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Research article

Examining risk and return profiles of renewable energy investment in developing countries: the case of the Philippines

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Abstract: This paper examines the risk and return profiles of energy companies with renewable energy (RE) investment in developing countries taking the Philippines as our country case study. First, we analyze the impact of the global RE project specific risk and country risk on RE projects using a simple capital asset pricing model (CAPM) by benchmarking stock returns of these companies to either the global S&P Global Clean Energy (S&P GCE) index or to the local Philippine Stock Exchange (PSE) index. Our findings show that the Energy Development Corporation (EDC), a "pure" RE company, is affected by both these risks examined on short- and mid- to long-term investment interval, while those with partial investment in renewables are affected only on the short-term. Next, we calculated these companies' abnormal returns by using the Jensen's alpha. Results show that EDC's alpha values are positive on all short- and medium-to-long term investments and on both indices, suggesting that Philippine RE companies are possibly underestimated on both the global RE market and the Philippine stock market. Lastly, we examined the latest feed-in tariff (FIT) level by using the beta results of EDC and the FIT structure of solar PV. Results show that the FIT rate generates profit to both the global and local RE companies' risk and returns from the investors' perspective, but is higher than the desired FIT rate from the policymakers' perspective. This paper aids in investment decision-making by showing that differences in investment timeframes and RE shares could impact investment outcomes in developing countries.

Keywords: renewable energy investment; CAPM; developing countries; Philippines

JEL Codes: G12, G15, Q20

1. Introduction

Global warming is a critical issue for the survivability of human beings. As one of the most effective actions from the industrial perspective, more than 170 countries now have already set up their renewable energy (RE) targets and an estimated 150 countries have created policies that support renewables (KPMG, 2016). In terms of generations, the developing countries of China, India and Brazil alone had electricity generation by renewables of 634.2, 121.5, and 104.5 TWh, respectively, whose sum consists of a 35% share of renewables globally of 2480.4 TWh in 2018 (BP, 2019). This trend is applicable to the current situation in the Philippines where the relative abundance of RE resources in the Philippines compared to other countries in Table 1.

Table 1. RE Potential by Fuel Type. This shows the RE potential of the Philippines as estimated by the Philippines Department of Energy.

Fuel Type	Potential Capacity, Grid Use (in MW)
Hydropower	10,000
Ocean Energy	170,000
Geothermal	4,000
Wind	76,600
Solar	5 kWh/ m^2/day
Sugar cogen, rice husk, and coconut revenues	500

Although the introduction of REs is accelerating in developing countries, we have the challenges that could affect RE investments in developing countries like the Philippines: It is important in making investment decisions for renewables that the risks involved are properly evaluated and likewise compensated for. When undertaking investments, debtors and investors are keen into knowing an asset/project’s cost of capital or the asset/project’s risk and returns. Knowing the proper cost of capital also gives an effective tool to the policymakers so that they too can structure the incentive rates like the feed-in tariff (FIT) to ensure it bears the right balance between sufficient enough to attract investments but won’t be too high to burden taxpayers.

The cost of capital for small and medium-sized RE companies in the Philippines mostly uses a higher percentage of own funding or equity finance given that banks are still unfamiliar with RE projects and are reluctant to lend (Saculsan and Mori, 2018). With an immature capital market that cannot provide long-term finance and without a “ready and guaranteed” power market for the output of renewables, renewables put it at a disadvantage compared conventional energies like coal in the Philippines (KPMG, 2013). In order to solve these issues, determining the risk and returns of equity finance for RE projects in the Philippines will be the primary focus of this paper.

The risk and return relationship of equity finance for RE projects is evaluated in financial markets. Thus we have literature of the performance of RE companies in financial markets. The value of RE companies based on the stock prices is often discussed with the relation with energy prices. Sadorsky (2012a) employs multivariate GARCH and dynamic conditional correlation (DCC) models to analyze the volatility spillovers between oil prices and the stock prices of clean energy companies and technology companies. Managi and Okimoto (2013) found a positive relationship between oil and clean energy prices after structural breaks around the beginning of 2008 by using Markov-switching VAR model. These studies are quite interesting. However, as the literature focusing on the performance of RE companies is limited. Inchauspe, Ripple, and Trück (2015) examine the dynamics of excess returns for the WilderHill New Energy Global Innovation Index, which lists firms in the RE sector and is used as a global benchmark and find evidence for underperformance of the RE sector relative to the considered pricing factors after the financial crisis. Sadorsky (2012b) uses a variable beta model to investigate the determinants of RE company risk listed in the global fund based on the WilderHill Clean Energy Index. The empirical results show that company sales growth has a negative impact on company risk while oil price increases have a positive impact on company risk. These studies are important in the sense that the risk and return relationships for global RE companies are examined based on global clean energy indices. But they do not focus on the local RE markets in developing countries, in particular the Philippines. We fill the gap with the existing literature on the performance of RE companies.

The contributions of our paper is threefold: First, we empirically show that on short- and mid- to long term investment interval, a "pure" RE company, the Energy Development Corporation (EDC), is affected by both the global RE project specific risk and country risk, while those with partial investment in renewables are affected only on the short-term. Next, the empirical study results show that EDC's Jensen's alpha values are positive on all short- and medium-to-long term investments and on both indices, suggesting that Philippine RE companies are possibly underestimated on both the global RE market and the Philippine stock market. Lastly, we show that the FIT rate generates profit to both the global and local RE companies' risk and returns from the investors' perspective, but is higher than the desired FIT rate from the policymakers' perspective.

The paper is organized as follows: Section 2 describes the data and methodology used for this paper zooming-in the profiles and characteristics of Philippine RE companies. Section 3 presents the regression results and findings. Section 4 looks into the current FIT structure and comparing this with the new FIT structure using the generated betas as benchmarked to either the global RE's S&P GCE index or the local PSE index. Section 5 concludes and summarizes the findings of this paper. Section 6 discusses the limitations and possible future research regarding this topic.

2. Data and methodology

2.1. Data samples

The primary data for this paper is derived from the weekly and monthly average stock returns of companies listed in the Philippines Stock Exchange (PSE) website (PSE, 2016). The selected companies are all classified under the group "Electricity, Energy, Power, and Water (EEPW)". To be conservative and consistent in our research approach, the authors excluded on the list the companies that are not regularly traded and/or not listed in the above category even if they have or may have RE investment. This is done because of the complexity and difficulty in fleshing out all the companies with renewables in their portfolio from the data at hand. For example, big conglomerates like San Miguel is categorized as a "Holdings Company" in the PSE but is actually the biggest energy company with some renewables in its energy portfolio. There are also RE companies like Vivant that is not regularly traded in the PSE. Overall, the authors came up with ten companies that passed these three criteria: (i) classified as an energy company in the PSE listing; (ii) have a RE investment; and

(iii) are regularly traded (SEC, 2019). Note that EDC was voluntarily delisted in 2018 and AC Energy acquired Phinma Energy in 2019.

Table 2. Profile of Listed Energy Companies with Renewables in their Energy Portfolio. This is a brief profile of each of the selected companies in the Philippines highlighting renewables in their investment portfolio. The information is taken from these companies' financial reports and their respective company websites. RE companies under study as listed and classified under the EEPW category in the PSE website. Additional information about the company were gathered from company reports.

Company	Code	Brief Description	RE Investment
Energy Development Corporation	EDC	Primarily renewables company with almost equal investment shares between the Philippines and other countries	Geothermal, wind, solar and hydropower. **EDC is part of the First Gen Corporation Group*
First Gen Corporation	FGEN	Natural gas but owns 40% indirect economic interest of EDC	The largest clean and RE IPP in the country; wind, solar , hydropower, and geothermal
First Philippine Holdings Corporation	FPH	Major investments in power generation, real estate development, manufacturing, and construction and other services.	About 1,459.6 MW of wind, solar, and hydropower, with shares on EDC and FGEN **mostly just partnerships or indirectly through its subsidiaries*
Aboitiz Power Corporation	AP	Power distribution and generation	Geothermal, large hydro, and run-of-river hydro
Alsons Consolidated Resources, Inc.	ACR	Investment holding company, and oil and coal exploration	Hydropower **mostly in Mindanao*
Petro Energy Resources Corporation	PERC	Oil exploration and development and mining activities	Solar and wind
Phinma Energy Corporation	PHEN	Oil and gas	Wind and geothermal
Basic Energy Corporation	BSC	Primary an investment holding company; oil and gas exploration; eco farms	Geothermal and biofuels
Petron Corporation	PCOR	Refining of crude oil and the marketing and distribution of refined petroleum products including gasoline, LPG, diesel, jet fuel, kerosene, asphalts, and petrochemicals.	Hydropower **mostly engaged in refinery investments abroad*
Manila Electric Company	MER	Coal	Hydroelectric through a joint venture **mostly, if not all are coal*

Among these ten companies, the Energy Development Corporation (EDC) is particularly taken as a focal company reference given its business scope that is "purely renewables". EDC is primarily engaged in the business of "exploring, developing, operating, and utilizing geothermal and other indigenous RE sources for electricity generation" (EDC, 2016). It is worth noting however that EDC is a subsidiary of the Lopez-group First Philippine Holdings (FPH) through its First Gen Group (FGEN) having an effective 50.6 percent economic interest and a 67.1 percent voting interest in EDC.

The monthly average data, which we pertain as the mid- to long-term investment interval, is from August 1, 2016 to July 31, 2017. The weekly average data or the short-term investment interval, on the other hand, is from August 1, 2016 to August 11, 2017. The difference in timeframe is due to the availability of S&P GCE data on RE returns globally. Also, RE (except large geothermal) is relatively at the early stage of development in the Philippines. The RE law was only passed in 2008 while incentives to promote renewables like FIT was only accomplished 4 years after in 2012.

2.2. Methodology

In setting the cost of equity, the capital asset pricing model (or CAPM) is the basic and the most widely used finance methodology. CAPM is used for pricing stocks and gauging the extent to which markets are integrated (Treynor, 1961; Sharpe, 1964; Mossin, 1966). Central to CAPM is the calculation of an appropriate beta or systematic risk because this is the kind of risk that cannot be eliminated through diversifying the assets portfolio. CAPM is called the single-factor model for asset pricing because it purports that the return to an investment is a linear function of the beta.[1] By using CAPM, we fill the gap in existing literatures where not so much are written to analyze the risk and return profiles of RE companies/projects in developing countries, in particular the Philippines.

The averages of the stock returns of these companies are benchmarked using either of these two index: (i) the S&P Global Clean Energy index (here referred to as S&P GCE) or (ii) the local Philippine Stock Exchange (here referred to as PSE) index. The S&P GCE is chosen to represent the RE project specific risk because this index is one of the most popular clean energy index use globally that tracks the performance of companies that invest in clean energy specifically in RE projects.[2] Aside from this, the S&P GCE index was also chosen because of the ease of access and availability of data online. These RE project specific risks (e.g., grid risk, technological risks, policy risks, credit risk) are specifically identified to be the risks commonly faced by investors when investing in RE projects worldwide (Wing and Jin, 2015). On the other hand, the PSE is chosen to represent the country risk vis-à-vis Philippine local conditions because this is the national and the only stock exchange in the Philippines with about 261 listed companies as of September 2014 (PSE, 2017).

[1] Some empirical studies have challenged the validity and efficacy of CAPM given its underlying theoretical assumptions including investors are risk averse who are maximizing utility in the same time horizon, which beg the question if it can be applicable to the real world more so in developing countries' conditions (Basu and Chawla, 2010). Many studies have already provided empirical studies that question the suitability of CAPM to quantify the returns and risk variables of a still immature and volatile market that characterize most developing countries (Pamane and Vikpossi, 2014; Ali et al., 2010; Sehgal, 1997; Madhusoodanan, 1997; Chiang and Doong, 1999; Bautista, 2003; De Ocampo, 2003; Mobarek and Mollah, 2005). Global market integration happens when a company's stockholders hold globally diversified portfolios (Bodnar et al., 2003), while the market segmentation happens when a country's stockholders investment is confined only to its own country. The choice between the global and the market indexes makes a substantial difference in CAPM estimates in developing countries (Mishra and O'Brien, 2005). While we recognize these limitations, CAPM is still a simple and powerful tool for practitioners to analyze the relationship between risk and return of RE projects in the developing countries. Thus our analyses employ CAPM in the first order approximation.

[2] From the S&P GCE website (S&P GCE, 2019), the index provides liquid and tradable exposure to 30 companies from around the world that are involved in clean energy related businesses. The index comprises a diversified mix of clean energy production and clean energy equipment and technology companies.

These country risks (e.g., political risk, economic risk) refer to the risks associated when investing in a particular country, in this case, the Philippines (Investopedia, 2019a).

For the calculation of beta, the authors made use of a simple linear regression, which indicates the relative risk of a RE company versus a benchmark market (i.e., global S&P GCE or local PSE index) over a period as shown in the formula.

$$\text{Regress } r_i \text{ on } r_m \tag{1}$$

β = the slope of the regression estimate
r_i = one of the companies' average weekly or monthly stock price returns
r_m = market portfolio index (e.g., S&P GCE or PSE index) average weekly or monthly stock returns

Furthermore, the companies' Jensen's Alpha (or simply "α") is included to measure the average return of a portfolio or investment above or below the predicted returns under the CAPM methodology (Investopedia, 2019b). Simply put, this is the excess market returns of an investment. The value of the alpha is shown as the intercept of the regression estimate of the CAPM. It can also be computed using the equation below.

$$\alpha = r_S - \left[r_f + \beta\left(r_b - r_f\right)\right] \tag{2}$$

α= Jensen's alpha
r_S = the average sum total of a company's average weekly or monthly stock price returns
r_f= risk free rate
β = the computed beta based on either of the two indices mentioned;
r_b = the average sum total (either S&P GCE or PSE index) average weekly or monthly returns

We also looked into the t-stat value and standard error to check for the statistical significance of the results. In this case, a greater than absolute value of 2 means the computed value is statistically significant. Publicly available data on FIT regulations, for example, as issued by the Philippine Department of Energy (DOE) and Energy Regulatory Commission (ERC) are used. At last take note that although many scholars have proposed alternative methodologies to fill in this weakness of CAPM to account for the risks that is not captured by the beta of the CAPM (e. g., arbitrage pricing theory (APT) of Ross (1976), the multi-factor model of Fama and French (1996), the downside or D-CAPM of Estrada (2002), among others, this paper does not intend to propose any alternatives to CAPM because of data limitation of the country reference study, the Philippines.

3. Empirical study results and discussions

3.1. Examining the beta in terms of the global renewable S&P GCE and the local PSE over the short-term and mid- to long-term investment intervals

First, we analyzed the regression results of generated betas from the weekly average stock returns, which represent the short-term investment interval, given in Table 3. The results have adjusted R-square higher than 90% for all companies except AP and MER in cases when these companies are benchmarked to either the global S&P GCE index or the local PSE index. The adjusted R-square indicates the percentage by which the dependent variable (i.e., company's stock returns) can be predicted or explained by the independent variable (i.e., index's stock returns). In this case, 90% of the movement in the stock returns are predicted or explained by the movement in the benchmark index used.

In terms of beta results, whether benchmarked to the global renewables S&P GCE or the local PSE, all companies generated positive and statistically significant betas close to 1. This entails that all companies stock price returns and thereby their risks can be predicted by the movement in both the global renewables market and the Philippine local market. This may be because of the characteristics of RE projects that are characterized by relatively short-term events like weekly events compared to the other generation sources like fossil fuel-fired power plants, resulting in no distinction between project risk and country risk.

Now zooming in the regression results of our proxy to a “pure” RE company, EDC, as shown in Table 3, EDC’s beta results are almost similar when benchmarked to both indices although a bit closer to 1 when data is benchmarked to the global renewables S&P GCE index. These beta results as well as the models itself are both statistically significant with less than 5% error of beta. Also, the two models’ adjusted R-squares are 98.9% indicating that the stock returns for short-term investment could be predicted by the movement in both of the two index used. Thus, looking at a short-term investment interval, we see that energy companies with RE investment are strongly affected by both global RE project specific risk (represented by the S&P GCE index) and the country risk (represented by the PSE index).

Next in Table 4, we analyzed each company’s monthly average stock returns to represent the mid- to long-term investment interval. When benchmarked to the global renewables S&P GCE index, beta results are more variable and have larger gaps from one company to another. Among these companies, only EDC and ACR have betas close to 1 although EDC alone is statistically significant. These results are also similar even when the stock returns were benchmarked to the local PSE index, only this time EDC and PERC have betas close to 1 and EDC alone is statistically significant.[3]

In both market index, EDC is the only company that have positive and statistically significant beta. However, EDC’s adjusted R-squares are 55.8% and 35.2% when benchmarked to the global renewables S&P GCE and local PSE respectively, as shown in Table 4. This suggest that the variability in the stock returns could only be “partially” explained by the movement in these benchmark markets on a mid- to long- term investment interval.

Overall, judging from positive and statistically significant beta, the results imply that on both short and mid- to long-term investment intervals, EDC is the only RE company that is affected by both the global RE project specific risk and country risk in the sense that S&P GCE and PSE markets reflect the global RE project specific risk and country risk, respectively. Meanwhile, energy companies with partial investment in renewables tend to work as defensive assets to market portfolio, which are affected by these two risks for the short-term investment interval only but not for the mid- to long-term investment interval. This implies that when investing in the RE projects in developing countries, it is important to examine in advance how much the RE projects’ share in the prospect companies is from the viewpoint of RE project specific risk and country risk.

[3] One may think that the company MER moves against the markets when monthly data are used. But the betas of MER are not statistically significant from the corresponding errors. The implication is that MER does not move with the markets.

Table 3. Beta Results using Weekly Average Stock Returns. Results show that adjusted R-squares are higher than 90% for all companies except AP and MER in both cases where these companies are benchmarked to the global S&P GCE and the local PSE indices. This suggests 90% of the movement stock returns for short-term investment is predicted or explained by the movement in the benchmark index used. In terms of beta results, whether benchmarked to the global S&P GCE or the local PSE, all companies generated positive and statistically significant betas close to 1.

Company	β-S&P GCE	S.E. of Beta	Adj. R^2	S. E. of the Model	Company	β-PSE	S. E. of Beta	Adj. R^2	S. E. of the Model
EDC	1.002	0.015	0.989	0.032	EDC	1.003	0.015	0.989	0.032
FGEN	0.992	0.016	0.986	0.035	FGEN	0.994	0.016	0.987	0.033
FPH	1.000	0.028	0.961	0.060	FPH	0.999	0.029	0.958	0.062
AP	0.776	0.088	0.599	0.188	AP	0.774	0.089	0.595	0.189
ACR	0.993	0.036	0.938	0.076	ACR	0.993	0.036	0.937	0.077
PHEN	0.993	0.011	0.993	0.024	PHEN	0.994	0.011	0.994	0.023
PERC	1.013	0.029	0.960	0.062	PERC	1.012	0.030	0.957	0.064
BSC	0.999	0.032	0.952	0.067	BSC	1.000	0.032	0.951	0.067
MER	1.010	0.104	0.647	0.221	MER	1.015	0.103	0.651	0.220
PCOR	0.995	0.016	0.986	0.035	PCOR	0.996	0.015	0.988	0.032

Table 4. Beta Result using Monthly Average Stock Returns. Data on monthly average or the mid- to long-term investment interval only has 11 observations covering one-year period from August 2016 to August 2017. The authors wish to expand the data timeframe in the future researches when data becomes available. When each company's monthly average stock returns are benchmarked to the global S&P GCE index, beta results are shown to be more variable and have larger gaps from one company to another. Among these companies, only EDC and ACR have betas close to 1 although EDC alone is statistically significant. These results are also similar even when the stock returns were benchmarked to the local PSE index. This time EDC and PERC have betas close to 1 although EDC alone is statistically significant.

Company	β-S&P GCE	S.E. of Beta	*Adj. R^2*	S.E. of the Model	Company	β-PSE	S.E. of Beta	*Adj. R^2*	S.E. of the Model
EDC	0.946	0.256	0.558	0.033	EDC	0.853	0.337	0.352	0.040
FGEN	0.277	0.196	0.091	0.025	FGEN	0.069	0.234	−0.101	0.028
FPH	0.301	0.248	0.045	0.032	FPH	0.126	0.287	−0.088	0.034
AP	0.314	0.131	0.322	0.017	AP	0.188	0.171	0.021	0.020
ACR	1.040	0.633	0.145	0.082	ACR	1.918	0.450	0.632	0.054
PHEN	0.529	0.344	0.121	0.045	PHEN	0.470	0.388	0.044	0.047
PERC	0.669	0.845	−0.039	0.120	PERC	0.847	0.905	−0.013	0.108
BSC	1.324	0.764	0.167	0.099	BSC	0.542	0.939	−0.071	0.112
MER	−0.939	1.073	−0.024	0.139	MER	−0.415	1.203	−0.097	0.144
PCOR	0.208	0.532	−0.093	0.069	PCOR	0.711	0.531	0.073	0.064

3.2. Examining renewable companies' profitability thru the Jensen's alpha

We then computed for the Jensen's alpha based on the CAPM regression estimate (see Table 5). Jensen's alpha (α) is a measure of profitability, or the average return of a portfolio or investment above or below the predicted returns under the CAPM methodology (Investopedia, 2019b). Put simply, this is the investment's excess returns relative the returns predicted by CAPM.[4] When comparing, we determine the "profitable" companies based on which has (greater) positive or (lesser) negative alpha values.

On a short-term investment interval, more companies are likely to more profitable when their beta is benchmarked to the local PSE index. These include companies such as EDC, FPH, ACR, PERC, PHEN, BSC, and MER. Among these companies only EDC, FPH, PERC, BSC, and MER have positive alpha values although none of which are statistically significant. The result is opposite on a mid- to long- term investment where all of these companies with the exception of only MER are likely to be more profitable if their beta is benchmarked to the global S&P GCE than otherwise. Two companies, EDC and BSC, have positive alpha values although both not statistically significant. On the other hand, AP has negative alpha value but is statistically significant.

The results show that on a short-term investment interval, RE companies are more profitable to the national market portfolio than to the global RE market portfolio. While on a mid- to long-term investment interval, Philippine RE companies are more profitable to the global renewable market portfolio than the national stock market portfolio. Taking into account this information can help investors make their investment strategies such that different time intervals could provide profitable returns to renewable investments. More importantly, EDC's alpha value is positive for both short- and medium- to long-term investments and both S&P GCE and PSE indices. It shows that Philippine RE companies are possibly underestimated in both the global RE market and the Philippine stock market.

Table 5. Jensen's Alpha Results. Jensen's Alpha (or simply "α") is computed to measure the average return of a portfolio or investment above or below the predicted returns under the CAPM methodology. Take note that those with * are companies with positive and greater alpha value compared opposite investment interval, while the company, which is in this case is AP with ** is the only company with statistically significant alpha value.

Company Name	Mid- to Long-Term		Short-Term	
	S&P GCE	PSE	S&P GCE	PSE
EDC	0.004*	0.001	0.003	0.004*
FGEN	−0.026	−0.027	−0.005	−0.005
FPH	−0.003	−0.004	0.001	0.002*
AP	−0.012**	−0.014**	−0.025	−0.025
ACR	−0.016	−0.02	−0.005	−0.004
PERC	0.064	0.061	0.014	0.015*
PHEN	−0.013	−0.015	−0.005	−0.004
BSC	0.027*	0.022	0.001	0.001*
PCOR	−0.009	−0.01	−0.003	−0.003
MER	−0.008	−0.005	0.014	0.015*

[4] The weekly and monthly data availability assumes $r_f = 0$ here but the impact on α is limited by the order of the data.

4. Evaluating the incentive for renewable energy investment through FIT

In the Philippines, the cost of equity is one of the basis in providing the incentives for RE investment as in Table 6. For most countries including the Philippines this incentive is usually in the form of the feed-in tariff (FIT). FIT refers to a long-term guaranteed payment, typically with rate higher than the conventional energy, calculated per kWh of energy produced from REs. It is considered the most popular RE incentive around the world with 75 countries and 29 states or provinces implementing this as means to promote and attract the investment to RE technologies (REN 21, 2017). Knowing the appropriate FIT rate from the calculated beta through CAPM could help policymakers decide the FIT rate at the level that is sufficient to boost investments in the sector while ensuring fairness to the taxpayers who will have to shoulder the cost. However we have a question whether the level of the FIT rate is appropriate or not from the point of the risk and return. To answer this question, we evaluate the FIT from the points of RE project risk and country risk.

Table 6 Eligible FIT projects as of January 2015 in the Philippines. The wind power has the biggest total approved FIT Capacity (IRENA, 2017).

	Capacity allocation/installation target (MW)	Number of eligible projects	Total approved FIT capacities	Subscribed allocation (%)
Biomass	250	5	21.651	6
Hydropower	250	3	12.6	5
Solar	500	1	22	4
Wind	200	3	249.9	124

FIT calculation in the Philippines basically follows the RE technology market-based weighted average cost of capital (WACC)[5] to determine return on invested capital (Philippine Department of Energy). Since debt is pretty much guaranteed and thus less risky comparing to equity from the point of default risk, it is not so much as tricky as the determination of the cost of equity where more risks are involved. The complexities of these risks and assigning each the appropriate values are matters altogether that gives the evaluators the headaches. Also, from the perspectives of investors and project developers who are after profits and even the government who is trying to strike the balance between luring investments into the RE sector yet would not compromise the public coffer, knowing the appropriate cost of equity could help create a strategy that is beneficial for each if not for everyone, thus, we are focusing here on the evaluation of the cost of equity in the calculation of FIT. As mentioned previously, the CAPM evaluates the cost of equity through the following equation:

$$r_i = r_f + \beta\left(r_m - r_f\right) \quad (3)$$

[5] WACC is defined by a calculation of a firm's cost of capital in which each category of capital is proportionately weighted. All sources of capital, including equity and debt, among others are incorporated into the WACC calculation: $\text{WACC} = r_i \frac{E}{V} + r_d \frac{D}{V}$ where r_i = cost of equity, r_d = cost of debt after tax, E = the amount of equity funding equivalent, D = the amount of debt funding equivalent and $V = E + D$.

where r_i= cost of equity, r_f = risk-free rate, β = beta or the systematic risk-free, r_m = expected market returns and $r_m - r_f$ = MRP.

The MRP follows the total risk premium (TRP) and is set at 8.600%. The TRP equals the estimated default spread of 190 basis points plus the historical risk premium for a mature equity market (estimated from historical US data). Note that 190 basis points for the Philippine come from the average of 219 basis point in 2012 (Damodaran, 2012) and 161 basis point in 2017 (Damodaran, 2017) as an example. Because most of the RE companies in the Philippines are still not listed in the Philippine Stock Exchange market, MRP estimate of RE investment relies on a sophisticated capital market of a developed country such as the U.S. The 5.270% risk-free rate (r_f), on the other hand, was benchmarked on the daily average of Philippine Dealing System Treasury Fixing (PDST-F) rates for the CY 2014 as published by Philippine Dealing and Exchange Corporation (PDEx) in its official website (PDEx, 2019).[6] Lastly, the beta of 1.0 is estimated from the levered and re-levered betas of listed comparable companies from Bloomberg database.

The authors recalculated the cost of equity as derived from the FIT structure for solar PV using the beta results from EDC, as proxy for all RE companies/projects (see results in Table 7, the second and the third columns). For purposes of comparison, two analyses were done. In the first analysis, all figures were retained except for the beta. In the second analysis, the MRP was set to 8.400% to reflect the latest computed Philippine market risk premium, as published by Damodaran (2017).

Table 7. Cost of Equity/FIT Structure from Generated Betas. The data is reported as annual basis unless noticing by brackets. Result of recalculated cost of equity as derived from the FIT structure for solar PV using the beta results from EDC as proxy for all RE companies/projects in the Philippines. Quarterly MPRs and risk free rates are one fourth of the annual ones for simplicity. Note that the current Cost of Equity/FIT level is greater than the computed Cost of Equity/FIT with ** from the new generated betas.

	Cost of Equity (viz. FIT)	Cost of Equity- EDC- S&P GCE	Cost of Equity- EDC- PSE
Market Risk Premium (MRP) $(r_m - r_f)$	8.600%	8.600% 8.400%**	8.600% 8.400%**
Beta (β)	1.000 (monthly)	0.946 (monthly) 1.002 (weekly)	0.853 (monthly) 1.003 (weekly)
Risk Free Rate (r_f)	5.270%	5.270%	5.270%
Cost of Equity/FIT	13.870% 3.468% (quarterly)	13.406% 3.472% (quarterly)	12.606% 3.474% (quarterly)
*Cost of Equity/FIT***	N/A	13.216% 3.422% (quarterly)	12.435% 3.424% (quarterly)

In the first analysis, the cost of equity computed from the generated betas on the mid- to long-term investment duration is lower than current FIT rate. The lowest FIT rate generated is at 12. 606% when

[6] Our empirical study covers the period from years 2016 to 2017. As the available and nearest data from the period, we use the risk free rate of 5.270%

beta is benchmarked to the local PSE index. In contrast, using generated betas on short-term investment interval resulted to a slightly higher cost of equity at 3.472% (S&P GCE) and 3.474% (PSE) respectively compared with only 3.468% when beta was 1.000 at current FIT rate. However as the second analysis the actual market premium was set to 8.400% recently. Thus the costs of equity in the short-term basis are 3.422% and 3.424% for S&P GCE and PSE, respectively which are lower than 3.468% for FIT.

In general, the current cost of equity/FIT rate is shown to be greater than the computed rates when benchmarked to either S&P GCE or PSE. This implies that the latest FIT level generates profit for both the perspectives of the Philippine RE companies' risk and returns and the global RE companies' risk and returns. This is particularly the most highlighted in a mid- to long-term perspective for Philippine companies' risk and returns because of the both effect of the lowest beta and the actual MPR. Although these results sound good for the investors who are after profits, this signals that policymakers may have to adjust the current FIT rate to reflect the lower cost of equity that is necessary to attract investments in the renewables sector. The FIT is basically funded from taxpayers who are now burdened to pay more for the development of renewables in the Philippines. These results and implications are the most important contribution of this paper.

5. Conclusions

Although clean energy projects are growing globally with bright prospect, investment in RE remains to be a challenge for developing countries. As a developing country with huge potentials for renewables but is struggling to attract investments in the sector because of the difficulty to access finance, administrative hurdles, local opposition to build renewable facility, uncertainty with FIT approval, among others, we take the Philippines as a country case study to analyze the risk and return profiles of energy companies with RE investments. By doing so the authors aim that the findings of this paper can help investors and policymakers alike in their investment decision-making and in setting appropriate incentive schemes that will promote renewables in the country.

First, the authors examine the impact of the global project specific risk and country risk to the Philippine energy companies/projects through the simple CAPM. Of the ten companies under study, a "pure" RE company, Energy Development Corporation (EDC), is taken as a focus of analysis. We specifically explored the calculation of the beta (β) through CAPM by employing a simple linear regression of each company's stock returns benchmarked to a market index, which is either the global renewables S&P Global Clean Energy (S&P GCE) or the local Philippine Stock Exchange (PSE). The S&P GCE market index represents the project specific risks in investing to renewables worldwide while the PSE market index represent the risks confined only to local conditions. Weekly and monthly average returns data from August 2016 to August 2017 were used to represent short and mid- to long-term investment intervals, respectively. Beta results show that on a short-term investment interval, all energy companies with RE investment are strongly affected by both the global RE project specific risk and country risk. However, for a mid- to long-term investment interval, EDC is the only RE company that is affected by these two risks as this is the only company that has statistically significant close to 1 beta results. Meanwhile, energy companies with partial investment in renewables tend to work as defensive assets to market portfolio, which are not affected by both risks. It implies that to invest in RE projects in emerging economies, it is important to examine in advance how much the RE project's share in the prospect company is from the viewpoint of RE project specific risk and country risk.

Next, EDC's abnormal returns, as derived from Jensen's alpha calculation, is shown positive for both short- and medium-to-long term investments whether benchmarked to S&P GCE index or PSE index. This shows that Philippine RE companies' expected returns are possibly underestimated in both the global RE market and the Philippine stock market. It may imply that the investing of RE businesses are promising from the perspectives of global RE business and the Philippine's business.

Lastly, we use the beta results of EDC as proxy to determine the incentive for investing in renewables in the form of the feed-in tariff (FIT), using the rate structure of solar PV as a case study. The result shows that the latest FIT rates are greater than the FIT rates computed from the generated betas accompanied by the recent MRP. This implies that the latest FIT level generates profit for both the perspectives of the global RE market and the Philippine companies' risk and returns. This gap is highlighted more in a mid- to long-term perspective for Philippine companies' risk and returns. Although this may sound good for the investors who are after profits, this signals that policymakers may have to adjust the current FIT rate to reflect the lower cost of equity so as not to burden the taxpayers who have to pay more for the development of renewables in the country. In opposite, it implies that renewable power generators get profits from the businesses due to the FIT level.

6. Discussions

While, overall, the paper provided a rich analysis of the use of CAPM in evaluating the RE investment and incentive of a developing country like the Philippines, the authors recognize that the study was limited in scope. Due to data availability, we are only able to include ten companies with only one company that is truly a "pure" RE company while the remaining others have only partial if not very little investments to renewables. Also, due to the relative early development of renewables in the Philippines, the timeframe is only limited to one year. In which case the small samples and short observation period may lead to some measurement errors.

In terms of market portfolio use as a benchmark, the S&P GCE index that is used to represent the project specific risk to renewables is a market portfolio not only confined to RE investments worldwide. Because it is impossible to gather and combine all RE assets into one global market portfolio we opt to use S&P GCE as our proxy. Also, the PSE index is not as sophisticated and developed compared that of course of developed markets, say, the US. As of the present there are only about 261 companies listed in the Philippine Stock Exchange. In one study, Krištofík (2010) pointed that using the stock price index as the market portfolio in developing countries like the Philippines is "rarely a good proxy" as it doesn't truly reflect the real local business environment of these countries. It is so because local businesses are subject to strong foreign impacts in much greater measure than their counterparts in developed countries and that most of the companies listed in the stocks are controlled by a monopoly of family groups or few shareholders.

Despite its weakness, the analysis presented in this paper add to the still few literatures on asset valuation of renewables in developing countries. At the same time the paper raises many issues and questions we can explore and further elaborate like, perhaps, expanding the CAPM to tailor fit the conditions of a developing country. As the first study in the Philippines that has, so far, utilize the tools of CAPM to analyze its RE investment, the authors hope that there will be succeeding future studies of the same topic.

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Conflict of interest

All authors declare no conflicts of interest in this paper.

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