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Research Article

Cost of Capital Estimation for Highway Concessionaires in Chile

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In this paper, we present the cost of capital estimation for highway concessionaires in Chile. We estimated the cost of equity and the cost of debt and determined the capital structure for each one of twenty-four concessionaires that operate highways. We based our estimations on the developments of Sharpe (1964), Modigliani and Miller (1958), and Maquieira (2009), which were also compared with the Brusov et al. (2015) developments. We collected stock prices for different highway concessionaires around the world from Google Finance and Reuters' websites in order to determine the Beta of equity using a representative company. After that, we estimated the cost of equity considering Hamada (1969) and a Capital Asset Pricing Model. Then, we estimated the cost of capital using the cost of debt and the capital structure of Chile's highway concessionaires. With all above, we were able to determine the Weighted Average Cost of Capital (WACC) for highway concessions which ranges from 5.49 to 6.62%.

1. Introduction

Highway concessions have been the main field where the Public Private Partnership (PPP) model has been applied in Chile. Eighty-four percent of the total investment in concessions since 1993 correspond to highways. This year, the Melón Tunnel was tendered through a public bid which raised an investment around 70 million dollars. After that, more than twenty years of concessions with an accumulated investment around 19.2 billion dollars have been demonstrated to be a good way of improving the road infrastructure of Chile. As Engel et al. [1] have mentioned, infrastructure provided by private participation has the advantage of ensuring funds for the future maintenance of the road and preserving standard and consistent services overtime. This has even been empirically proven in Chile.

As we mentioned above PPP has had success, not only from the private perspective but also from that of the State. In fact, the promulgation of the Chilean Concessions Law and its modifications have allowed the Government to regulate this market as well as make it a more friendly environment for investors. Nevertheless, this market faces some information asymmetries, specifically those associated with the costs incurred by concessionaires [2].

Considering this, we think it would be necessary to estimate the cost of capital. This represents the minimum return of investment that concessionaires would be willing to accept for a business or, in other words, the opportunity cost of their money. Thus, we might perform a better assessment of highway concession projects fitted to the real concessionaires' costs, and in this way, we could reduce fares paid by users and improve the people welfare caused by the use of roads well maintained and with good level of services.

However, the estimation of the cost of capital is not an easy task, specifically when the analyzed companies do not trade in stock exchanges, as is the case with Chilean concessionaires. For this reason, we had to collect stock prices from foreign highway concessionaires using information provided by websites like Google Finance and Reuters in order to estimate the Beta of equity used to calculate the cost of equity by means of the Capital Asset Pricing Model (CAPM) developed by Sharpe [3].

The aforementioned and the cost of debt calculation, along with the data related to capital structure of Chilean concessionaires, both gathered from Assets and Insurances Authority website [4], allowed us to determine the Weighted Average Cost of Capital (WACC). We used WACC [5] in our calculations, although we could have used a more general and modern theory, that is, the developments of Brusov et al. [6] (BFO theory) who dismiss the perpetuity considered by Modigliani and Miller [5] and take the finite lifetime of companies to estimate their market values. However, most of the highway concessions in Chile have been tendered using the Present Value of Revenues (PVR) method. In this case, the company that bid the minimum PVR gets the concession. After that, the lifetime of concession is calculated every year. If the company's revenue has reached the PVR it finishes its operation; on the contrary it follows operative. Given that, we could not use this clever approach because it is difficult to know when the concession will expire.

This article is organized as follows. Section 2 presents a review of the literature related to determining the cost of capital. Section 3 shows our developments and the way we estimated the cost of equity, the cost of debt and the cost of capital for highway concessionaires in Chile. Finally, Section 4, presents some comments and the main conclusions.

2. The Review of Related Literature

Many companies' investment decisions are assessed using the cash flow method, which represents the sum of discounted future benefits. In this way, they can estimate the net present value associated with the stream of future flows of money due to, among other things, a project, the operational company result, or the asset performance. However, the cash flow estimation depends on the cost of the capital rate, which represents the money opportunity cost for companies. The money opportunity cost is what the return of its investment would be because of having put their money in an alternative asset or project. For this reason, the cost of capital estimation is a sensible topic for companies whose value might depends on not only the company's operational behavior, but also its finance risk associated with the debt. As Modigliani and Miller [12] demonstrated, in a world where a company pays taxes (T), the cost of capital (K_0) for a levered company depends on the cost of capital related to a company financed only with equity (ρ) and the rate between debt (D) and the company market value (V), as shown in the next equation.

$$K_0 = \rho * \left(1 - T * \frac{D}{V}\right) = \text{WACC}. \quad (1)$$

In this context, shareholders require a cost of capital lower than ρ, which is when they finance the company completely with their equity. This is due to the fact that shareholders transfer some of the risk to financiers. Another way to express the cost of capital, usually used by the industry's professionals, considers that it is a weighted sum between cost of equity (K_E) and cost of debt (K_D), as follows:

$$\text{WACC} = K_E * \frac{E}{V} + K_D * \frac{D}{V} * (1 - T), \quad (2)$$

where E/V and D/V represent the ratio of equity and debt with respect to the company market value. These two fractions represent the capital structure of the company. Equations (2) and (1) are the Weighted Average Cost of Capital (WACC). Equation (2) is the trivial determination of WACC, while (1) is just perpetuity limit of WACC. Recent development of capital structure theory presents another way to calculate the WACC. In 2008, a modern capital structure theory (BFO theory) [13] was developed, Modigliani-Miller being a particular case of the BFO theory. The WACC in the BFO theory can be calculated from the following expression:

$$\frac{1 - (1 + \text{WACC})^{-n}}{\text{WACC}} = \frac{1 - (1 + K_0)^{-n}}{K_0 * \left[1 - w_D T \left(1 - (1 + K_D)^{-n}\right)\right]} \quad (3)$$

which has been obtained having considered the present value of company's cash flow without perpetuity. Here, n is the finite lifetime of the company and w_D is D/V. The finite lifetime of the companies is one of the main differences with the Modigliani-Miller theory. However, in this work, we chose Modigliani-Miller theory because an estimation of n is a difficult task. As we told early, highway concessions have tendered using the Present Value of Revenues (PVR) method, where companies bid the minimum PVR in order to get the concession. After that, the accumulated revenues are calculated every year and compared with the PVR bid by the company. If the PVR is reached, then the concession is finished; otherwise the company follows operating the highway. Additionally, the Government has allowed many concessionaires to extend their contracts, since they have built additional works improving their highways and bettering the experience of users (car drivers). The aforementioned do not allow us exactly to determine when a concession will expire.

If we use (2) to estimate the cost of capital, then we should calculate the cost of equity as well as the cost of debt and determine the company's capital structure, which comes from its finance reports.

To determine the cost of debt (K_D) is easier than the equity. In fact, there are some proxies to do that. For example, it is possible to use the average estimation of the interest debts rate at which companies borrow funds [14]. It is possible also to use the internal return rate of the debt if the companies' debts have different periods or a Capital Assets Pricing Model (CAPM) can be used, as will be explained below.

On the other hand, to determine the cost of equity (K_E), according to the risk level of the company, we can use the Capital Assets Pricing Model (CAPM), proposed by Sharpe [3], as follows:

$$K_E = R_F + (R_M - R_F) * \beta_E, \quad (4)$$

where the return of the equity (K_E) depends on R_F, which is the risk free rate, that will always be fixed and will not depend on the market changes. In general, R_F is associated with securities released by the State. Additionally, R_M is the expected or average market return (associated with the stock exchange where the asset is traded). The difference between R_M and R_F represents the Expected Risk Premium (ERP) which is related to investment in an asset whose return will be different of risk free rate and it will depend on market change. Given this, Beta of equity (β_E) measures the sensitivity of the

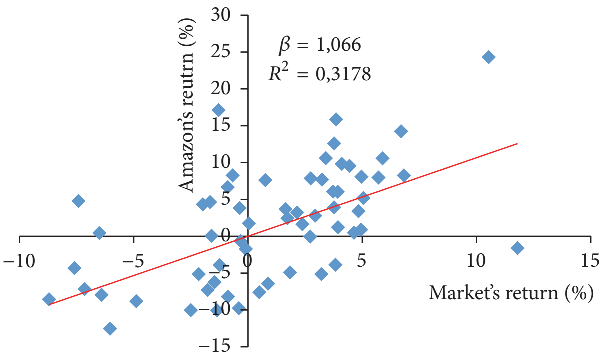

Figure 1: An example of Beta estimation. Source: elaborated by the authors based on Brealey et al. [11].

company to the risk of investing in the market instead of a risk free asset [11].

Thus, Beta values greater than one mean that the return of the equity moves more than the market and it would be riskier than an asset whose Beta is less than one. Therefore, the estimation of Beta allows us to infer the risk of the equity, as well as, along with the above variables, to determine its expected return.

According to Brealey et al. [11], the Beta estimation can be performed doing a linear regression between the returns of the company's stocks and their market index as, for example, with S&P 500, Nikkei 225, FTSE 100, or IPSA in Chile.

Figure 1 presents Amazon's returns with respect to the market index returns between 2010 and 2014. The red line represents the tendency obtained by means of a linear regression analysis. The slope corresponds to Beta, which is greater than one and means that an Amazon's stock returns more than the market where it is traded.

The method mentioned before applies when the company trades in a stock exchange and it would allow us to estimate Beta and the return of equity (K_E) as a part of the WACC in (2). However, if the company does not trade, we will not have the necessary data to do a linear regression and to obtain Beta. In this case, Maquieira [15] proposes taking a representative company in the same industry that trades in a stock exchange which, after having the Beta of equity estimation (β_L), will be levered, to use Hamada [16] in order to unlever Beta (β_U) with the representative company's capital structure, according to

$$\beta_L = \beta_U \left(1 + \frac{D}{E} * (1 - T)\right). \quad (5)$$

However, according to Maquieira [15], this equation can only be used when the representative company does not have risky debt. If it does, we should use the equation proposed by Rubinstein [17], as follows:

$$\beta_L = \beta_U \left(1 + \frac{D}{E} * (1 - T)\right) - \beta_D \frac{D}{E} (1 - T). \quad (6)$$

In this case, it has an added expression related to the debt after the Hamada [16] equation, where β_D is the Beta associated with the company's debt and it can be calculated according to the following expression:

$$\beta_D = \frac{K_D - R_F}{\text{ERP}}. \quad (7)$$

With all above, we could estimate the cost of capital (WACC) for highway concessionaires in Chile, by estimating the cost of debt and the cost of equity. Given that Chile's concessionaires do not trade in a stock exchange, we had to collect data from offshore companies in order to estimate Beta of equity. After doing this, we are able to calculate the cost of capital which is reported in the next section.

3. The Cost of Capital Estimation

Here, we present the procedure that allowed us to estimate the cost of capital for highway concessionaires based on the references that were depicted in Section 2.

As (2) indicates, the cost of capital may be calculated using the WACC which is divided into two parts. The first of them is the cost of equity (K_E) and the other is the cost of debt (K_D).

In order to estimate the cost of capital, we began calculating the cost of equity, which is the most difficult part of this equation. Due to the fact that Chilean highway concessionaires do not trade in the stock exchange, we had to take stock price data from offshore highway concessionaire companies, as recommended by Maquieira [15], in order to estimate the Beta of equity using a CAPM model. Table 1 shows the name of the representative companies from which we collected stock prices.

First, we had to collect a series of stock price data for every company and the Stock Index in the stock exchange where they are trading. Additionally, we had to gather the risk free rate in each case for calculating the ERP. We took data from January 2010 to December 2014 and set up a database with 60 monthly stock returns for each company and their corresponding Stock Index returns (S&P 500 (United States), FTSE Italy Midcap (Italy), SSE Composite (China), and IPSA (Chile)).

After that, following Brealey et al. [11], we did pairs of linear regressions between stock returns and their Index returns. From these we obtained the levered Betas of equity for representative companies (β_L). These results are shown in Table 2.

From Table 2, it is important to notice that 7 out of 22 companies have levered Betas of equity (β_L) that are greater than one, which means their stock returns move more than the expected by the market. In other words, we could say they are riskier than the others.

Additionally, the reader must notice that the Betas above were levered by the capital structure of each representative company, which is why we had to unlever these using Rubinstein's equation. To do this, we gathered the tax rates of each company and calculated the Betas of debt (β_D) for each one using (7) and the following expression, as a cost of debt (K_D) proxy:

$$K_D = \text{Spread} + R_F, \quad (8)$$

Table 1: Representative offshore concessionaire companies.

Company's name	Country
Transurban Group	Australia
Beijing Capital Co., Ltd.	China
Chongqing Road & Bridge Co., Ltd.	China
Dongguan Development (Holdings) Co., Ltd	China
Fujian Expressway Development Co., Ltd.	China
Guangxi Wuzhou Communications Co Ltd	China
Henan Zhongyuan Expressway Co Ltd	China
Huabei Expressway Co., Ltd.	China
Jiangsu Expressway Co Ltd	China
Jiangxi Ganyue Expressway Co., Ltd	China
Xiandai Investment Co., Ltd	China
Shenzhen Expressway Company Limited	China
Sichuan Expressway Co Ltd	China
Hopewell Highway Infrastructure Ltd	Hong Kong
Road King Infrastructure Limited	Hong Kong
Zhejiang Expressway Co., Ltd.	Hong Kong
Autrostrada Torino-Milano SPA	Italy
Societa Iniziative Autostradali e Servizi	Italy
Autostrade Meridionali S.p.A.	Italy
Abertis Infraestructuras S.A.	Spain
Obrascon Huarte Lain SA	Spain
Sacyr SA	Spain

Source: elaborated by the authors based on Agencia Nacional De Transportes Terrestres [7].

where the Spread represents an additional cost over the risk free rate (R_F) associated with the company's risk classification, where the representative company is located. This classification can be related to the company's Interest Coverage Rate indicator. If the indicator is less than 1, it means the company does not have enough revenue to pay their interest expenses. Therefore, the lower the indicator, the worse the risk classification and a greater Spread is expected.

Given this, we combined (7) and (8) as follows:

$$\beta_D = \frac{\text{Spread}}{\text{ERP}}. \quad (9)$$

Thus, to estimate the Betas of debt (β_D), we used the Interest Coverage Rate indicator of the representative companies published in Reuters website. After that, we looked for each of these indicators in the Damodaran website [10] and obtained the associated Spread that depends on the risk classification. In the same website, we got the countries' ERP for each representative company. This allowed us to calculate β_D, according to the (9), which is presented in Table 3.

The results shown in Table 4 allowed us to estimate the unlevered Betas of equity (β_U) for representative companies using (6), as well as the tax rates of each one and their own capital structures which were obtained from the Reuters website.

Table 4 presents the unlevered Betas of equity for representative companies.

With these results we estimated an average unlevered Beta of equity of 0.56. In order to estimate the Chilean levered Betas of equity (β_E) we used Rubinstein's equation again, but this time we levered the 0.56 with the capital structure of each Chilean concessionaire, their tax rate, and their Beta of Debt.

In this case, we had access to the information related to the concessionaires' debts and their capital structures from their finance reports which are published in the Assets and Insurances Authority website. We were then able to calculate Beta of Debt (β_D) using (7) where K_D was calculated as the average cost of debt of each company. The risk free rate (R_F) was calculated as an average of the interest rates of the Chile's Central Bank Bonds, for 5, 10, and 20 years. Additionally, to calculate the market return (R_M) we used the IPSA (IPSA corresponds to the Stock Index of Santiago Stock Exchange) returns of the same period and a tax rate of 20% associated with the period at concessions was launched.

The Betas of equity (β_E) for the concessionaires under analysis and the variables mentioned before are shown in Table 5.

It is important to notice we took concessionaires' data related to the debt and capital structure from years soon after their launches because we wanted to simulate the process of economic assessment in the period of their bid preparation. Unfortunately, only information from 2000 onwards is available on Insurances and Assets Authority website. For these reasons we took a tax rate equal to 20% and were not interested in their current finance performance.

From Table 5, we can see that 10 out of 24 concessionaires have a Beta of equity greater than one which means their stock returns move more than the expected by the market (IPSA in this case).

Finally, with these results and using (2) and (4) we estimated the cost of equity and the cost of capital (WACC) for these concessionaires. The data is displayed in Table 6.

Table 6 shows that the cost of capital for highway concessionaires in Chile ranges from 5.49 to 6.62% with an average value around 5.93%. As we mentioned in the Introduction, since this value represents the opportunity cost for concessionaires, it should therefore be used to assess the highway concession projects. It may also be used by the State to test some policy proposals aimed at bettering the people's social welfare such as, for example, a policy related to reducing the cost of debt whose impact was associated with a fare reduction.

If the reader looks at Table 6, 15 out of 24 concessionaires have an equity to market value ratio (D/V) greater than 50%, which is expected to have been even greater if we had been able to obtain older information from Insurances and Assets Authority website. This reveals that these kinds of companies are mainly composed of debt. In fact, most of the tender documents request an equity equal to or greater than 20%. Therefore, we think a policy that allows us to reduce the cost of debt would have an impact on the cost of capital and subsequently on the fares paid by people.

Finally, we plotted our estimation of K_e and WACC from Table 6 as function of the debt to equity ratio D/E, as is shown in Figure 2.

The shape of both curves follows Modigliani and Miller theory and BFO theory, that is, the cost of equity (K_e) increases and Weighted Average Capital Cost (WACC)

Table 2: Levered Betas of equity for representative companies (β_L).

Representative company	Levered Beta (β_L)	t-test
Transurban Group	0.36	2.67
Beijing Capital Co., Ltd.	1.28	2.30
Chongqing Road & Bridge Co., Ltd.	0.80	3.91
Dongguan Development (Holdings) Co., Ltd	1.02	6.59
Fujian Expressway Development Co., Ltd.	0.80	8.20
Guangxi Wuzhou Communications Co Ltd	0.85	4.00
Henan Zhongyuan Expressway Co Ltd	0.95	11.22
Huabei Expressway Co., Ltd.	0.67	4.22
Jiangsu Expressway Co Ltd	0.70	6.63
Jiangxi Ganyue Expressway Co., Ltd	0.92	12.55
Xiandai Investment Co., Ltd	0.66	4.21
Shenzhen Expressway Company Limited	1.06	9.29
Sichuan Expressway Co Ltd	1.29	11.46
Hopewell Highway Infrastructure Ltd	0.35	3.25
Road King Infrastructure Limited	0.78	6.26
Zhejiang Expressway Co., Ltd.	0.57	4.15
Autrostrada Torino-Milano SPA	1.04	5.46
Societa Iniziative Autostradali e Servizi	0.72	5.12
Autostrade Meridionali S.p.A.	0.57	3.87
Abertis Infraestructuras S.A.	0.80	9.76
Obrascon Huarte Lain SA	1.07	7.66
Sacyr SA	1.66	6.37

Source: elaborated by the authors.

Table 3: Betas of debt for representative companies (β_D).

Representative company	Interest coverage rate	Company's risk classification	Spread	Country ERP	Beta of debt β_D
Transurban Group	1,58	B	5%	6.28%	0.80
Beijing Capital Co., Ltd.	3,26	A−	1.20%	7.50%	0.16
Chongqing Road & Bridge Co., Ltd.	16,4	AAA	0.40%	7.50%	0.05
Dongguan Development (Holdings) Co., Ltd	2,38	BB+	2.12%	7.50%	0.28
Fujian Expressway Development Co., Ltd.	2,63	BBB	1.75%	7.50%	0.23
Guangxi Wuzhou Communications Co Ltd	1,94	B+	4.00%	7.50%	0.53
Henan Zhongyuan Expressway Co Ltd	1,56	B	5.00%	7.50%	0.67
Huabei Expressway Co., Ltd.	2,38	BB+	2.12%	7.50%	0.28
Jiangsu Expressway Co Ltd	97,9	AAA	0.40%	7.50%	0.05
Jiangxi Ganyue Expressway Co., Ltd	3,21	A−	1.20%	7.50%	0.16
Xiandai Investment Co., Ltd	2,38	BB+	2.12%	7.50%	0.28
Shenzhen Expressway Company Limited	3,34	A−	1.20%	7.50%	0.16
Sichuan Expressway Co Ltd	4,04	A−	1.20%	7.50%	0.16
Hopewell Highway Infrastructure Ltd	2,38	BB+	2.12%	6.50%	0.33
Road King Infrastructure Limited	2,38	BB+	2.12%	6.50%	0.33
Zhejiang Expressway Co., Ltd.	2,38	BB+	2.12%	6.50%	0.33
Autrostrada Torino-Milano SPA	2,38	BB+	2.12%	8.33%	0.25
Societa Iniziative Autostradali e Servizi	4,01	A−	1.20%	8.33%	0.14
Autostrade Meridionali S.p.A.	1,67	B	5.00%	8.33%	0.60
Abertis Infraestructuras S.A.	12,21	AAA	0.40%	7.51%	0.05
Obrascon Huarte Lain SA	2,68	BBB	1.75%	7.51%	0.23
Sacyr SA	2,38	BB+	2.12%	7.51%	0.28

Source: elaborated by the authors based on information provided by Reuters [8], Damodaran [9], and Damodaran [10].

Table 4: Unlevered Betas of equity for representative companies (β_U).

Representative company	Market index	D/E	Beta of debt β_D	Tax	Levered beta β_L	Unlevered beta β_U
Transurban Group	All Ordinaries	1.17	0.80	0.30	0.36	0.56
Beijing Capital Co., Ltd.	SSE Composite	2.15	0.16	0.25	1.28	0.59
Chongqing Road & Bridge Co., Ltd.	SSE Composite	1.61	0.05	0.25	0.80	0.39
Dongguan Development (Holdings) Co., Ltd	SSE Composite	1.61	0.28	0.25	1.02	0.62
Fujian Expressway Development Co., Ltd.	SSE Composite	0.96	0.23	0.25	0.80	0.56
Guangxi Wuzhou Communications Co Ltd	SSE Composite	2.69	0.53	0.25	0.85	0.64
Henan Zhongyuan Expressway Co Ltd	SSE Composite	3.40	0.67	0.25	0.95	0.75
Huabei Expressway Co., Ltd.	SSE Composite	1.61	0.28	0.25	0.67	0.46
Jiangsu Expressway Co Ltd	SSE Composite	0.26	0.05	0.25	0.70	0.60
Jiangxi Ganyue Expressway Co., Ltd	SSE Composite	1.07	0.16	0.25	0.92	0.58
Xiandai Investment Co., Ltd	SSE Composite	1.61	0.28	0.25	0.66	0.45
Shenzhen Expressway Company Limited	SSE Composite	0.71	0.16	0.25	1.06	0.75
Sichuan Expressway Co Ltd	SSE Composite	1.10	0.16	0.25	1.29	0.78
Hopewell Highway Infrastructure Ltd	Hang Seng	1.61	0.33	0.17	0.35	0.34
Road King Infrastructure Limited	Hang Seng	1.61	0.33	0.17	0.78	0.52
Zhejiang Expressway Co., Ltd.	Hang Seng	1.61	0.33	0.17	0.57	0.43
Autrostrada Torino-Milano SPA	FTSE Midcap	1.61	0.25	0.31	1.04	0.63
Societa Iniziative Autostradali e Servizi	FTSE Midcap	1.68	0.14	0.31	0.72	0.41
Autostrade Meridionali S.p.A.	FTSE Midcap	1.69	0.60	0.31	0.57	0.59
Abertis Infraestructuras S.A.	IBEX 35	2.47	0.05	0.30	0.80	0.33
Obrascon Huarte Lain SA	IBEX 35	3.25	0.23	0.30	1.07	0.49
Sacyr SA	IBEX 35	1.61	0.28	0.30	1.66	0.93
β_U Unlevered Beta of Equity (average)						0.56

Source: elaborated by the authors.

Table 5: Betas of equity for highways concessionaires in Chile.

Concessionaire's name	K_D (%)	β_D	D/E	β_E	β_U	R_F (%)	R_M (%)
Sociedad Concesionaria Costanera Norte S.A.	5.46	0.38	5.84	1.39	0.56	2.95	9.48
Sociedad Concesionaria Camino Nogales Puchuncavi S.A.	4.65	0.26	4.27	1.59			
Sociedad Concesionaria Autopista Del Itata S.A.	4.40	0.22	3.50	1.51			
Sociedad Concesionaria Amb S.A.	4.95	0.31	3.40	1.26			
Ruta Del Bosque Sociedad Concesionaria S.A	4.85	0.29	3.09	1.23			
Sociedad Concesionaria Vespucio Norte Express S.A.	5.28	0.36	2.97	1.05			
Ruta De La Araucania Sociedad Concesionaria S.A.	4.42	0.23	2.66	1.28			
Sociedad Concesionaria Tunel San Cristobal S.A.	6.40	0.53	2.51	0.63			
Sociedad Concesionaria Autopista Del Aconcagua S.A.	4.40	0.22	2.41	1.22			
Sociedad Concesionaria Autopista Los Libertadores S.A.	4.73	0.27	2.40	1.12			
Ruta De Los Rios Sociedad Concesionaria S.A.	4.33	0.21	2.16	1.17			
Sociedad Concesionaria Del Elqui S.A.	4.80	0.28	1.83	0.97			
Sociedad Concesionaria De Los Lagos S.A.	4.83	0.29	1.62	0.92			
Sociedad Concesionaria Autopista Del Sol S.A.	4.90	0.30	1.60	0.90			
Sociedad Concesionaria Autopista Central S.A.	5.30	0.36	1.09	0.74			
Ruta Del Maipo Sociedad Concesionaria S.A.	4.85	0.29	0.75	0.72			
Sociedad Concesionaria Valles Del Desierto S.A.	6.57	0.55	0.52	0.57			
Sociedad Concesionaria Rutas Del Pacifico S.A.	5.80	0.44	0.49	0.61			
Sociedad Concesionaria Autopista De Los ANDES S.A.	6.26	0.51	0.44	0.58			
Sociedad Concesionaria Autopista Interportuaria S.A.	4.25	0.20	0.43	0.69			
Sociedad Concesionaria Autopista Nororiente S.A.	7.45	0.69	0.04	0.56			
Sociedad Concesionaria Autopista Vespucio SUR S.A.	5.08	0.33	0.01	0.56			
Sociedad Concesionaria Litoral Central S.A.	6.98	0.62	0.01	0.56			
Sociedad Concesionaria Melipilla S.A.	6.50	0.54	0.002	0.56			
β_E (average)				0.93			

Source: elaborated by the authors.

Table 6: Costs of equity and capital for Chilean highways concessionaires.

Concessionaire's name	K_E (%)	E/V	D/V	K_D (%)	R_F (%)	WACC (%)
Sociedad Concesionaria Costanera Norte S.A.	12.03	0.146	0.854	5.46%	2.95	5.49
Sociedad Concesionaria Camino Nogales Puchuncavi S.A.	13.34	0.19	0.810	4.65%	2.95	5.55
Sociedad Concesionaria Autopista Del Itata S.A.	12.83	0.222	0.778	4.40%	2.95	5.59
Sociedad Concesionaria Amb S.A.	11.16	0.227	0.773	4.95%	2.95	5.60
Ruta Del Bosque Sociedad Concesionaria S.A	11.00	0.244	0.756	4.85%	2.95	5.62
Sociedad Concesionaria Vespucio Norte Express S.A.	9.80	0.252	0.748	5.28%	2.95	5.63
Ruta De La Araucania Sociedad Concesionaria S.A.	11.30	0.273	0.727	4.42%	2.95	5.66
Sociedad Concesionaria Tunel San Cristobal S.A.	7.07	0.285	0.715	6.40%	2.95	5.67
Sociedad Concesionaria Autopista Del Aconcagua S.A.	10.90	0.293	0.707	4.40%	2.95	5.68
Sociedad Concesionaria Autopista Los Libertadores S.A.	10.23	0.294	0.706	4.73%	2.95	5.68
Ruta De Los Rios Sociedad Concesionaria S.A.	10.58	0.316	0.684	4.33%	2.95	5.71
Sociedad Concesionaria Del Elqui S.A.	9.27	0.354	0.646	4.80%	2.95	5.76
Sociedad Concesionaria De Los Lagos S.A.	8.94	0.381	0.619	4.83%	2.95	5.80
Sociedad Concesionaria Autopista Del Sol S.A.	8.82	0.384	0.616	4.90%	2.95	5.80
Sociedad Concesionaria Autopista Central S.A.	7.77	0.478	0.522	5.30%	2.95	5.93
Ruta Del Maipo Sociedad Concesionaria S.A.	7.68	0.571	0.429	4.85%	2.95	6.05
Sociedad Concesionaria Valles Del Desierto S.A.	6.64	0.658	0.342	6.57%	2.95	6.17
Sociedad Concesionaria Rutas Del Pacifico S.A.	6.94	0.671	0.329	5.80%	2.95	6.18
Sociedad Concesionaria Autopista De Los Andes S.A.	6.74	0.697	0.303	6.26%	2.95	6.22
Sociedad Concesionaria Autopista Interportuaria S.A.	7.43	0.701	0.299	4.25%	2.95	6.22
Sociedad Concesionaria Autopista Nororiente S.A.	6.59	0.963	0.037	7.45%	2.95	6.57
Sociedad Concesionaria Autopista Vespucio Sur S.A.	6.63	0.988	0.012	5.08%	2.95	6.60
Sociedad Concesionaria Litoral Central S.A.	6.62	0.988	0.012	6.98%	2.95	6.60
Sociedad Concesionaria Melipilla S.A.	6.62	0.998	0.002	6.50%	2.95	6.62
$WACC_{min}$ (%)						5.49
$WACC_{max}$ (%)						6.62
$WACC_{Average}$ (%)						5.93

Source: elaborated by the authors.

decreases, while debt to equity ratio D/E increases. Although WACC decreases, it does not do with a sharp slope, the reason why we think our estimations could behave as BFO theory. However, we cannot exactly know when the concessions will expire.

4. Conclusions

In this document we have presented a method to estimate the cost of capital using a CAPM for Chilean highway concessionaires. We have followed Maquieira's [15] recommendations in order to estimate a Beta of equity based on offshore representative companies that trade their stocks, which was also used to calculate the cost of capital for our highway concessionaires using the WACC equation.

From Table 6, it is possible to see the cost of equity ranges between 5.49% and 6.62% with an average value of 5.93%. These estimations can be compared with results obtained for Peru and Portugal by Huamaní [18] and Correia [19], respectively. In the first case, Huamaní [18] estimated the cost of equity (K_E) for highway concessionaires and he obtained values from 12.08 to 15.77%, both greater than our estimations. On the other hand, the results obtained by Correia [19] correspond to the cost of capital (WACC) and these range from 4.74 and 7.22%, where the lower limit is less than our estimations, but the upper is greater; this

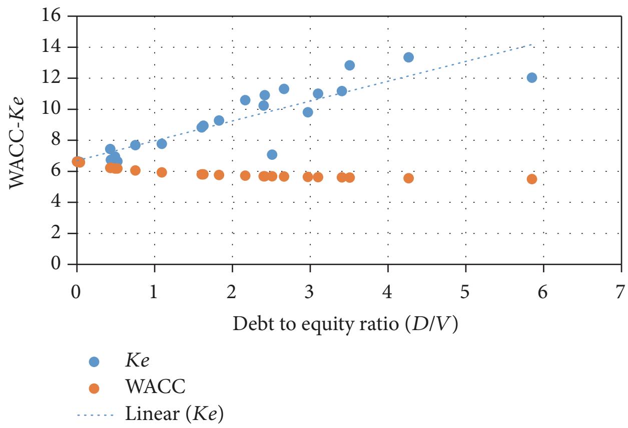

FIGURE 2: k_e and WACC as Function of debt to equity ratio. Source: elaborated by the authors.

is why our results are within those of Portugal. We looked for the risk classifications for these three countries in the Damodaran website [9] and found that Chile (Aa3) has the best and it is followed by Peru (A3) then Portugal (Ba1). This would confirm that our estimations would be consistent, since a worse risk classification would mean a greater cost of capital.

Additionally, we assessed how a 1% reduction in the cost of debt would impact the fares. To do that, we evaluated (2) in the average point and we obtained a reduction in WACC equal to 0.37%. After that, we modified the WACC in some of the economic assessment spreadsheets related to the Chile's concession projects which we developed based on examples provided by [20], and we found that fares would be reduced by between 1 and 2%, which means users could save around 100 million dollars a year. If we had had access to financing reports from the beginning of concessions probably the debt to market value ratio would have been near to 20%; then the reduction of fares would be greater than previous reaching up to 5%. In this way, users could save around 250 million dollars a year.

Other alternative could be to transfer these savings to an Infrastructure Fund, which would finance public works in other place of the country where these are necessary. In this way highway concessions would allow the State to expand its capacity to provide infrastructure to regions which require it.

Additionally, we plotted K_e and WACC from Table 6 versus the leverage rate D/E from Table 5, for each concessionaire. We could confirm that if the leverage rate increases, then K_e also increases and WACC decreases, as Modigliani and Miller [5] and Filatova et al. [13] have shown with their developments.

Finally, as the reader should notice, the method implemented here could be carried out as often as is necessary, in particular, when a concession project must be tendered, in order to obtain accurate and updated cost of capital estimations. In this way, the projects economic assessment process performed by the State will accurately reflect the concessionaires' finance characteristics.

Conflicts of Interest

There are no conflicts of interest related to this paper.

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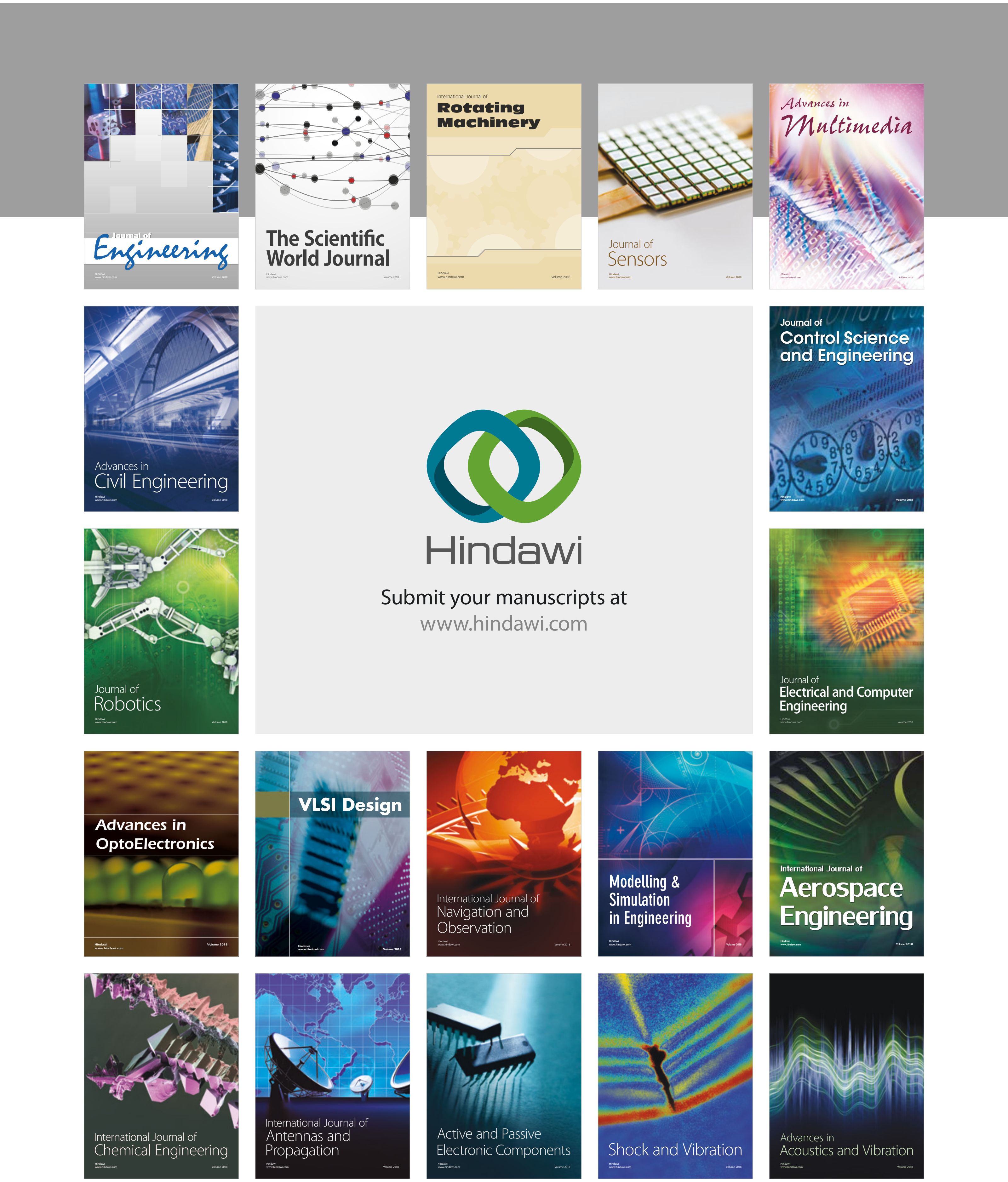
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