities under incentive-based regulation face more risk, the highest value of the range is used in calculations.

As a U.S. risk free rate, the rate of the 10-year U.S. Government bond is used. The average rate of 10-year U.S. Government bond for 2008 January to 2010 June is about 3.5% [45]. Even though there is room for tax benefits from higher leverage, half of the capital structure of the utilities is foreseen as equity.

The parameters used in the calculations are summarized in Table 3.

Table 3 List of Parameters

Parameters	Value
Risk free rate for Turkey (%)	5.58
Risk free rate for the U.S. (%)	3.50
Debt premium (R_{pr}) (%)	1.50
Cost of debt (%) (5.58 + 1.50)	7.08
Market risk premium (%)	4 - 6
Electricity utility asset beta (unlevered beta)	0.50
Electricity utility equity beta (levered beta)[a]	0.90
Debt/equity ratio (%/%)	50% / 50% = 1
Country risk premium / sovereign risk (%)	2.37
Credit default swap spread (%)	2.10
Statutory tax rate (%)	20
Standard deviation of returns in the equity market of Turkey (%)[b]	14.90
Standard deviation of returns in the debt market of Turkey (%)[b]	7.14
Standard deviation of returns in the equity market of U.S. (%)[b]	6.49
Beta between Turkish equity market return and the U.S. market return[b]	0.39
Beta between Turkish equity market return and the global market return[b]	0.70
10 year expected inflation rate for the U.S. (%)	1.69
Long-term inflation rate difference for Turkey and the U.S. (%)	2.00
γ_1, γ_2, γ_3 parameters in The SalomonSmithBarney Model	$\gamma_1 = \gamma_2 = 0$ and $\gamma_3 = 10$

[a] *The asset beta of 0.5 is relevered by using Hamada conversion method.*

[b] *Monthly data for the period from 2001 January to June 2010 are used. For Turkish equity market, ISE 100 index (called as IMKB 100 Index in Turkish), for the U.S. equity market, S&P 500 Index, and for the global equity market, MSCI World Index is used.*

3.5 Results and Discussion

Cost of capital estimation results are summarized in Table 4. As mentioned in earlier section, the correlation coefficient and country beta for Turkey from 2001 to 2010 are volatile. Real pre-tax WACC values are calculated by using different correlation coefficients and country betas and the results are reported in Table 5.

As seen from Table 4, the results change from 4.86% to 11.34%. It seems that the model based on addition of a country risk premium instead of the U.S. market risk premium provide unrealistic results, which are close to the U.S. risk free rate while Damodaran's proposal of country risk premium based on the relative volatility of Turkey's equity market to the U.S. market provides relatively higher results compared with those of other models.

If all results are taken into consideration and the market risk premium is assumed to be 6%, then the arithmetic average becomes 8.64% with a standard deviation of 1.71%. Again assuming the same market risk premium and ignoring the result of the model based on the addition of a country risk premium instead of the U.S. market risk premium, the results are between 6.18% and 11.34% with an average value of 8.28% and a standard deviation of 1.77%.

Referring to Table 5, when the Goldman Model-2 is applied to Turkey, assuming a 6% market risk premium, the result changes from 9.98% to 12.63% depending on the different volatility of Turkey's equity market with regard to the U.S. equity market.

On the other hand, EMRA estimated a real pre-tax WACC of 10.49% for the second implementation period between January 1, 2011 and December 31, 2015 [46]. The approved WACC seems reasonable when compared with the results of different models.

Table 4 Weighted Average Cost of Capital Estimates

Model	Formula for estimating cost of equity		Real pre-tax WACC (%) Market Risk Premium[a] (%)		
			4	5	6
R_c is added instead of the U.S. market risk premium.	$R_e= R_{fu}+\beta_u R_c$ =3.50+0.90*(2.37)		4.86	4.86	4.86
Beta Approach	$R_e=R_{fu}+\beta_u(R_{mu}-R_{fu}+R_c)$=3.50+0.90$(R_{mu}-R_{fu}+R_c)$				
	Country risk premium (R_c) (%)	1.86	6.80	7.35	7.90
		2.37	7.08	7.64	8.19
		4.50	8.26	8.81	9.36
		4.95	8.50	9.06	9.61
		1.30*$(R_{mu}-R_{fu})$	8.65	9.91	11.19
Bludgeon Approach	$R_e= R_{fu}+\beta_u(R_{mu}-R_{fu})+R_c$ = 3.50+0.90$(R_{mu}-R_{fu})+R_c$				
	Country risk premium (R_c) (%)	1.86	6.91	7.46	8.01
		2.37	7.23	7.78	8.33
		4.50	8.54	9.09	9.64
		4.95	8.81	9.36	9.91
		1.30*$(R_{mu}-R_{fu})$	8.96	9.76	10.56
Goldman Model-1	$R_e=R_s+\beta_w(R_{mw}-R_{fw})$=2.37+0.90$(R_{mu}-R_{fu})$		5.80	5.63	6.18
Risk premium approach	$R_e= R_{fl}+(R_{mu}-R_{fu})$=5.58+$(R_{mu}-R_{fu})$		7.29	7.91	8.53
	R_e for a utility in Turkey=R_e for a utility in the U.S.+R_c=3.50+2.37+0.90$(R_{mu}-R_{fu})$		7.05	7.60	8.15
Goldman Model-2	$R_e=R_s+(\sigma_c/\sigma_u)(R_{mw}-R_{fw})$=2.37+2.30$(R_{mu}-R_{fu})$		8.51	9.93	11.34
Godfrey and Espinosa Model	$R_e=R_{fu}+R_c+0.60(\sigma_c/\sigma_u)(R_{mu}-R_{fu})$=3.50+2.37+(0.60*2.30)$(R_{mu}-R_{fu})$		8.40	9.25	10.10
Lessard Model	$R_e=R_{fu}+R_c+(\beta_p\beta_c)(R_{mu}-R_{fu})$ =3.50+2.37+(0.90*0.39)$(R_{mu}-R_{fu})$		5.88	6.09	6.30
SalomonSmith Barney Model	$R_e=R_{fw}+\{(\gamma_1+\gamma_2+\gamma_3)/30)\}R_c+\beta_p(R_{mw}-R_{fw})$=3.50+(10/30)*2.37+0.90$(R_{mu}-R_{fu})$		6.25	7.36	7.36

[a] It represents the U.S. market risk premium over the U.S. risk free rate and is formulated as $(R_{mu}-R_{fu})$.

Table 5 WACC Values for Different Country Betas (B_c) and Relative Volatilities (σ_c/σ_u)

Models	Country beta (β_c) *(ISE vs. S&P 500*	Real pre-tax WACC (%) Market risk premium (%)		
		4	5	6
Lessard Model	0.39	5.88	6.09	6.30
	0.53	6.19	6.48	6.78
	0.55	6.23	6.54	6.84
	0.66	6.48	6.84	7.20
	0.72	6.60	7.00	7.40
	0.73	6.63	7.03	7.44
	0.75	6.68	7.09	7.50
	Relative Volatility (σ_c/σ_u)			
Goldman Model-2	1.93	7.60	8.79	9.98
	2.06	7.93	9.19	10.46
	2.16	8.18	9.50	10.83
	2.30	8.51	9.93	11.34
	2.34	8.61	10.05	11.49
	2.38	8.71	10.18	11.64
	2.64	9.35	10.98	12.63
Godfrey and Espinosa Model	1.93	7.86	8.58	9.29
	2.06	8.05	8.81	9.58
	2.16	8.20	9.00	9.79
	2.30	8.40	9.25	10.10
	2.34	8.46	9.33	10.19
	2.38	8.53	9.40	10.28
	2.64	8.90	9.88	10.85

The models applicable to Turkey do not provide utility-specific cost of capital values even though finance theory informs us that return expectations of the utility's shareholders are more important than that of the concerned utility [47, 48, 49]. However, the SalomonSmithBarney Model would not be easy to apply for the regulator because it requires input parameters, which are subjective and difficult to differentiate on the utility basis. As a result, the regulator is likely to apply the same value of parameters to all utilities.

It seems that the models do not consider the specific ownership structure of the utilities. As long as all distribution utilities are owned and operated by the state or the same private group, this would be the right approach. However, as noted earlier, most of the distribution utilities are being privatized in Turkey and it is predicted that all privatization will be completed by the beginning of 2012.

Electricity distribution utilities in Turkey and the diversification status of equity holders are given in Table 6. As can be seen from Table 6, some utilities are owned by the state and in this case, it is difficult to comment on their diversification status. Regarding the indirect owners of the state owned utilities, would it be right to assume that the indirect owners are citizens or taxpayers? [50]. This is a controversial issue and there is no generally accepted viewpoint. Therefore, local diversification for wholly state owned utilities has been assumed because this would be the most logical approach, no matter which viewpoint is accepted.

Table 6 Equity Holders and Their Diversification Status

Distribution utilities	Shareholder structure		Status of diversification	Which CAPM index?
	Shareholders	Equity (%)		
Akdeniz Electricity Distribution Co.	Local private	100	Locally diversified	Local
Aras Electricity Distribution Co.	Local private	100	Locally diversified	Local
Aydem Electricity Distribution Co.	Local private	100	Undiversified	Local
AYEDAS Electricity Distribution Co.[a]	Local private	100	Globally diversified	Global
Baskent Electricity Distribution Co.	Local private	50	Globally diversified	Global
	Foreign private	50	Globally diversified	
Bogazici Electricity Distribution Co.	Local private	100	Globally diversified	Global
Camlibel Electricity Distribution Co.	Local private	100	Locally diversified	Local
Coruh Electricity Distribution Co.	Local private	100	Locally diversified	Local
Dicle Electricity Distribution Co.	Locally private	100	Locally diversified	Local
Firat Electricity Distribution Co.	Local private	100	Locally diversified	Local
Gediz Electricity Distribution Co.	Local private	100	Globally diversified	Global
Goksu Electricity Distribution Co.	Local private	100	Locally diversified	Local
Kayseri ve Civari Electricity Co.	State & Municipality	62.9	Locally diversified	Local
	Local private - A	27.6	Locally diversified	
	Local private - B	9.5	Undiversified	
Meram Electricity Distribution Co.	Local private	100	Locally diversified	Local
Osmangazi Electricity Distribution Co.	Local private	100	Locally diversified	Local
Uludag Electricity Distribution Co.	Local private	100	Locally diversified	Local
Sakarya Electricity Distribution Co.	Local private	50	Locally diversified	?
	Foreign private	50	Globally diversified	
Toroslar Electricity Distribution Co.	Local private	100	Locally diversified	Local
Trakya Electricity Distribution Co.	Local private	100	Locally diversified	Local
Vangolu Electricity Distribution Co.	Local private	100	Locally diversified	Local
Yesilirmak Electricity Distribution Co.	Local private	100	Globally diversified	Global

Source: Adapted from Privatization Administration of Republic of Turkey [51] and the internet sites of the shareholders of the utilities. This table is produced using the argument introduced by Sabal [7] which would be stated shortly as the diversification of investors on the local or global basis is the key for deciding which market index to use. Moreover, the table is produced by using information and data based on privatization tender results in Turkey, ignoring whether or not the actual transfer of shares is completed or that there is an ongoing legal debate related to the privatization tender. Notes: The utilities are listed in alphabetical order. The diversification status of shareholders of the utilities is based on the information obtained from the relevant *internet sites of shareholders. The diversification status of the final shareholders in the utility ownership is taken into account. [a] The full commercial name is Istanbul Avrupa Yakasi Electricity Distribution Inc.*

Referring to Table 6, according to the argument introduced by Sabal [7], the regulator could use either local or global market indexes as long as the diversification status is homogenous. However, as in the case of the Sakarya Electricity Distribution Co., the local shareholder is locally diversified while the host shareholder has a globally diversified portfolio. The regulator could consider this particular case when setting rates because two groups of investors in the utility have different risk-return characteristics. The local investor is likely to be rewarded less when the global approach is accepted. This difference of diversification status would be a challenging issue for the regulator when the number of changes in equity owners of utilities increases.

On the other hand, the shareholders of the Baskent Electricity Distribution Co., Yesilirmak Electricity Distribution Co., AYEDAS Electricity Distribution Co., Bogazici Electricity Distribution Co. and Gediz Electricity Distribution Co. are globally diversified and the global market index is appropriate in estimating the cost of capital for these utilities. But, as no distribution utility is listed in ISE or in other stock exchanges, it is not possible to apply the suggestion of Sabal [7].

4. Suggestions to the Energy Regulator

Since estimation is the only tool to determine cost of capital, it is inappropriate to calculate a single rate of return value. Thus the regulator should calculate a range of values with lower and upper bounds and decide on the allowed rate of return within this range [7, 52].

In addition, from the cost of capital viewpoint, each distribution utility is not the same; even it operates the same activity, particularly if it has a different ownership structure with heterogeneous risk-return expectations. This requires that each utility should be analyzed differently from others when setting the cost of capital and then each utility should be allowed different cost of capital depending upon the shareholder structure and other circumstances. Whenever there is a change in the ownership of utilities, this will likely affect the cost of capital of the concerned utility due to the changing risk-return expectations of new equity holders. It is obvious that this requires a dynamic monitoring approach from the regulator.

The observed data of Eurobond rates issued by the Turkish government includes a certain sovereign risk premium and thus cannot be used directly as a risk free rate. As noted earlier, an adjustment of the observed data is necessary before it is used in the calculation. As an alternative, the suggestion of Pereiro [20] would be a solution.

In addition, EMRA should prepare a WACC calculation methodology that its decisions are based on and publish it on its internet page to meet part of the transparency requirements.

EMRA approves the tariffs of natural gas networks as well. Therefore, it would be logical if the same source and parameters are used in all energy tariffs to provide consistency.

All the models discussed take the perspective of a host investor entering Turkey; they do not, however, consider the return expectations of the local investor. Thus the results of the models are questionable. As noted earlier, they are not helpful if the distribution utility has different shareholders with different return expectations.

5. Summary and Concluding Remarks

Turkish energy regular is legally bound to set a fair rate of return for electricity utilities. It is evident that this task plays a critical role in the successful regulation of the market.

Following the end of a transitional period in 2010, Turkey entered a new period in terms of tariff regulation of electricity distribution networks. Even though the determination of an acceptable return accepted by all interested parties is a difficult task in developing countries, this task is even more difficult and expected to be more controversial in Turkey.

On the other hand, the cost of capital concept is future-oriented, and consequently the regulator should base its decision within a range of cost of capital values, instead of a single value.

Because of the recent privatizations, the distribution utilities have different shareholders. That means that different utilities have different return expectations due to their unique ownership structure. Therefore, each utility must be treated separately and as a result, the rate of return allowed must be different for each utility. As long as the return expectations of the shareholders are the same, it would be easy for the regulator to handle this situation. However, if the shareholders of the utility have different risk-return expectations, as in the case of the Sakarya Electricity Distribution Co., then the regulator will likely face with difficulty in harmonizing different return expectations. There is no clear solution to this specific issue.

In conclusion, there are several models developed for the international setting. None of the models is expected to become an international standard in the near future. When the models are applied to electricity distribution utilities in Turkey, the results vary widely and this makes the task of the regulator even more difficult. Depending upon the model selection, the results will be different.

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