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Modelling the Effect of Wholesale Electricity Prices at WESM and the Prices of Fuel Input in the World Market on the Share Prices of Listed Energy Companies in the Philippine Stock Market

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Abstract: The aim of this research is to determine if the share prices of 10 listed energy companies in the Philippine Stock Market are correlated with the wholesale electricity prices at the Wholesale Electricity Spot Market (WESM) and the prices of fuel input such as coal, natural gas, and crude oil. With significant correlations, the next phase is to formulate significant models in order to account for the significant association and the effect of the wholesale electricity prices and fuel input prices on the share prices of these 10 listed companies. With the enactment of Republic Act 9136 known as the Electric Power Industry Reform Act (EPIRA) in 2001, the Philippine power industry changed from a state-led model to a free market model. The 10 listed companies are Aboitiz Power Energy, Alsons Consolidated Resources, Basic Energy Corporation, Energy Development Corporation, First Gen Corporation, First Philippine Holdings, Salcon Power Corporation, Manila Electric Company, Phinma Energy, and Vivant Corporation. The spirit behind the reform act is to patch up the profuse bleeding of the national government from the debts contracted by the government of Ferdinand Marcos in behalf of the National Power Corporation (NPC), a state-owned and controlled corporation, which was tasked to generate power and transmit it through its high voltage lines to cooperatives and industrial users. The EPIRA Law aims to perpetuate a power industry that could sustain itself in the midst of an expanding demand for electricity through the private sector. In order to sustain this, these companies should have continuous capitalization in the midst of competition as envisioned in a free-market model. This research found significant correlations and significant models in regard to the effect of wholesale electricity prices and fuel price input on the share prices of 10 generating companies listed in the Philippine Stocks Exchange.

Keywords: WESM, Wholesale Electricity Prices, Ex ante, Ex post, EPIRA Law, Share Prices.

JEL Classification: G11, G13, G17

Introduction

Aside from re-establishing the democratic institutions after President Ferdinand Marcos was deposed, the administration of President Corazon Aquino was confronted with several challenges among which was energy production. The administration of Corazon Aquino was best remembered with rotating brownouts which most Filipinos attributed to the administration's incompetence. But in reality those power outages were not her government's doing.

When Marcos declared Martial Law in 1972 and placed the entire country under authoritarian regime, he issued Proclamation 40in the same year, which provided for the integration of power distribution into one power grid that linked the major islands of Luzon, Visayas and Mindanao and empowered the National Power Corporation (NPC) to construct, own and manage power plants to supply the increasing demand for electricity while privately-owned generating facilities in operation even before the proclamation would remain in operation subject to the determination and authorization of the government. Since the NPC is a government owned and controlled corporation, power generation and grid transmission were assumed by the state which the government pursued through foreign borrowing since the NPC was also authorized to borrow domestic and foreign loans that the government guaranteed under Republic Act 6395. That law was enacted in 1971 by the government of Marcos a year before the declaration of Martial Law.

But the construction of power plants needed huge capitalization with which the government incurred huge debts. By 1983, the Marcos regime gained a debt-to-GDP ratio of 56% compared to debt-to-GDP ratio of 35% in 1980 ("External debt…"2019). When President Corazon Aquino assumed power in 1986, these power plants had aged and were in need of rehabilitation. But rehabilitating them would need huge amount of cash again and a new government strapped with cash could not afford such massive and immediate rehabilitation. The government of Corazon Aquino enacted Executive 215 in 1987, permitting the re-entry of private corporations for the construction of power plants subject to the rules of NPC which has operational management of the grid. But constructing power plants cannot happen overnight. It needed huge amounts of capitalization and assurances of profit with enough incentives to attract the private sector's entry.

On June 8, 2001, President Gloria Macapagal Arroyo signed the Electric Power Industry Reform Act (Republic Act 9136) of 2001 or the EPIRA law which was envisioned to solve the energy problem by privatizing the NPC and breaking it into two components, the power generation component

and the power transmission component. The Power Sector Assets and Liabilities Management (PSALM) was also set up to facilitate the sale of NPC's assets to private hands while NPC was vested with the new task of managing watersheds and reservoirs where hydro-electric power was generated. In order to create a power industry faithful to the tenets of competition as the free-market model hopes to deliver, the Wholesale Electricity Spot Market (WESM) was created as trading platform for about 9% of electricity transactions while almost 91% are arranged through bilateral contracts. The spot market commenced operation on June 26, 2006 with only the Luzon Grid integrated in the platform and on December 26, 2010, the Visayas Grid joined in the operation, (WESM 2002).

In the spirit of a free market system, one characteristic is the sustenance of capital which the generating companies should acquire. This will ensure the availability of electricity as demand for it rises while keeping these generating companies' profit in order for them to stay as players in the industry.

Review of Literature

The idea of selling electricity like any other commodity being sold in the futures market came with the publication of Paul Joskow and Richard Schmalensee's (1983) book *Markets for Power.* After which, countries adopted a market of electricity traded in a platform that mimics that of the stock market. Market efficiency becomes a central concern since a number of countries in America and Europe adopted a liberalized market for electricity. To this end, challenges for research became the theme of Richard Green's (2003) paper "Electricity Markets: Challenges for Electricity Markets." His paper explores the areas of economic research where electricity market finds challenging concerns. He figured out the following:

a) the market design or model being adopted whether zonal pricing system or nodal spot-pricing approach; of which is simpler to run and what factors drive the prices;
b) market power, on which *ex ante* market research where methodology has to be improved and structural remedies need to be explored;
c) retail markets which could do away with wholesale market;
d) investment and supply security whether profit can well be gained in consideration of cost;
e) linking markets together, where the problem of capacity and coordination comes in; and
f) regulating the wires, where efficient transmission becomes a necessity through grid distribution.

Green's paper promotes these challenges as a way to improved industry performance in consideration of the price, cost, and reliability.

Another of Richard Green's (2008) work "Electricity Wholesale Markets: Designs Now and in a Low Carbon Future" is the comparison between United States and European electricity market models. The standard market design of the US involves nodal pricing with financial transmission rights, independent system operator and integrated markets for capacity and ancillary services. The European model, however, includes national and occasional zonal pricing, spot markets run by companies independent of the transmission operator and the operator's purchases of ancillary services. As the amount of low-carbon electricity generation increases, electricity prices and transmission constraints would become more volatile. Six principles became the benchmark of Green's analysis as lifted from the Stanford Energy Modelling Forum for which electricity prices in a free-market model should have:

a) promote the efficient day-to-day operation of the bulk power market,
b) signal locational advantages for investment in generation and demand,
c) signal the need for investment in the transmission system,
d) compensate the owners of existing transmission assets,
e) be simple and transparent, and
f) be politically implementable.

In the same manner, the principles for the wholesale markets should be:

a) to ensure the efficient day-to-day operation of the generation sector,
b) to signal the need for investment in generation and demand-side management,
c) to promote efficient locational choices for these investments,
d) to compensate (sufficiently) the owners of existing generation assets,
e) to be as simple, transparent, and stable as possible, and
f) to be politically implementable.

Green concluded that nodal pricing run by independent system operator in real time provides for more efficient operation than zonal pricing. While signalling for investments, each design has advantages as liberalization of the market has achieved more success in Europe than in the US (Green 1997, 178).

By the time Joskow (2008) wrote "Lessons Learned from Electricity Market Liberalization," it has been 20 years (33 years now) since Joskow and Schmalensee wrote their book *Markets for Power* which became the

stimulus to liberalize the electricity markets in the United Kingdom and many countries followed the lead. Joskow cited 12 lessons learned within the parameters of standard liberalization prescription. Among which are:

a) privatization of the energy sector;
b) the creation of the spot market;
c) vertical separation of competitive segments such as generation, transmission, distribution, retail;
d) horizontal integration of generation to assure competition;
e) horizontal integration of transmission; and
f) the unbundling of tariffs.

Within these parameters, the 12 lessons learned from across different countries include among others:

a) electricity sector reforms have significant potential benefits but also carry the risk of significant potential costs if the reforms are implemented incompletely or incorrectly;
b) the textbook model of restructuring, regulatory reform and market design is a sound guide for successful reform;
c) departing significantly from the textbook model of restructuring, competitive market institutions and regulatory reforms are likely to lead to performance problems;
d) transparent organized spot energy and ancillary services markets should be integrated with the allocation of scarce transmission capacity;
e) market power is a significant potential problem in electricity markets, but the cure can be worse than the disease;
f) good transmission and distribution network regulatory institutions are important but sometimes neglected components of the reform process;
g) creating a well-functioning transmission investment framework is important but continues to be a significant challenge in many countries; and
h) system reliability, "supply security" and "resource adequacy" are of great concern to policy makers in almost every country.

The jury is still out on how competitive power markets can stimulate levels of investment in new generating capacity in the right places at the right times consistent with political preferences for reliability.

Since the deregulation process has transformed electricity provisioning into a market of electricity exchanges, different types of market set-ups

have emerged and among which is called day-ahead-markets where power providers are confronted with a process that uses on a central bid-offer or auction-type-mechanism. This apparatus determines the price of electricity according to energy demands. The central concern in this type of market is the determination of the minimal price of electricity to satisfy a fixed amount of demand. This is the central theme of Bossy et. al. (2006) paper "Using Game Theory for the Electricity Market." The authors used mathematical modelling involving several suppliers offering their bids but with two scenarios, where in the first case the supplier strives to maximize market share and in the second scenario the supplier strives to maximize profit. The models indicate that in both scenarios, the Nash Equilibrium can be achieved in a strategy of either to sell or not to sell in the market. But an interesting note was also indicated, that in profit maximization, the equilibrium strategies may not be realistic. This suggest that in unregulated markets where suppliers are interested in instant profit maximization, an equilibrium may not occur, prices may become "arbitrarily high and anticipation of this market behaviour may be impossible."

Nonetheless, whether nodal or zonal pricing that the spot market adopts in the re-structured electricity markets, the free-market innovation would centre on the supply-side of the market. Within the central mechanism of decision-making apparatus for pegging the prices, the consumers would have no choice to find the lowest price offered by other power providers. In re-structuring the electricity market, the United States adopted the retail choice system in some states where consumers at the bottom of the market would have the choice to select their power provider that would offer them the lowest price. After almost 20 years after the system was adopted in 1990, the system was assessed according to the same objectives of the innovated wholesale market of the consumer side. It was intended that competition in generation services would induce technological and management improvements in energy production which would reduce generation costs and improve generation performance. Likewise, the removal of barriers to trade among utilities would bring down the price of electricity. Morey and Kirsch (2016) of the Christensen Associates Energy Consulting, wrote in their report that:

Retail choice system had improved the efficiency on the use of power system resources, lowered the average cost of producing power and improved resource adequacy… Retail choice promoted renewable resources… But retail choices, from the beginning to the present, have had retail prices higher than those in other states, with the price gap varying over time with changes in fuel prices and other factors. While the overall trend has been toward a lower price gap, the gap has been due to the varying

prices of natural gas… Retail choice exacerbates the resource adequacy problem by materially adding to the financial uncertainties faced by investors in generating resources because it adds to uncertainties in the revenues that a generator acquires for its services. These uncertainties make investments in new generation less attractive. The risk of retail supplier bankruptcies under retail choice is greater than under traditional regulation (Morey and Kirsch 2016, 66-67).

While these pieces of literature agree on the positive effect of liberalization of the electricity market, distortions in the market leading to market failure are the concerns of the theory of harm. The theory has its roots in classical economics with Adam Smith's (1776) rejection of cartels and monopolies which could sell commodities beyond the effectual price and John Stuart Mill's (1859) advocacy that restraints on trade or production for trade are intrinsically evil. The theory of harm suggests that market distortions in the energy market are aberrations that could hurt consumers and stifle competition. The Competition Market Authority (CMA) is a body in the United Kingdom tasked to investigate the existence of these distortions and set out four principles of the theory of harm namely:

Opaque prices and low levels of liquidity in wholesale electricity markets create barriers to entry in retail and generation, perverse incentives for generators and/or other inefficiencies in market functioning… Vertically integrated electricity companies harm the competitive position of non-integrated firms to the detriment of customers, either by increasing the costs of non-integrated energy suppliers or reducing the sales of non-integrated generating companies… Market power in generation leads to higher market prices…. Energy suppliers face weak incentives to compete on price and non-price factors in retail markets, due in particular to inactive customers, supplier behaviour and regulatory interventions (CMA, 2017).

Synthesis

These pieces of literature attest to the benefits that the free-market re-structuring of the electricity market could assure. Electricity is one product prone to monopolies and monopolies hurt consumers because the monopolists could increase commodity prices beyond the effectual supply and demand dynamics. Monopolies could also stifle improvements in the product which would result in inefficient services. Two objectives of the re-structuring were envisioned right from the start: product innovation and cheaper prices. These two objectives according to these pieces of literature have been attained, though certain market distortions could result because of vertical provisioning, that is, one company could both generate

and distribute electricity, and other factors that violate anti-trust rules. These are the factors that CMA guards against.

Electricity is one product like no other since its production and delivery is not the same as any product available in a shelf in a department store. The stimulus that precipitated the idea of an electricity market weaved along a free-market idea originated from the work of Joskow and Schmalensee (1983). This came with the central thesis that free-market makes economic provisioning efficient. Since the timing of this publication came also with world trend towards economic liberalization, political leaders and economic managers followed on the lead to liberalize the provisioning of electricity that would behave like that of a market. Economic scholars and researchers followed on this lead to ascertain if the electricity market has attained a certain level efficiency. This is the theme of the works of Green (1997 and 2008) and Joskow (2008). Pricing strategies became another trend which was assessed in the works of Bossy et. al. (2006) and Morey and Kirsch (2016). But with the years experiencing a liberalized market of electricity, certain ill-effects of high prices became the theme of another group of scholars which espoused the theory of harm (CMA 2017). Within the theme of these writings, the present research will also look at price strategy but will look at its relation with the price of fuel input on the one hand in order to find out the level of price sensitivity and also look at the relation of electricity prices with the prices of stocks of listed energy companies in order to find some indications if prices are driven with the end in view of a competitive market marked with self-sustaining expansion to meet increasing demand.

While electricity market re-structuring had its beginnings 20 years ago, the Philippine experience has hers only about 15 years back and which got its motivation about 20 years also after brownouts plagued the Philippine households shortly after the change in government at the aftermath of the 1986 EDSA People Power Revolution. The Philippine experience in liberalized market is fairly young to find out its long term effects. What the present research would do initially is to find out if the prices of electricity bid and offered at WESM respond to the prices of fuel in the world market that determine if these variables also generate effects on the share prices of generating companies that generate this power.

Rationale

Power generation as envisioned by the EPIRA Law should emanate from private companies to veer away from the state-centric model of power generation implemented during the Marcos Regime which eventually bled the government with much debt. But placing the burden of power

generation in private hands should ensure profitability among the generating companies so the private sector would stay in business and even use that income for expansion as electricity needs would increase in the future. The continuous electricity supply can be achieved with the continuous generation of power and this can only be achieved if the power plants are working because the generating companies are earning from it.

On the other hand, these generating companies are listed in the Philippine Stocks Exchange where investors could buy shares they could use for capital expenditures. One indication of a healthy free-market operation is the sensitivity of these generating companies' share prices to the wholesale prices traded in WESM and the prices of fuel input. Such sensitivity can be translated into the fitness of these prices with one another and, if they are fitted, modeling them in order to give an indication of the movement of the prices of fuel input and wholesale electricity prices with the share prices that they achieve in the stocks market.

Statement of the Problem

This research then tries to find out if the share prices of the 10 energy companies listed in the Philippine Stocks Exchange are correlated with the wholesale electricity prices transacted at WESM and the prices of coal, natural gas, or crude oil in the world market. The idea is that, when wholesale electricity prices transacted and closed at WESM go up or down, does the share prices of these listed energy companies also go up or down as well? When the prices of fuel in the world market which these energy companies use also fluctuate, do their share prices fluctuate as well? When significant correlations are achieved can models be created to account for their variations? The 10 listed energy companies include Aboitiz Power Energy, Alsons Consolidated Resources, Basic Energy Corporation, Energy Development Corporation, First Generation Corporation, First Philippine Holdings, Salcon Power Corporation, Manila Electric Company, Phinma Energy, and Vivant Corporation.

Wholesale electricity is the same as "electricity bought in bulk" as provided for in Republic Act 6395. Electric cooperatives and industries with high electricity needs could buy electricity in bulk or wholesale from generating companies. This electrical power which comes in kilovolts and megawatts is generated by power plants and released in the high power transmission lines as managed by the National Grid Corporation. The electric cooperatives and industries capture the electricity they need through these power lines and reduce them to the needed voltage in their franchise areas which they sell it at retail price to households.

Theoretical Framework

Price theory assumes that "a change in price leads to a change in quantity demanded, which is the same as the movement along the demand curve; a change other than price can lead to a change in demand , which is a shift of the demand curve itself; a change in price leads to a change in quantity supplied, which is the same as the movement along the supply curve; a change in something other than price can lead to a change in supply which is a shift in supply curve itself (Landsburg 2008, 24). This is the classic law of supply and demand where price becomes a function of the oppositional direction of the quantity of demand and supply. But the assumption that underlies the price theory is that the consumer is the sole decision-maker who can bargain with the supplier over the goods that he or she wants to have. There is no intervention from any apparatus of whatever nature to seek for the price he or she could attain over the product or service he or she needs to have. The electricity market, however, does not operate in that manner. The prices of electricity are set by a central mechanism which receives offers from cooperative and private distribution facilities over the quantity of electricity they need and which power generators would bid. The central apparatus determines the price in conformity with their rules. The mechanism goes every hour since the demand for electricity varies by the hour.

On the other hand, the share prices of companies listed in the Philippine Stock Market move by virtue of the Efficient Market Hypothesis (EMH) of Eugene Fama (2008) which assumes that no amount of information could assure any investor in the market of any excessive returns all the time, whether such information exists as a historical outcome of the stocks' performance (weak form), or information that is publicly available that would give an extra stimulus for investors to favour certain stocks (semi-strong form) or information which someone or a few has special knowledge of from the inside (strong form) (Brealey et al., 2004). In all these cases, an investor would not have all the opportunities of winning and the others losing for even if an investor possess insider information, his bet would encourage a bandwagon and many would bet on the choice to take advantage of his purchase.

> *A market where there are large numbers of rational, profit-maximizers actively competing with each other, trying to predict future market values of individual securities, and where important current information is almost freely available to all participants. In an efficient market, competition among the intelligent participants leads to a situation where, at any point in time, actual prices of individual securities already reflect the effects of information based both on newspaper-article-events that have already occurred and on events which, as of now, the market expects to take place*

> *inthe future. In other words, in an efficient market at any point in time the actual price of a security will be a good estimate of its intrinsic value (Fama 2008).*

The weak form of market results in a Random Walk, where "a drunk would waywardly walk to a certain direction" and even historical and technical analysis would not give an advantage to make excessive returns. The modelsthat would illustrate the effect of wholesale electricity prices and fuel input prices in the world market on the share prices of these energy companies are part of technical analysis which may fall under the information the constitute the weak form of a market.

Methodology

This study covers wholesale electricity prices recorded in the WESM website from January 1, 2011 to December 31, 2016. The prices of coal, natural gas, crude oil and the prices of stocks of listed energy companies cover the same time period. Trading electricity in wholesale prices at WESM emanate from the demand side coming from cooperatives and industrial users and matched by the supply side offered by generating companies or gencos. This generates two types of wholesale prices. The offer prices or prices tendered before the transaction called ex ante and the prices at the close of the transactions called ex post. Both ex ante and ex post prices are reckoned as to the maximum or minimum price offers and close and the mean of the prices is their average for the hourly trading. All of the wholesale prices of electricity, the prices of fuel, and the share prices of companies are accounted for daily in this research. For the 5-year period, there are 2,192 cases of the wholesale electricity prices ex ante and ex post, at their maximum, minimum and average; the prices of coal, natural gas and crude oil; and the share prices of the 10 listed energy companies. These variables were treated with correlation and significant correlations were further subjected to regression in order to arrive at the models.

Analysis of Data

Wholesale Electricity Prices at WESM

The daily ex ante and ex post wholesale electricity prices were on the slight dip within the 2011-2016 time period (Figures 1 and 2). It began with P 1,714 per megawatt-hour ex ante and P 1,564 per megawatt-hour ex post in the beginning of 2011. Thenwholesale electricity prices suddenly jolted sky high at P 48,190 per megawatt-hour ex ante and P 47,047 per megawatt-hour ex post on December 7, 2013. This was due to the lack of supply brought about by the devastation of typhoon Yolanda in November of that year where high power lines were destroyed. From November 9, 2013 to

March 25, 2014, trading in the Visayas grid was suspended because of power line structures needing repairs. The wholesale prices dropped to P 877 per megawatt-hour ex ante and P 699 per megawatt-hour ex post. The year 2016 finished with P 1,784 per megawatt-hour ex ante and P 1,745 per megawatt-hourex post.

Fuel Input Prices

Since the supply of electricity in the Philippines comes from different sources such as coal, geothermal, hydro, natural gas, diesel, wind, and biogas, WESM had to proportionately combine them in order to ensure

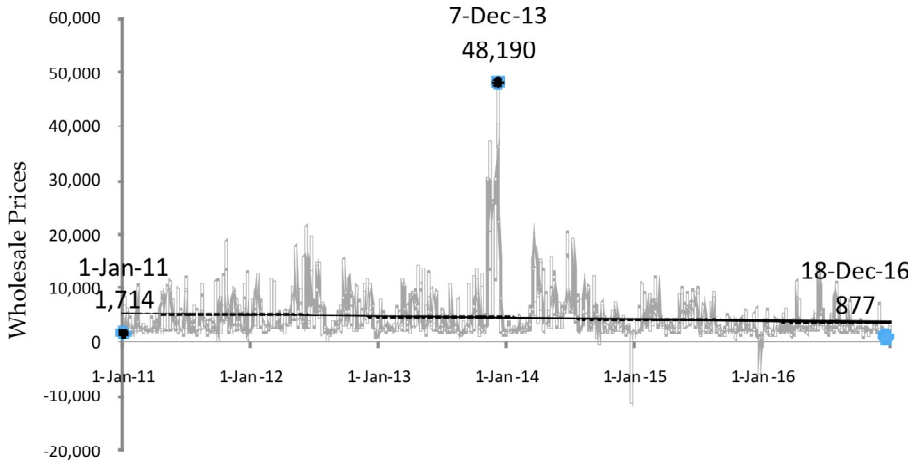

Figure 1: Daily Average Wholesale Electricity Prices Ex Ante at WESM (2011-2016)

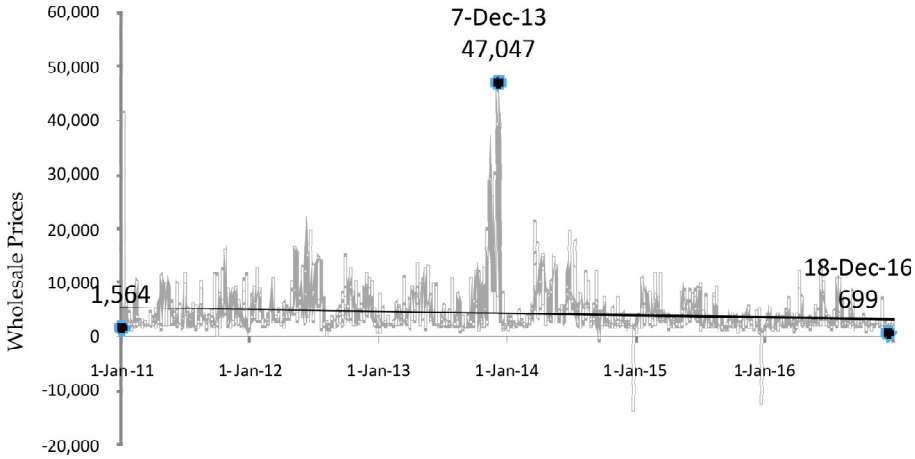

Figure 2: Daily Average Wholesale Electricitiy Prices Ex Post at WESM (2011-2016)

profit from participating generating companies. The mix gives the largest share from coal (Figure 3) with 46.3% ex ante 43.4 % capacity offer. Natural gas has a share of 30% ex ante and 27.5% capacity offer. Electricity coming from geothermal sourcecomes in with 14.3% ex ante and 11.7% capacity offer. Hydro powergets a share of 6.7% ex ante and 7.9% capacity offer. The most expensive fuel is diesel or oil with 2.1% ex ante and 9.2% capacity offer. The combination of wind and biomass sources has the lowest share with 0.7% ex ante and 1.3% capacity offer. Hydro power and wind may offer their cheap prices but their generating capacity is subject to the blessings of nature for in summer months water in the dams are low and wind power sources may have interrupted electrical supply when wind is not peaking enough to rotate the blades.Under the WESM rules of trading, upon taking all the offer prices from generating companies, WESM had to arrange from the highest bid to the lowest offer. The highest bid wins which would dictate the wholesale price of electricity for that hour.

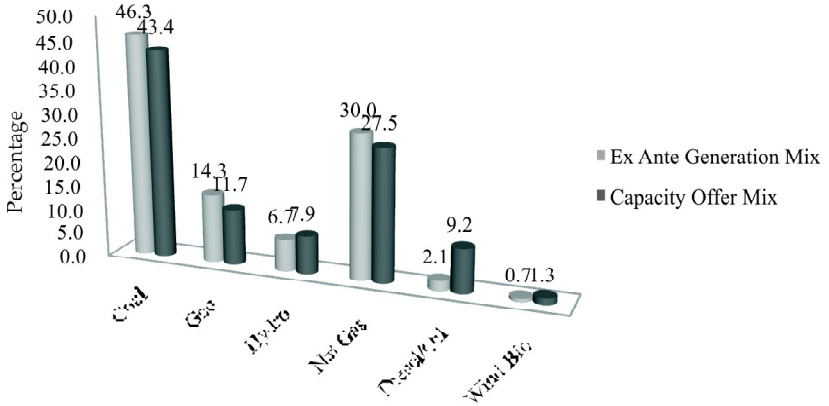

Figure 3: Percentage of Electricity Generation Mix by Origin for 6 Years (2011-2016)

Coal

The daily prices of coal began with $71.00 per ton on February 22, 2011 (Figure 4) and ended with $58.30 on December 30, 2016 in the world market. The downward slide could be accounted for by the following model:

$$\text{Coal Price}_{\text{Daily}} = 55.8358 - 0.0210\ \text{Day}$$

The model suggests that the prices of coal were decreasing by 0.0210 with each passing day. Except for sudden spikes on August 17, 2011 which moved the prices up to $79.75 per ton, the slide in prices even on other occasions of those price spikes at $66.90 per ton on January 28, 2014 to $63.05 per ton on November 1, 2016.

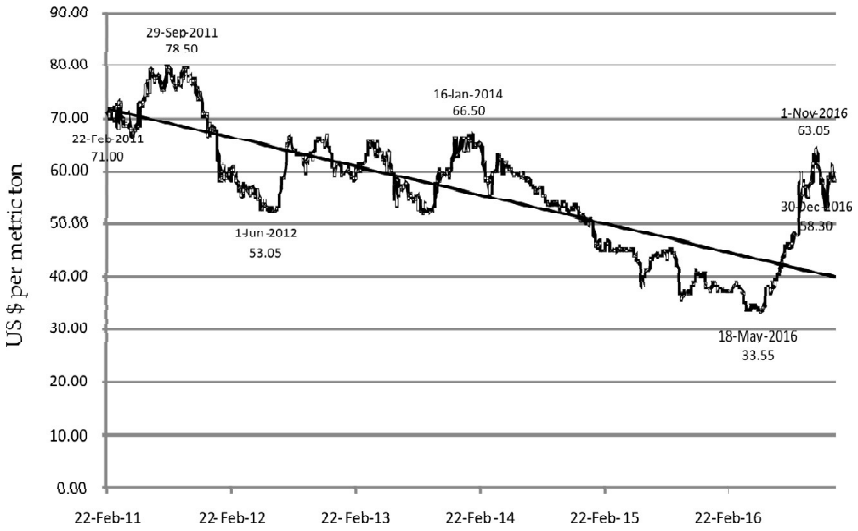

Figure 4: Daily of Prices of Coal in the World Markiet (Feb. 22, 2011- Dec. 30, 2016)

There are two types of coal available in the world market,

a) thermal coal which is used for fueling boiler to produce steam and generate electricity and
b) metallurgical coal which used to process iron ore for the production of steel.

The main reason for the falling prices of both types of coal was decreasing demand. The United States which also produces coal had significantly reduced demand in favor of renewable sources of energy and environmentally friendly fuel sources. China which had insatiable appetite for steel at 16% every year for 10 years from 2002 had suddenly cut down its demand for steel, slowing down its growth rate from 10% to 7% by 2015. Thus both thermal coal and metallurgical coal were at low demand (Roberts 2016).

> *Between 2011 and 2014, 93% of the decline in US coal producer revenue was due to a drop in met (metallurgical) quantities and prices. A sharp drop in US coal-fired power generation—and the resulting drop in steam coal production—played a more significant role in 2015, but met (metallurgy) still accounted for 57% of the revenue decline relative to 2011 (Roberts 2016).*

Natural Gas

The prices of natural of gas were also on a downward glide with $4.650 per millionth BTU[1] and finished off with $3.724 per millionth BTU on December 30, 2016 (Figure 5). The model could be illustrated with:

Figure 5: Daily Prices of Natural Gas in the World Market (Jan. 3, 2011-Dec. 30, 2016)

$$\text{Natural Gas Price}_{\text{Daily}} = 3.33605 - 0.0004\ \text{Day}$$

The model states that the prices of natural gas were decreasing at slower rate by 0.0004 each day. The highest price could be reckoned on February 19, 2014 with $6.149 per millionth BTU with the lowest price registered on February 23, 2016 at $1.782 per millionth BTU.

The volatility of the prices of natural gas was due to demand and storage. Natural gas has various uses. Rather than directly used for heating in the US, it is also used for electricity production and fuel for transportation. Since households directly use natural gas, warm winters would decrease demand for it but increase the price of storage while cold winters would increase its price and decrease storage cost.

During the last five years, we have seen both extremes: the winters of 2011-2012 and 2015-2016 were both exceptionally warm, reducing natural gas demand. Subsequently, natural gas prices declined over the course of both winters and reached decadal lows below $2/MMBtu in spring. Conversely, the winters of 2013-2014 and 2014-2015 were both very cold. During the 2013-2014 winter, heating demand was so high that it drove natural gas storage down to only 800 Bcf, less than 20% of capacity and a level not seen in at least ten years. Prices quickly rose and, from a range a $3-4/MMBtu in 2013, were above $4/MMBtu for most of 2014 (Gilbert 2017).

Compounding the price volatility was the fracking technology used by the United States to break at shale formations to extract natural gas and the refracking of old wells to produce more of it. On the other hand, while

the prices of natural gas were also in its decline over the past six years, the movement of natural gas prices was opposite to that of crude oil and coal. With the sharp decline on the prices of coal and crude oil in 2014, demand for crude oil and coal rises, leading industrial consumers to opt for coal and crude and raising the prices of natural gas due to lack of demand for it in power generation.

Crude Oil

Crude oil prices in the world market (Figure 6) were also moving in the downward trend which began with $91.55 per barrel on January 3, 2011 to $53.72 per barrel on December 30, 2016. The down sloping movement could be illustrated with the following model:

$$\text{Crude Oil Price}_{\text{Daily}} = 78.4635 - 0.0434\ \text{Day}$$

The model indicates that the prices of crude oil in the world market were decreasing by 0.0434 with the daily addition. Spikes in prices could be accounted for on April 27, 2011 at $112.76 per barrel and on June 12, 2014 at $106.53 per barrel but prices suddenly dropped at $44.84 per barrel on March 13, 2015.

The decline of oil prices was due to several factors. Crude oil prices experienced one of their highest spikes from 2000 to 2008, soaring crude oil prices to about $150 per barrel (De Persio 2018). After the recession brought about by the properties sector in the US economy in 2008, which also affected other economies in the world, crude oil prices began to drop and such drop was so sharp from 2014 to 2015. The main culprit was

Figure 6: Daily price of crude oil in the world market (Jan. 3, 2011-Dec. 30, 2016)

oversupply. Canada tapped in to its new found oil sand in Alberta while the United States capitalized on fracking to extract oil and natural gas from shale formations. By 2015 US oil inventory was at its highest with 500 million barrels, the highest in 80 years (Tarver 2015).This removed its dependence on oil produced externally. The global recession also had its effect on China, India and Brazil; China, most especially, which was guzzling a lot of oil for its industries. But the decline in the demand for these countries resulted in oversupply. The job of cleaning up oversupply lay on the turf of the Organization of Petroleum Exporting Countries (OPEC), but Saudi Arabia which has the largest oil reserves did not want to cut supply as it reasoned that since processing oil from sand fracking is an expensive process, keeping the prices of oil low would eventually make Canada and the US oil industries lose out on profit. Thus no concession to cut oil supply was reached by OPEC member countries at a meeting on November 27, 2014 in Vienna ("Why Oil Prices are Falling" 2014).

Correlation between Share Prices and Share Values with Wholesale Electricity Prices and Fuel Input

Significant correlations were computed between share prices, wholesale electricity prices and prices of fuel input (Table 1). Aboitiz Power's share prices were negatively correlated with the maximum ex ante and ex post wholesale electricity prices at –0.233as its share prices were also highly correlated with the prices of coal at –0.793. Alsons Consolidated Resources had its share prices negatively correlated with both the maximum ex ante and ex post wholesale electricity prices at –0.097 while the prices of crude oil were also negatively correlated with its share prices at –0.395. Basic Energy Corporation had its share prices negatively correlated with the minimum ex ante wholesale electricity prices at –0.149 and also negatively correlated, nonetheless, with the minimum ex post wholesale electricity prices at –0.136 as it showed no significant correlation with any of the fuel input since it is highly dependent on renewable sources of energy. First Generation's share prices were negatively correlated at –0.164 with the average ex ante wholesale electricity prices and at –0.180 with the average ex post wholesale electricity prices while its share prices were, likewise, negatively correlated with the prices of natural gas at –0.288. Energy Development Corporation, the renewable energy corporation of the Lopez Group of Companies, had its share prices negatively correlated with the average ex ante wholesale electricity prices at –0.107 and with the average ex post electricity prices at –0.111. Since it generates power through wind, solar, hydro, and geothermal, its share prices and values had no correlation with any of the fuel input.

Meralco got significant negative correlations between its share prices and the average ex ante wholesale electricity prices at –0.064 and with the average ex post wholesale electricity prices at –0.074. As a distribution company, it had no correlation with any of the fuel input. Phinma Energy Corporation's share prices posted negative correlation between the maximum ex ante wholesale electricity prices at –0.123 and between the maximum ex post wholesale electricity prices at –0.126 while its share prices were also negatively correlated with the prices of coal at –0.647 and with the prices of crude oil at –0.433. Vivant Corporation also got negative correlation between its share prices and the maximum ex ante wholesale electricity prices at –0.233 and between the maximum ex post wholesale electricity prices at –0.225. At the same time, Vivant Corporation's share prices were also negatively correlated with the prices of coal at –0.817 and with the prices of crude oil at –0.881. These negative correlations may relatively be weak but they were significant between 0.01 and 0.001 nonetheless. All these negative correlations mean one thing, the declining wholesale electricity prices are well fitted to the increasing share prices of these listed companies. Increasing share prices would mean more viability, more prospect for profitability and more bullish trading for investors in the stock market. At the same time, the declining prices of fuel input is also well fitted to the increasing share prices. These specific fuel inputs are exactly what their power plants were using. This would indicate that the sliding wholesale electricity prices at WESM and the decreasing prices of fuel input resulted in increasing share prices of these listed energy companies. (Table 1)

Only two listed energy companies namely First Philippine Holdings Corporation and Salcon Power Corporation acquired positive correlation. First Philippine Holdings, the holdings company of First Generation and Meralco had its share prices positively correlated with the minimum ex post wholesale electricity prices at 0.066.Since this is a management company, the effect on the movement of wholesale electricity prices on its share prices is opposite from the purely power generating companies. Salcon Power Corporation's share prices were positively correlated with the maximum ex ante wholesale electricity prices 0.197 and withmaximum ex post wholesale electricity prices at 0.201 while its share prices are also positively correlated with the prices of crude oil at 0.331. The positive correlation would indicate that the declining wholesale electricity prices at WESM and the sliding prices of fuel input were well-fitted to their declining share prices. For Salcon Power Corporation the reason for its slide in share prices is the decrease in the Gross Revenues from P 2,920,729,250 in 2016 to P 2,350,121,191 in 2017 (Edge. PSE, 2017).

Table 1: Correlation between Wholesale Electricity Prices, Fuel Prices and Share Prices of Listed Energy Companies (2011–2016)

		Wholesale Ex Ante Prices			*Wholesale Ex Post Prices*			*Fuel Prices*		
Genco	*Energy Type*	*Min*	*Max*	*Ave*	*Min*	*Max*	*Ave*	*Coal*	*Natural Gas*	*Crude Oil*
Aboitiz Power	G, H, B		–0.233**			–0.233**	–0.214**	–0.793**		
Alson's Cons. Resources	H, D, C		–0.097**	–0.059*		–0.097**	–0.074**			–0.395**
Basic Energy Corp	B, G, S	–0.149**	–0.069*		–0.136**	0.061*				
First Phil Holdings	Holding Co. of First Gen. and Meralco				0.066*					
First Generation	H, N		–0.0173**	–0.164**		–0.0178	–0.180**		–0.288**	
Energy Dev't Corp	W, S, H, G		–0.073**	–0.107**	–0.054*	–0.079**	–0.111**			
Meralco	C			–0.064*		–0.052*	–0.074**			
Salcon Power Corp	D		0.197**	0.190**		0.201**	0.196**			0.331**
Phinma Energy Corp	W, S, G, D, C		–0.123**	–0.091**		–0.126**	–0.108**	–0.647**		–0.433**
Vivant Corporation Corp	H, G, D, C	–0.122**	–0.223**		–0.125**	–0.225**	–0.232**	–0.817**		–0.881**

*Legend:*G = Geothermal; H = Hydro; C = Coal; D = Diesel; N = Natural Gas; W = Wind, S = Solar; B = Biomass

** Significant at 0.01 level or higher (Two tailed), *Significant at 0.05 level (Two-tailed)

Models of Electricity Prices, Fuel Prices and Share Prices

Listed in the Philippine Stocks Exchange are 10 companies engaged in electricity generation: Aboitiz Power, Alsons Consolidated Resources, Basic Energy Corporation, First Philippine Holdings Company, First Generation, Energy Development Corporation, Meralco, Salcon Power Corporation, Phinma Energy Corporation, and Vivant Corporation.

These significant correlations could translate into significant regression models:

Aboitiz Power

The average share price of Aboitiz Power from 2011 to 2016 (Figure 7) was P 37.40 with the highest closing share price of P 48.90 recorded on June 7,

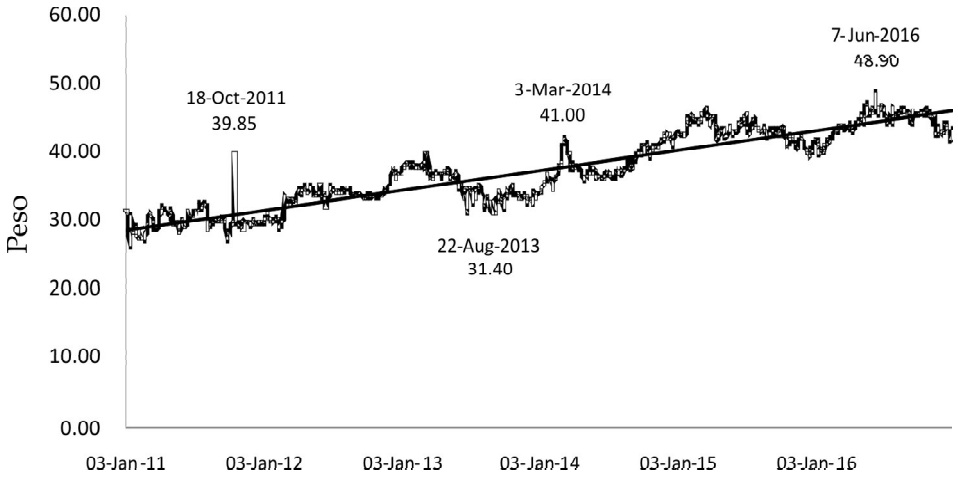

Figure 7. Price per Share of Aboitiz Power for Six Years (2011-2016)

2016 and the lowest share price of P 31.45 registered on January 3, 2011, April 4, 2011, and August 27, 2013. Aboitiz Power's share prices were moving upward.

$$\text{Aboitiz Share Prices}_{\text{Daily}} = 58.341 - 0.000053\,\text{WEP Max Ex Post}_{\text{Daily}} - 0.358\,\text{Coal Prices}_{\text{Daily}} + 3.19471_{\text{error}}$$

This model indicates that P 1.00 decrease in the daily maximum wholesale ex post prices of electricity determined as a price set for the hour at WESM results in the increase of share prices of Aboitiz Power by 0.000053 while holding the effect of coal prices constant and $1.00 decrease in the daily prices of coal in world market delivers an increase in the share prices of Aboitiz Power by 0.358 while holding the effect of the wholesale electricity prices constant. Let us say, the average maximum wholesale electricity prices from P 1,000 per megawatt-hour two days ago decreased to P 999 per megawatt-hour inyesterday's trading. If the share prices of Aboitiz Power was P 38.00 the previous day, then it would likely increase by 0.000053 at the amount of P 0.002014 resulting to a total of P 38.002014 at the present trading. If coal's prices which closed two days ago at $66.00 decreased $1.00 at $65.00 per metric ton during yesterday's trading, then the price of Aboitiz Power's share prices at P 38.00 would likely increase by 0.358 at the amount of P 13.64 at the present trading. Since the effects are moving in the same direction then we add the two coefficients with a net effect of 0.358053 at the amount of P 13.606014. Thus, with the decrease in the wholesale electricity prices closed at WESM and with the slide in the prices of coal in the world

market, the share price of Aboitiz Power could increase from P 38.002014 to P 51.606014 during the period of 2011-2016.

Alsons Consolidated Resources

Alsons Consolidated Resources' share prices were also in the upward trend (Figure 8) from 2011 to 2016 with an average share price of P 1.54; with the highest share price of P 2.27 found on March 27, 2015 and with the lowest share price of P 1.10 registered on September 29, 2011 and October 3, 2011.

$$\text{Alsons Share Prices}_{\text{Daily}} = 1.576 - 0.0000024\ \text{WEP Max Ex Post}_{\text{Daily}} + 0.29235_{\text{error}}$$

This model tells us that P 1.00 decrease in the closing wholesale ex post prices of electricity at WESM increases the share prices of Alsons Consolidated Resources at the Philippine Stocks Exchange by 0.0000024. Let us say that the average maximum ex post wholesale electricity prices at WESM was recorded at P 1,501 per megawatt-hour two days ago and decreased by P 1.00 at yesterday's trading at P 1,500 per megawatt-hour, thenAlsons Consolidated Resources' share price which closed the previous day at P 1.30 would likely increase by 0.0000024 at the amount of P 0.00000312 or a total of P 1.30000312 in the present trading within period of 2011-2016.

$$\text{Alsons Share Prices}_{\text{Daily}} = 1.888 - 0.004\ \text{Crude Oil Prices}_{\text{Daily}} + 0.27396_{\text{error}}$$

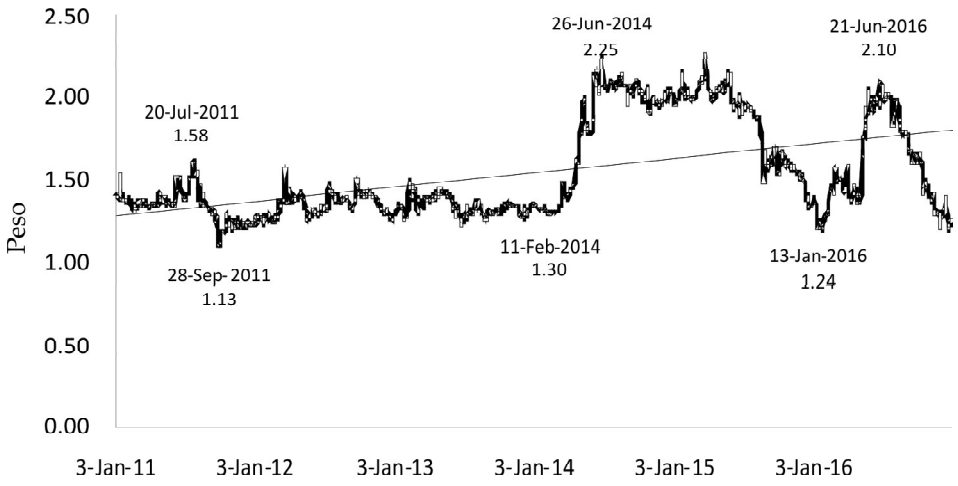

Figure 8: Price per Share of Alsons Consolidated Resources for Six Years (2011-2016)

While the Alsons company runs hydro-electric power plants, they also operate diesel engines that guzzle a crude derivative with which diesel is the most expensive fuel to generate electricity with. This model indicates that $1.00 per barrel decrease in the prices of crude oil in the world market could likely push the share prices of Alsons Consolidated Resources by 0.004. Let us say that crude oil prices closed at $112.00 per barrel two days ago and decreased by $1.00 at yesterday's trading at $111.00 per barrel, then the share prices of Alsons Consolidated Resources would likely increase by 0.004 at the price of P 0.0052, resulting to the price of P 1.3052 at the present trading within period of 2011-2016.

Basic Energy Corporation

Basic Energy Corporation runs power plants that operate on biofuel and geothermal energy. Since fossil fuels were declining in the world market, market players shied away from Basic Energy Corporation in favor of a more volatile generating companies that use fossil fuels where they could claim more profit. For this reason, Basic Energy Corporation's share prices were on a downtrend and almost ran flat (Figure 9) from 2012 to 2016. Its average share prices were at P 0.438 from 2011 to 2016 with the highest share price of P 3.930 recorded on July 18, 2011 and with the lowest share price of P 0.180 found on September 14, 2015.

$$\text{Basic Energy Share Prices}_{\text{Daily}} = 0.399 + 0.00000294\ \text{WEP Max Ex Post}_{\text{Daily}} + 0.576111_{\text{error}}$$

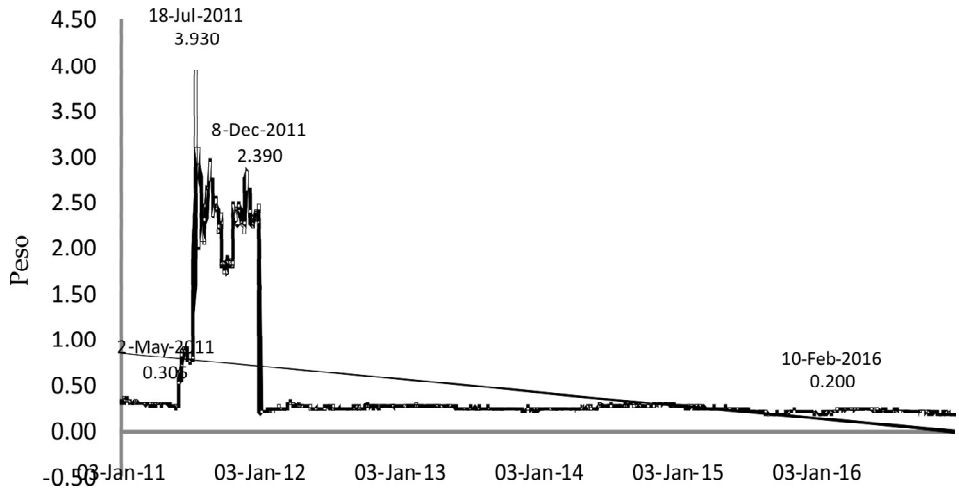

Figure 9: Price per Share of Basic Energy Corporation for Six Years (2011-2016)

This model tells us that P 1.00 decrease in the closing price of WESM trading at maximum ex post results in the decrease of the Basic Energy share prices by 0.00000294. Let us say that the average maximum ex post wholesale electricity prices at WESM was recorded at P 1,456 per megawatt-hour two days ago. It declined by P 1.00 in yesterday's close at P 1,455 per megawatt-hour. If the share prices of Basic Energy closed previously at P 2.35, then it would likely decrease by 0.00000294 at P 0.000006909 resulting in the share prices pegged at P 2.349993091within the period of 2011-2016.

First Philippine Holdings Corporation

First Philippine Holdings Corporation is a holding or management company with First Generation and Meralco as its subsidiary. All three companies were established and owned by the Lopez clan, except for Meralco which the industrialist, Manuel V. Pangilinan bought its controlling shares in 2013. From 2011 to 2016, (Figure 10) the First Philippine Holdings' share prices was on its upward trend with an average of P 74.14, its highest share price of P 113.70 which closed on February 28, 2013 and its lowest share price of P 49.00 was recorded on December 13, 2013.

$$\text{First Philippine Holdings Share Prices}_{\text{Daily}} = 72.715 + 0.001\ \text{WEP Min Ex Ante}_{\text{Daily}}\ 14.39836_{\text{error}}$$

This model tells us that P 1.00 increase in the minimum wholesale electricity prices ex ante translates into an increase in the share prices of First Philippine Holdings Corporation from 2011 to 2016. Let us say that the average minimum wholesale electricity price two days ago at WESM

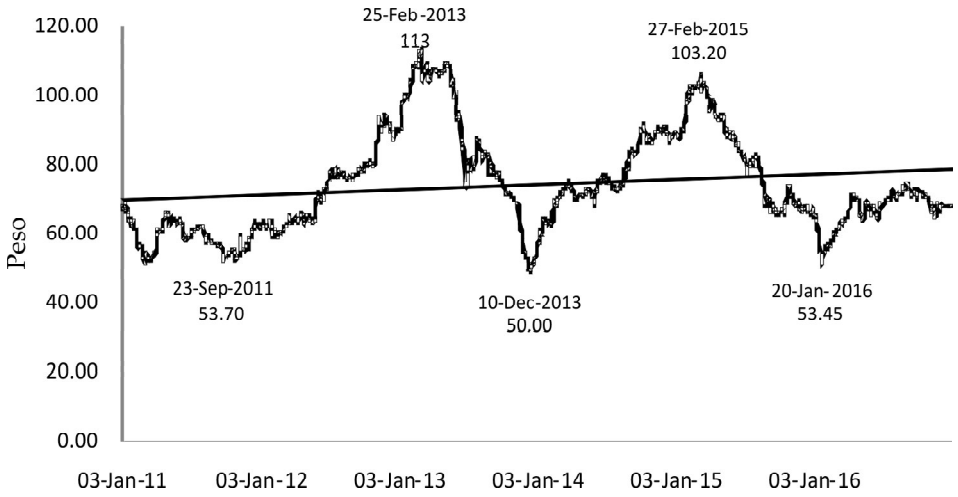

Figure 10: Price per Share of First Philippine Holdings for Six Years (2011-2016)

was P 1,356 per megawatt-hour. It increased by P 1.00 to P 1,357 per megawatt-hour at yesterday's trading and if First Philippine Holdings' share prices closed the previous day at P 110.00, then its share price would likely increase in the present trading by 0.001 at the amount of P 0.11 and in the sum of P 110.11 as reckoned within the period 2011- 2016. The movement of First Philippine Holdings' share prices is different since it is not actually a company operating power plants but rather owns and operates other generating companies like First Generation, Energy Development Company and Meralco. The effect on wholesale electricity prices is different from purely power companies involved in the production of electricity.

First Generation

First Generation is a subsidiary of the Lopez owned and controlled First Holdings Corporation. While it operates hydroelectric plants, its other power generation ventures use natural gas for fuel. First Generation's share prices was on its upward trend (Figure 11) with an average share price of P 20.09, its highest share price of P 31.20 was registered on January 28, 2015 and its lowest share price of P 10.82 was recorded on February 25 and 28, 2011.

$$\text{First Generation Share Prices}_{\text{Daily}} = 23.139 - 0.000059\ \text{WEP Max Ex Post}_{\text{Daily}} - 1.626\ \text{Natural Gas}_{\text{Daily}} + 4.74155_{\text{error}}$$

This model indicates that P 1.00 decrease in the closing wholesale electricity prices taken to be the maximum ex post prices generates an increase in the share prices of First Generation by 0.000059 while holding

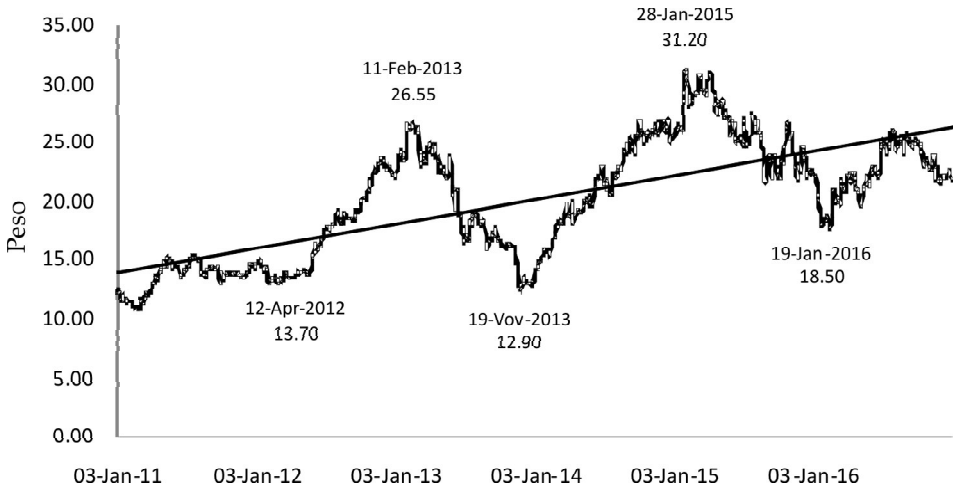

Figure 11: Price per Share of First Generation for Six Years (2011-2016)

the prices of natural gas constant. On the other hand, $1.00 decrease in the prices of natural gas in the world market pulls up First Generation's share prices by 1.626 while holding the wholesale prices of electricity constant. Let us say that the average maximum wholesale electricity price ex post at WESM was P 1,350 per megawatt-hour two days ago. It decreased yesterday by P 1.00 which made it at P 1,349 per megawatt-hour. At the same time the share price of First Generation closed at P 15.50 the previous day, then it would likely increase by 0.000059 in the amount of P 0.0009145 to a total of P 15.5009145 today. If the price of natural gas which closed two days ago at $4.50 per millionth BTU decreases by $1.00 at $3.50 yesterday, then the share prices of First Generation would likely increase by 1.626 or P 25.203 which translates to P 40.703 as the day's share price. With such a decrease in the minimum wholesale electricity price ex postand the decrease in the price of natural gas in the world market, the share price of First Generation could increase between P 15.5009145 to P 40.703 within the 2011-2016 period.

Energy Development Corporation

Formerly the Philippine National Oil Company-Energy Development Corporation (PNOC-EDC), a state-owned energy exploration company, it became simply EDC when First Generation bought its controlling stake and was listed in the Philippine Stocks Exchange in 2006. From then on, EDC had become the geothermal platform of First Generation's power generation engaged in generation and exploration of geothermal sources, wind and solar. The share prices of Energy Development Corporation

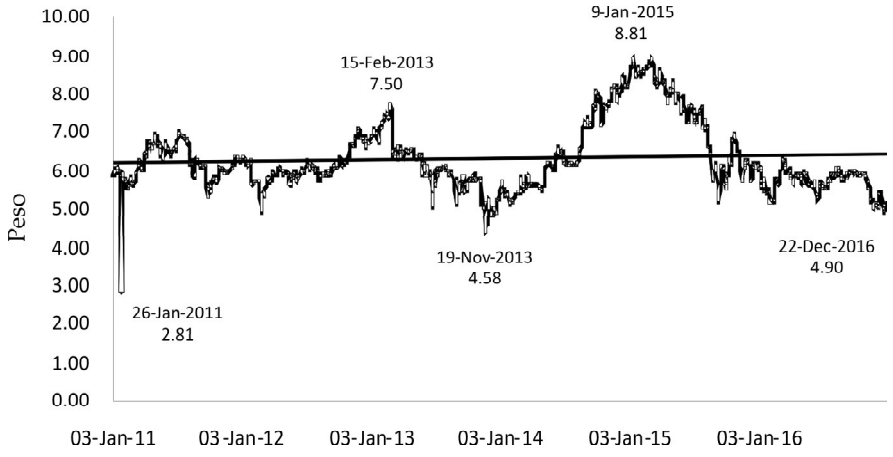

Figure 12: Price per Share of Energy Development Corporation for Six Years (2011-2016)

(Figure 12) was lazily moving upwards with the average share prices of P 6.31, with the maximum share price recorded on March 3, 2015 at P 8.96 and with the minimum share price gathered on January 26, 2011 at P 2.00.

$$\text{Energy Development Share Prices}_{\text{Daily}} = 6.382 - 0.\ 0.0000057\ \text{WEP Max Ex Post}_{\text{Daily}} + 0.87188_{\text{error}}$$

Energy Development Corporation basically runs power plants that use renewable energy source more specifically geothermal. It is not affected by the volatility of fossil fuel prices and it is for this reason that hardly did fluctuating prices downward was matched with its upward trend, barely pushing the share prices upward. Nevertheless, the model illustrates that P 1.00 decrease in the wholesale electricity prices at its maximum ex post increases the share prices of Energy Development Corporation by 0.0000057. Let us say that the average maximum ex post wholesale electricity price at WESM was registered at P 2,001 per megawatt-hour two days ago. It decreases by P 1.00 yesterday making it P 2,000 per megawatt-hour, then if the share prices of Energy Development Corporation was at P 8.00 yesterday, it would likely increase by 0.0000057 at the amount of P 0.0000456 up to a total of P 8.0000456 today as reckoned within the period of 2011-2016.

Meralco

The share prices of Meralco were on their upward trend (Figure 13) with an average of P 279.65, with the highest share price of P 395.00 registered on May 10 and 23 of 2013 and with the lowest share price of P 216.00

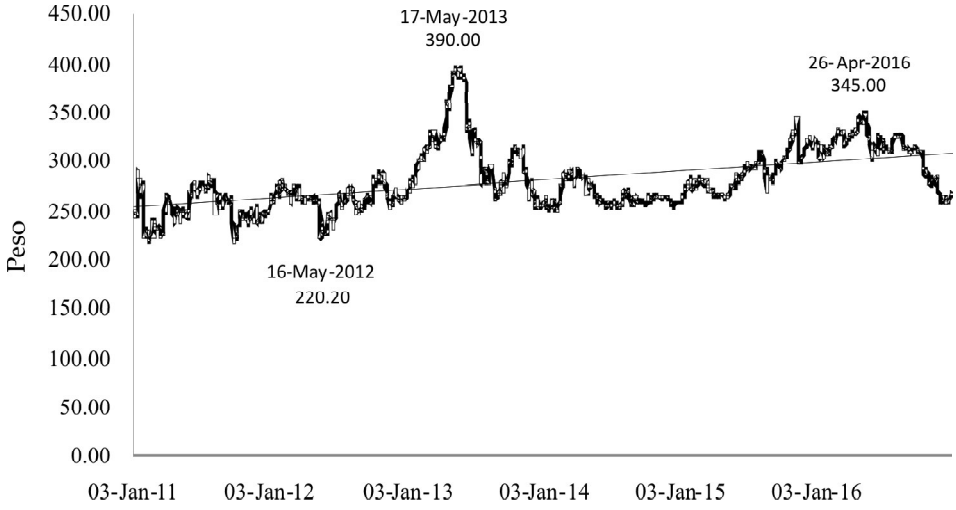

Figure 13: Price per Share of Meralco for Six Years (2011-2016)

recorded on September 26, 2011. The effect of the wholesale maximum ex post prices of electricity is negative which means that a decrease in the wholesale electricity maximum prices affects the increase of share prices by 0.052.

$$\text{Meralco Share Prices}_{\text{Daily}} = 282.465 - 0.001\text{WEP Ave Ex Post}_{\text{Daily}} + 31.7614_{\text{error}}$$

The only model in relation to Meralco share prices is the average wholesale electricity prices which indicate that P 1.00 decrease in the average ex post wholesale electricity prices generates an increase in Meralco share prices at the Philippine Stocks Exchange by 0.001. Let us say, the average ex post wholesale electricity price was P 1,675 per megawatt-hour two days ago and decreased by P 1.00 in yesterday's trading, while Meralco's share prices closed at P 315.00 yesterday, then Meralco's share price could increase by 0.001 in the amount of P 0.315, translating it to P 315.315 total in the present trading within the period of 2011-2016.

Salcon Power Corporation

Salcon Power Corporation's share prices trend at the Philippine Stocks Exchange was on its very gentle slide (Figure 14) with the average price of P 4.54 recorded from 2011 to 2016, its maximum share price of P 7.13 obtained on June 28, 2012 and its lowest share price of P 2.90 achieved on November 9, 2011.

$$\text{Salcon Power Share Prices}_{\text{Daily}} = 3.891 + 0.00000602\ \text{WEP Max Ex Post}_{\text{Daily}} + 0.007\text{Crude Oil}_{\text{Daily}} + 0.50561_{\text{error}}$$

This model indicates that P 1.00 drop in the maximum wholesale electricity prices ex post at WESM translates to a decrease in Salcon Power's

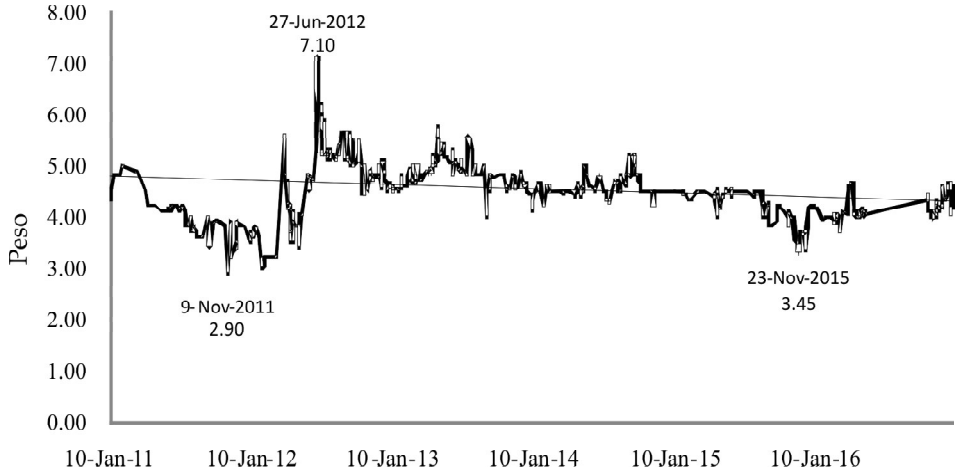

Figure 14: Price per Share of Salcon Power Corporation for Six Years (2011-2016)

share prices by 0.00000602. Salcon's power plants are diesel-fired. Thus, $1.00 plunge in the prices of crude oil, from which diesel is derived, results in the drop of Salcon Power's share prices by 0.007. Let us say, the average maximum wholesale electricity price ex post was recorded two days ago at P 2,000 per megawatt-hour. It declined by P 1.00 making it P 1,999 per megawatt-hour in the previous day's trading. If the share price of Salcon Power Corporation closed at P 5.10 then it would likely decrease by 0.00000602 at P 0.000030702 to as much as P 5.099969298. If the price of crude oil which closed two days at $121.00 per barrel, decreases by $1.00 at $120.00 per barrel, then Salcon Power's share prices could likely decrease by 0.007 at P 0.0357 to the price of P 5.0643. Salcon Power's share prices then could decrease between P 5.099969298 to P 5.0643 within the 2011-2016 period. The reason why Salcon's share prices were on a plunge and investors were shying away from the stock was due to declining revenues from P 2,920,729,250 in 2016 to P 2,350,121,191 in 2017 (Edge.PSE, 2017).

PHINMA Energy Corporation

Between 2011 and 2016, PHINMA Energy Corporation's share prices were on its upward movement (Figure 15) with an average of P 1.87, the maximum share price of P 2.91 was recorded on May 2, 2013 while the minimum share price of P 0.92 was observed on September 26, 2011. PHINMA operates power generating plants that use coal and diesel.

$$\text{PHINMA Energy Share Prices}_{\text{Daily}} = 3.599 - 0.031\text{Coal}_{\text{Daily}} + 0.41604_{\text{error}}$$

This model illustrates that P 1.00 decline in the prices of coal in the world market pulls PHIINMA Energy Corporation's share prices upward

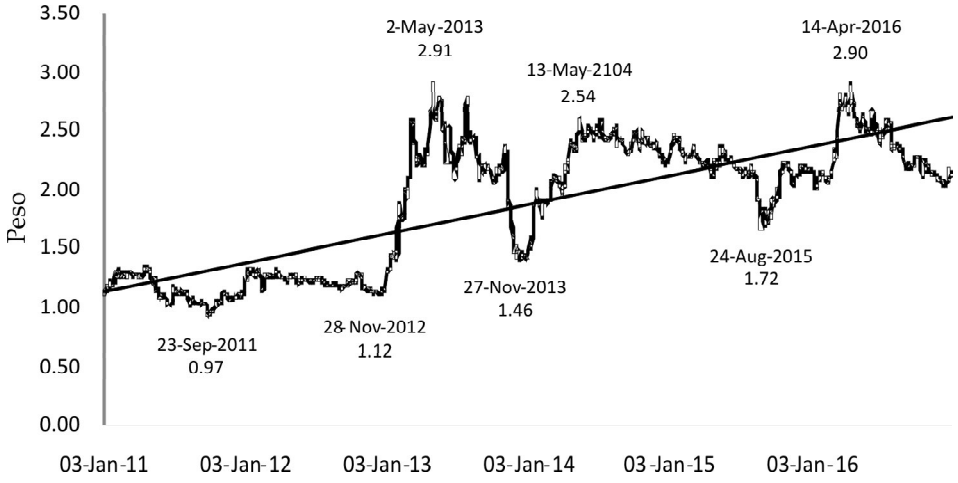

Figure 15: Price per Share of PHINMA Energy Corporation for Six Years (2011-2016)

by 0.0031.Let us say that the price of coal two days ago closed at $75.00 per metric ton and decreased by $1.00 in yesterday's trading down to $74.00 per metric ton. If PHINMA share price was P 1.50 in yesterday's trading, then it would likely increase by 0.031 in the amount of P 0.0465 for a total of P 1.5465.

$$\text{PHINMA Energy Share Prices}_{\text{Daily}} = 2.600 + 0.0000288\ \text{WEP Min Ex Ante}_{\text{Daily}} - 0.010\ \text{Crude Oil} + 0.49287_{\text{error}}$$

The combination of wholesale electricity prices and the prices of crude oil yielded a significant model other than coal prices. This model suggests that P 1.00 decrease in the minimum wholesale ex ante electricity prices, from which trading at WESM begins, the share prices of PHINMA Energy Corporation decreases by 0.0000288 while holding the effect of crude prices constant. On the other hand, $1.00 decrease in the prices of crude oil, from which diesel is derived and from which PHINMA power plants operate, the share prices of PHINMA Energy Corporation increases by 0.010. Let us say, the average minimum wholesale electricity price ex ante registered at P 1,230 per megawatt-hour two days ago and decreased by P 1.00 yesterday at P 1,229. If the share price of PHINMA Energy Corporation is P 1.50 in yesterday's trading then it would likely go down by 0.0000288 in the amount of P 0.0000432. If the price of crude oil closed at $98.00 per barrel two days ago and declined by $1.00 down to $97.00 per barrel in yesterday's trading, then the share price of PHINMA would likely increase by 0.010 in the amount of P 0.015.Since the effect runs on opposite directions then we minus the effect of price of crude oil with the wholesale electricity prices leading to a net effect of 0.0099712 in the amount of P 0.0149568 resulting in a total of P 1.5149568 within the period 2011-2016.

Vivant Corporation

Vivant Corporation Corporation's share prices were climbing steeply from 2011 to 2016 (Figure 16) with an average of .P 14.99. The highest share price was observed on April 27 and May 6, 2016 at P 35.90 and the lowest share price of P 2.55 was recorded on December 22, 2011. Vivant Corporation's power plants run on coal and diesel though they have hydro and geothermal plants.

$$\text{Vivant Corporation Share Prices}_{\text{Daily}} = 46.828 - 0.000041\ \text{WEP Max Ex Post}_{\text{Daily}} - 0.249\text{Coal}_{\text{Daily}} - 0.217\ \text{Crude Oil}_{\text{Daily}} + 3.38264_{\text{error}}$$

This model illustrates that P 1.00 decline in the wholesale maximum ex post electricity prices raises Vivant Corporation's share prices by 0.000041 while holding the other variables constant. At the same time, $1.00 drop in

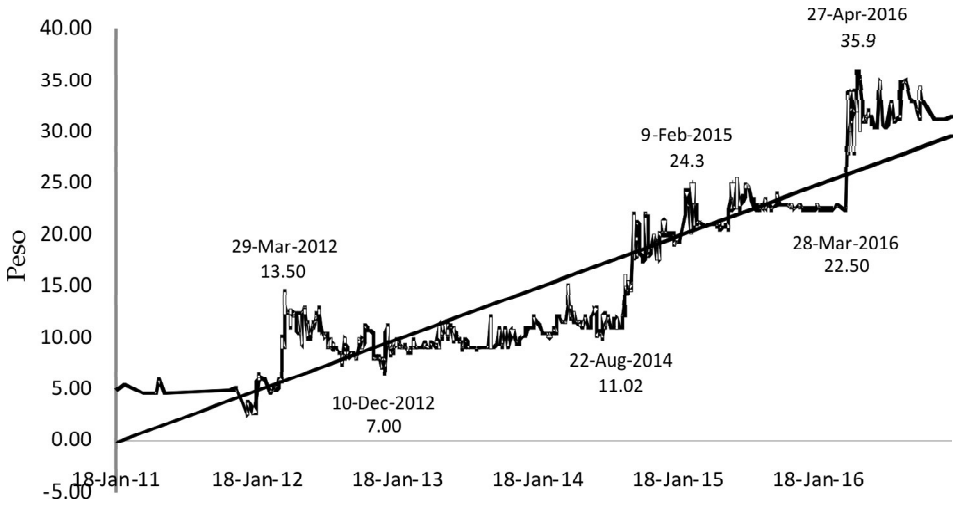

Figure 16: Price per Share of Vivant Corporation for Six Years (2011-2016)

the prices of coal in the world market and $1.00 decline in the prices of crude oil in the world market pulls up the share prices of Vivant Corporation by 0.249 for the effect of coal prices and 0.217 for the effect of crude oil prices while holding the other variables constant. Let us say that the average maximum wholesale electricity price ex ante at WESM two days ago was registered at P 1,350 per megawatt-hour. It decreased by P 1.00 down to P 1,349 yesterday. If Vivant Corporation's share price was P 15.00, then it would likely increase by 0.000041 in the amount of P 0.000651to a total of P 15.000651. Let us assume also that coal prices was at $73.00 per metric ton two days ago and closed lower by $1.00 down to $72.00 per metric ton, then Vivant Corporation's share price in yesterday's trading at P 15.00, would likely increase by 0.249 in the amount of P 3.735. If crude oil prices which closed two days ago at $100 per barrel and decreased by $1.00 to $99 per barrel in yesterday's trading, then Vivant Corporation's share price at P 15.00 could increase by 0.217 in the amount of P 3.255. Since all the effects are moving in the same direction, adding all the coefficients will result in a net effect of 0.466041 amounting to P 6.990615 to a total of P 21.990615. Thus Vivant Corporation's share price could increase from a range of P 15.000651 toas high as P 21.990615 within the period of 2011-2016.

Conclusion

In order to encourage investors to pick certain stocks, share prices should not be flat. Those prices should vibrate upward with the volume of transactions to characterize the stocks' bullishness or fluctuate downwards with the volume of transactions to account for their bearishness. This

research has shown that the share prices of 10 listed energy companies in the Philippines Stock Market is affected by the prices of coal, natural gas and crude oil in the world market and the wholesale electricity prices at WESM.

In 1983, Paul Joskow and Richard Schmalensee (1983) wrote a book *Markets for Power*, where they argued for the establishment of a free market model of energy production using a platform for electricity to be traded like that in a futures market. WESM was envisioned within this framework. This research has shown that the listed energy companies are affected by the movement of the wholesale prices of electricity which are transacted at WESM and the prices of fuel input in the world market. The significant correlations testify of their associations and the significant models would show the effect of the wholesale electricity prices and fuel input prices on the share prices of the 10 listed energy companies at the Philippine Stock Exchange. This research has also shown 8 of the 10 listed companies had their share prices in the upward trend as wholesale electricity prices and fuel input prices were on the downward movement. Higher share prices means greater attraction of portfolio investors on these energy companies which the energy companies could use for capitalization as the investors would also be assured of profit from their investments.

The significant models here created are part of the technical analysis on the movement of the stock prices of the 10 listed companies. While the significant models provide a window on how the share prices of these stocks behave, Eugene Fama's Efficient Market Hypothesis (EMH) still argues that in a weak form of the market, this technical analysis would not ensure excessive returns in the future for the efficient market would still behave in a random walk.

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Note

1. BTU is the measure of natural gas equivalent to 1 million British Thermal Unit. This is has the same value of 1,000 cubic meters.

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