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Application of Valuation Model in Iranian Electricity Distribution Companies

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Abstract

One of the main concerns of power system restructuring in developing countries is to divest the asset to private sector. This divestment for electricity distribution companies is more critical and has a vital role in the electricity supply chain because of vicinity to customer. This paper applies the valuation approach for electricity distribution companies. For valuation of the companies, Discounted Cash Flow (DCF) model is used and Terminal Value (TV) model is applied to forecast future costs and incomes of companies in a stable manner. Systematic risks of these companies are taken into account by using Capital Asset Pricing Model (CAPM). Five Iranian electricity distribution companies are selected and considered technically and economically to obtain their valuations. As a result, these companies are ranked based on their valuations and technical factors.

Keywords: Valuation approach; Terminal value; Free cash flow to firm; Discounted cash flow.

1. INTRODUCTION

Privatization has become more common in the world and Iran is not an exception. In recent decades, electricity power industry in Iran has tried to attract private sectors to invest in this industry. The privatization process in electricity power industry was initiated in generation electricity companies and has been continued in electricity distribution companies (Dist. Co.'s).

Electricity distribution companies own and operate electrical distribution network and are responsible to supply electricity to end-customers in Iran. Attracting private sector's capital and transferring state properties to private companies are one of the processes of privatization. Valuation of electricity distribution companies is necessary in this regards. Therefore, this paper evaluates electricity distribution companies from valuation perspectives. The valuation approach can help investors to decide on investing in this field or not.

Similar analysis has been done in Sweden in order to investigate whether it is possible to develop a disaggregated measure of systematic risk and weighted average cost of capital (WACC) for electricity distribution firms [1]. Systematic risk and beta rate are estimated econometrically based on economic and accounting data provided by the energy markets on Sweden and CAPM (Capital Asset Pricing Model) is used to link beta rate and weighted average cost of capital [1].

As another instance, Republic of Moldova has had an experience in valuating distribution companies [2]. The analysis has provided an approximation of the way in which investors would view the companies and establish their own values [2]. In this regard some beneficial factors

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such as WACC, Terminal Value (TV) and cash flow are used.

During the analysis, main indicators of the technical studies are determined and then assessed absolutely and relatively. Technical studies are programmed to be done in two parallel activities. Firstly, it is relatively important to compare indicators, which can be done through two methods of Simple Additive Weighted (SAW) and Analytical Hierarchy Process (AHP). Secondly, distributing companies should be ranked based on each indicator.

There are two main common methods to value a business or company: Discounted Cash Flow (DCF) and Relative Valuation [3].

The DCF method is the most precise and popular method of valuation and it is a main of concern [3]. For instance, Russian electricity distribution companies which have adopted the fundamentally new tariff regime, have chosen the DCF approach for valuation as it is believed that this method is best suited to the specifics of regulation in Russia [4]. In this method, instead of using dividends paid by the company to evaluate the company, Free Cash Flow to Firm (FCFF) is used [3].

The purpose of this paper is to perform the valuation approach for electricity distribution companies in Iran. This valuation is conducted on the basis of the DCF method and TV for five companies that are selected from thirty nine Iranian electricity distribution companies. These companies are prioritized based on economic and technical factors with different weighted coefficients. These techno-economic factors depend on private sectors' perspectives and can help them to decide on investment issues.

This paper proceeds as follows: In section 2 methodology and steps for valuation of electricity distribution companies is described Implementing of the approach is expressed elaborately in section 3. Section 4 is allocated to variable changes and sensitivity analysis. Finally, conclusion is presented in Section 5.

2. VALUATION APPROACH

The DCF analysis is a method of valuing a project, company or asset using the concepts of the time value of money. The DCF approach is widely accepted as the most appropriate valuation method, because it replicates the best way to measure enterprise performance [2]. The DCF method converts future earnings to today's money which can be mentioned as:

$$DCF = \sum_{i=1}^{n} \frac{FCFF_i}{(1+r)^i} + \frac{TV}{(1+r)^{n+1}} \quad (1)$$

where:

$FCFF_n$: Free cash flow to firm for i^{th} year of the projection period;

r: The expected discount rate that can be replaced by weighted average cost of capital (WACC).

To calculate the valuation of each distribution company, this paper uses TV model. The TV can be calculated in three ways: liquidation method, multiple method, and stable growth in perpetuity method [3].

The last method is also referred to as the perpetuity growth method. This method assumes that the FCFF will grow at a constant rate forever; hence, it's another name is stable growth rate method. When growth is constant, (2) is used to calculate the terminal value (TV) based on a perpetual growth model [3]:

$$TV = \frac{FCFF_n(1+g)}{(WACC-g)} \quad (2)$$

where:

$FCFF_n$: Free cash flow to firm for n^{th} year of the projection period;

g: The stable growth rate expected in perpetuity (expected growth FCFFs to grow with perpetuity);

WACC: Weighted average cost of capital (index r in (1)).

In valuation approach, the growth rate (g) can be considered above the expected long-term inflation rate and below or equal to the expected long-term GDP growth rate of the economy.

The WACC is used to calculate the opportunity cost of investing [3]. In other words, calculation

of WACC provides information for private investors to decide whether to participate in this business environment or not [1]. WACC can be calculated by (3):

$$WACC = \frac{D}{D+E} \times r_D (1-t) + \frac{E}{D+E} \times r_E \quad (3)$$

where:

t: Corporate tax rate

r_E: Cost of equity;

r_D: Cost of debt;

E: Market Value of the firm's equity in company's financial structure;

D: Market Value of the firm's debt in company's financial structure.

In formulation of WACC [3], cost of equity can be calculated by using Leveraged Beta (β). To compute r_E, the CAPM is used to link Beta and cost of equity. In CAPM model, the risk associate with each asset in a systematic risk manner is considered for each asset [1]. The formulation of the CAPM is as follows:

$$r_E = r_f + \beta(r_m - r_f) \quad (4)$$

where:

r_f: Risk-free rate that is obtained from treasury bond rate for the period which the projections are being considered.

r_m: Market Return Rate

β: Leveraged Beta

3. IMPLEMENTING THE APPROACH

This section shows how to implement the mentioned valuation approach for electricity distribution companies in Iran. Fig. 1 illustrates flowchart of the DCF approach which is applied in company valuation.

The considered sample includes five distribution companies that are located in different provinces of Iran. These companies are chosen among thirty nine distribution companies based on technical studies.

A. Data Collection and Assumptions

For each of the electricity companies, annual performance report from 2009 to 2011 are collected and considered to extract the technical and economical data of them. These data are shown for five electricity distribution companies in tables 1 and 2; respectively.

In this study, some other assumptions have been applied. One of them is related to beta factor. The main approach to set the value of Leveraged Beta is based on the result of market trend in the same field of industry. The value is based on the relation between company profit and market profit. In [1] and [5], two different experiences for obtaining the β factor in electricity distribution companies are proposed. The accepted range of Beta in electricity power industry is between 0.3 and 0.45 [5].

The other parameters such as growth rate, beta, cost of debt, cost of equity and so on that are used for valuation, are shown in table 3.

B. Analyzing the Past Financial Data

The related financial statements including balance sheet and income statement are evaluated to determine any item that influences on incomes and costs of these companies. Future trends of the companies' costs and incomes can be obtained based on these historical data.

A sample of assets and liabilities is displayed in Fig. 2 and 3 for distribution company no. 2 or Dist. Co. #2.

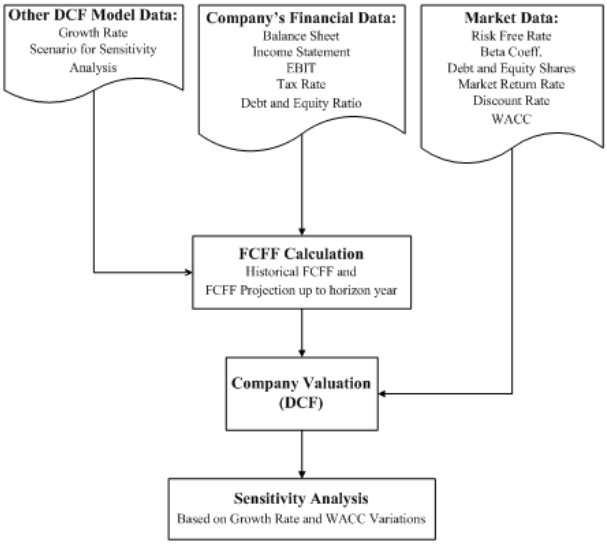

Fig. 1. Flowchart of the DCF approach.

Table 1. ***Macro technical indexes for five electricity distribution companies in 2011.***

Items	Dist. Co. #1	Dist. Co. #2	Dist. Co. #3	Dist. Co. #4	Dist. Co. #5
Area (km^2)	11304	1005	3168	16104	15637
Number of customers (thousands)	439	3824	1172	910	438
Maximum non-coincidence peak load (MW)	2049	3981	1066	989	715
Maximum coincidence peak load MW)	2020	3675	1066	871	602
Total energy consumed (million kWh)	6278	16631	5042	4362	3514
Delivered energy (million kWh)	8111	18553	5644	4767	3957
Number of transformers	11341	15134	8370	8826	9510
Transformers capacity (MVA)	3813	9653	2238	2234	1543
Distribution line length (km)	8289	27204	12916	12072	11093
Distribution losses (%)	23	10	11	8	8
Customer density ($customer/km^2$)	39	3805	57	370	28
Number of employees (persons)	439	2009	589	360	252

Table 2. ***Macro economical indexes for five electricity distribution companies in 2011 (million dollars).***

Items	Dist. Co. #1	Dist. Co. #2	Dist. Co. #3	Dist. Co. #4	Dist. Co. #5
Current assets	44.98	126.50	22.75	29.34	44.31
Non-current assets	79.48	310.13	119.80	87.82	50.31
Current liabilities	62.87	48.92	45.13	13.11	10.96
Non-current liabilities	41.25	86.87	16.06	40.83	35.65

Table 3. ***Considered data.***

Items	Icon	Amount
Growth rate	g	3%
Leveraged Beta [5]	β	0.42
Market value of the firm's debt	D	30%
Market value of the firm's equity	E	70%
Cost of debt	r_d	12%
Tax rate	t	25%
Risk-free rate	r_f	15.5%
Market return	r_m	21%

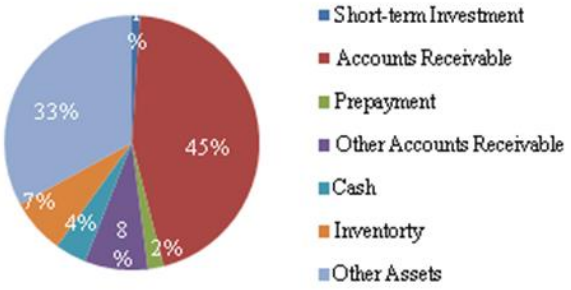

Fig. 2. Asset portions of Dist. Co. 2.

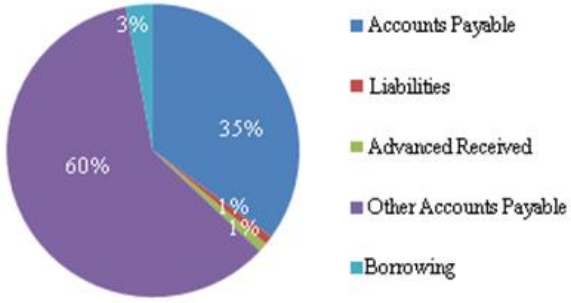

Fig. 3. Total liabilities of Dist. Co. 2.

According to historical balance sheet and income statement report of companies, items of cost and income can be extracted and all these data can be used for developing the future perspective of company's activities. Data of Dist. Co. 2, related to the past three years, is presented in table 4.

C. Forecasting Parameters and Analyzing Financial Data

In this paper, according to the data between 2009 and 2011, the estimated FCFF has been obtained for next five years (2012-2016). In calculation of the FCFF, it is assumed that the company is in stability and its terminal value is calculated with a constant growth rate. Forecasting of the future trend of the costs and incomes of the company is conducted based on geometric mean (GM) of historical data trend. In a normal period, the average growth rate of financial data is used by many researchers, but GM has been used instead of arithmetic mean in our paper because of lack of data for distribution companies and also the shock occurred during 2010 and 2011 by increasing the electricity price tariff and changing the

subsidy payments. Afterwards, FCFF for next five years can be calculated.

The GM in (5) has been applied in this paper for the forecasting process in which X_i is the growth rate of variable X in year i.

$$GM = \sqrt[n]{\prod_{i=1}^{n}(1+X_i)} - 1 \quad (5)$$

For other income and non-operating income, GM of the mentioned three years is calculated and applied with a constant growth for next five years. Besides, GM is applied in forecasting of government earning income so that this forecasting is changed based on increasing of electricity sales. Also, future electricity sales' income is calculated by using GM based on two separate factors and then multiplying them: the amount of electricity sales and electricity tariffs in different sectors such as residential, public, agriculture, industrial, commercial, etc.

According to the past three years data, costs and incomes of the five companies are forecasted. For instance, costs and incomes forecasting of the Dist. Co #2 are mentioned in table 5.

Besides, incomes and costs trend of five distribution companies are displayed between 2009 and 2016 for a period of 8 years in Fig. 4 and 5. It can be observed that there is a dramatic increase in the second year, 2010. But, it does not last long and is followed by a downward trend.

Although there is a fluctuation at the beginning of the period, all companies enjoy a steady upward trend. To be more specific, according to the forth article of Iran budget law in 2010, the government was supposed to pay difference between generated and selling price of electricity. Since then, related tariffs and governmental payments have been diminished.

Consequently, incomes and costs of companies have been decreased. It should be also mentioned that the graph remaining significantly greater than others, is related to a company with a large number of customers.

The FCFF is calculated for the five upcoming years, since then it is assumed that the company is stable and the terminal value is calculated based on this growth rate. Table 6 shows the results in Million Dollar.

D. Analyzing the Past Technical Data

As mentioned before, SAW method is a technically measure to study companies. This is one of the simplest methods in multi-criteria decision making which can be used by weighted indexes. In fact, weighted indexes are defined based on different conditions of companies. Technical ranking of companies is done according to six fields of indexes consisting of customer-side effects, load management, operation perspectives, planning aspects, technical/engineering and financial issues. For each field, different indicators have been defined and evaluated based on interview with expert persons to select the weighting coefficients for the indicators.

Table 4. ***Costs and incomes of Dist. Co. #2 during the past years.***

Year	2009	2010	2011
Incomes (million Dollar)			
Electricity sales	147.87	519.97	437.80
Government commitment	105.10	152.20	97.20
Other income	0.13	0.34	0.05
Non operating	1.55	23.99	1.19
Costs (million Dollar)			
Electricity purchase	186.03	626.93	208.59
Administrative	8.92	8.60	10.31
Salaries	222.53	671.04	260.04
Supply services	5.85	8.49	8.51
Cost of rent to own contract [b]	17.79	8.01	8.57
Subsidy share [c]	-	-	248.67

[a] Government committed to pay the difference between the market price and the determined price

[b] Rent to own Contract is a contract between Tavanir Company, the holding governmental electricity company in power industry in Iran that has the preferred share of Dist. Co's, and their private shareholders, in order to transfer distribution assets from the public/government sector to -private sector.

[c] There is a law entitled "Targeted Subsidies Law" in Iran that is acted in 2010. Accordingly, energy prices are supposed to increase to international level in two phases in which the first phase was started in 2011. Till fully liberalization of electricity market, those companies should pay portion of their energy sells income to the government because of cross-

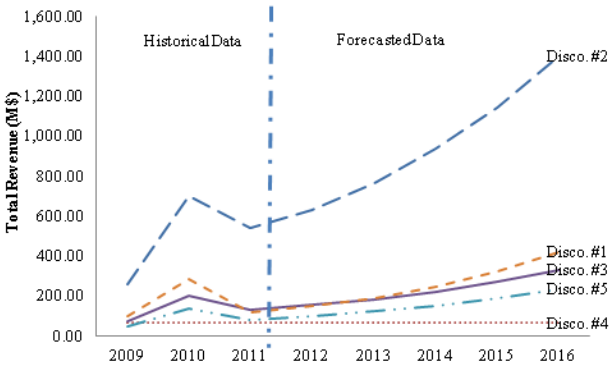

Fig. 4. Income of distribution companies.

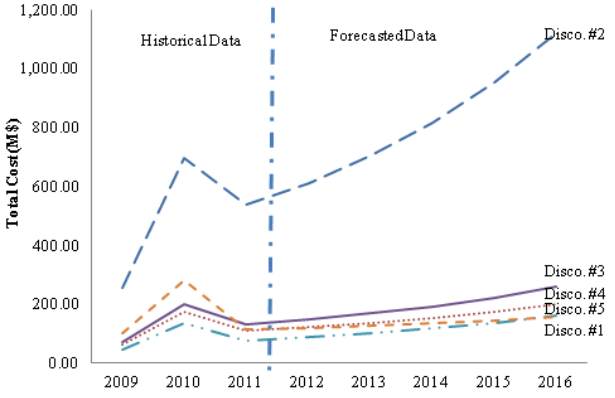

Fig. 5. Cost of distribution companies.

Table 5. ***Forecasting costs and incomes of Dist Co. 2.***

Year	2012	2013	2014	2015	2016
Incomes (million Dollar)					
Electricity sales	511.06	621.11	754.14	925.86	1135.93
Government commitment	117.78	143.15	174.49	213.38	261.79
Other income	0.04	0.02	0.02	0.01	0.01
Non operating	1.04	0.91	0.80	0.70	0.61
Costs (million Dollar)					
Electricity purchase	220.88	233.88	247.66	262.25	277.69
Administrative	11.09	11.93	12.83	13.80	14.85
Salaries	282.52	308.16	337.69	371.97	412.14
Supply services	10.26	12.37	14.92	17.99	21.69
Cost of rent to own contract	5.94	4.12	2.86	1.99	1.38
Subsidy share	301.35	366.23	446.44	545.93	669.79

Finally, 46 indicators have been obtained to assess the technical situation of each distribution company. As an illustration, ten high weighted indicators are shown in table 7.

E. Results

According to the results, companies have been ranked for being purchased and the value of them has been estimated based on both economical and technical survey, with different weights. The economic rate (α_1) in calculating the final rank is considered 0.7, which is more significant than the technical rate (α_2) that is considered 0.3. Bearing in mind that the final decision is highly related to the offered price, decisions have been made based on (6) in which α_1 and α_2 are constant:

$$LI = \alpha_1 . \frac{Company\,Valuation}{Total\ Assets} + \alpha_2 . \frac{Technical\ Rate}{100} \quad (6)$$

The final rate of all companies has led to organize top companies. Table 8 displays ranked companies in order to be presented to investors. Private shareholders as well as private investors are able to make an appropriate decision on the basis of obtained results.

Table 6. ***Free cash flow to Dist Co. 2.***

Year	2012	2013	2014	2015	2016	Terminal Value at g= %3
Earn before interest and tax (EBIT) with tax shield implemented (1-t)	8.34	38.80	78.39	129.62	195.70	
Current capital cost	21.23	22.58	23.99	25.46	27.01	-
Depreciation	13.59	14.76	16.04	17.42	18.93	
Changes in working capital	0	0	0	0	0	
FCFF	0.69	30.97	70.44	121.58	187.62	1586.91
WACC	16%	16%	15.5%	15.5%	15.2%	15.2%
Present value of FCFF	0.60	23.01	45.68	68.25	92.56	782.90

Table 7. ***Allocated weight to indicators.***

Indicator	Indicator SAW weight
Proximity of distributed generation	0.125
Total power consumption to installed capacity (WH/VA)	0.119
Sold energy to medium voltage network length (MWh/km)	0.119
Sold energy to installed capacity (Wh/VA)	0.119
Total normal charge coefficient	0.055
Total energy selling share of distribution companies to electricity industry	0.046
Sold energy to poor voltage network length (MWh/km)	0.04
Sales growth rate rank in distribution companies	0.025
Capacity of transformers	0.023
Geographical accessibility	0.016
Other indicators	0.313

Table 8*: Ranking of five electricity distribution companies.*

Name	Final ranking (LI index)	Technical rate (weight= 0.3)	Ratio of company valuation to total assets (weight= 0.7)
Dist. Co. #1	5	54.59	2.290395
Dist. Co. #2	1	73.41	11.06485
Dist. Co. #3	4	52.88	3.102195
Dist. Co. #4	3	75.93	2.233254
Dist. Co. #5	2	64.98	3.774121

4. SENSITIVITY ANALYSIS

In this section, sensitivity analysis for the valuation of electricity distribution companies is carried out. This analysis is for the free cash flow and has been conducted based on two main variables: WACC and the growth rate.

To be more specific, the base value of growth rate is considered 3% and the sensitivity analysis is performed in its range of 1% to 5%, and the base value of WACC is 15.2%, ranging from 12.1% (-20% of base case) to 19.7 (+30% of base case). Results are shown in table 9. These outcomes are obtained for Dist. Co. #2.

Table 9. ***Sensitivity analysis of Dist. Co. 2.***

		Growth Rate (million Dollar)				
		1%	2%	3%	4%	5%
WACC	12.1%	984	1,049	1,125	1,214	1,321
	13.7%	935	996	1,067	1,150	1,250
	15.2%	890	947	1,013	1,091	1,184
	16.7%	848	901	963	1,037	1,124
	18.2%	809	859	918	986	1,068
	19.7%	773	820	875	940	1,016

5. CONCLUSION

The aim of this paper is to demonstrate the valuation method which is used for electricity distribution companies.

Empirical work of this paper shows that the DCF model is highly useful to valuate different companies. Implementation of this model has several steps such as: data collection, analyzing and forecasting. In addition, the TV and specific equations are adopted to implement the approach.

After making the mentioned implementation steps, obtained results play a significant role in for proper investment. Private investors can benefit from the results, as well.

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