Estimating and Forecasting Aggregate Demand in the Energy Industry

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Aggregate Demand refers to the final total demand for services and goods in an economy at a specific time (Hahnel, 2014). It is an economic measure of the total amount of goods and services demanded in an economy. The aggregate demand measures the economic demand relative to the economic supply, that is, what an economy can produce at a given time. The parameter consists of capital goods like equipment and factories, consumer goods, imports, exports, and the government expenditure. Economists express aggregate demand as the total amount of money that the economy spends on goods and services at a given price level and time. In the long-term, aggregate demand is equal to the Gross Domestic Product. While GDP represents the total amount of services and goods that an economy produces in a given time, aggregate demand measures the desire for those goods (Michaillat & Saez, 2015). Aggregate demand and GDP are directly related in such a way that, as aggregate demand increases, GDP also increases and vice versa. The two measures are equal only in the long run since GDP could have adjusted for the price level. The quantity of any good demanded in the market is a function of the price of the service or good, the income of the consumers, the price of substitutes and complements, the preferences and tastes of consumers, and the future price expectations. Aggregate demand includes all kinds of expenditure on consumer goods, exports, imports, government programs and capital goods.

The energy industry consists of all the industries that take part in the production, refinement and sale of energy, including the extraction of fuel, manufacture, refine and energy distribution. The demand for the energy industry products has been increasing due to the increase in the usage of energy in factories for production, infrastructure, and societal maintenance (Næss et al., 2015). The components of the energy industry include the fossil fuel industry, electrical power industry, traditional energy industry, the renewable energy industry and the nuclear power industry. The fossil fuel industry comprises of the petroleum refiners, the oil companies, fuel transport, coal extraction and processing industries, coal manufacture, natural gas extraction, sales and distribution. The electrical power industry is made up of electricity generation, electric power sales and distribution. Traditional energy is made up of firewood collection and distribution for heating and cooking. The renewable energy industry comprises of the sustainable energy companies and alternative energy producers like companies involved in wind power, hydroelectric power, manufacture, solar power, sale and distribution of alternative energies.

The energy industry has a great connection with the economical aspect of the society (Petropoulos & Kourentzes, 2015). All the economical processes such as production, processing, manufacturing and distribution rely on energy for efficiency. Most of the production processes are shifting from labor intensive to capital intensive. Labor intensive means that production companies employ more human beings to take part in the production process compared to the number of machines they have employed for the same activity. Due to an increase in the cost of labor and decreased efficiency in the use of human resources in the production process, industries use machines to increase the productivity and decrease the levels of wastage. Energy industry as well contributes to the processing activity as some energies like fossil fuel and coal serve as raw materials in the process. Some energies such as tar help in the development of infrastructural facilities like tarmac roads. Due to an increase in the number of uses and the sectors that it can serve, the demand for energy has been increasing continuously over the last years.

Nature and structure of the energy industry

Energy industry is an oligopoly kind of market since there are a few organizations that have specialized in selling and distributing the energy resources. Since the suppliers are few, they can easily influence the output and hence the price. When they want to increase the price of the energy, they decrease the output. When the output decreases, the level of demand exceeds the level of supply. Sellers utilize the high opportunities of decreased supply and high demand to increase the price of energy beyond the market level (Nemfakos et al., 2013). The suppliers also can decide to hoard the energy sources such as gas. When they hoard the energy, the supply in the market falls below the demand. When the demand exceeds the supply, the price of the energy increases.

Since the number of sellers is small, each seller controls a very large portion of the general market. The price of a single supplier in the market affects the price and output of other suppliers. When a single supplier decides to sell the product at a relatively lower price than the market equilibrium, the demand for its product increases while the demand for other similar suppliers decreases (Næss et al., 2015). A decrease in demand for their products compels them to lower their price and sell at no or normal profits. The sellers are also compelled to lower their output in a bid to cut down on their operation costs.

Most of the energy producers have differentiated their products through branding and packaging. The other methods that the energy sellers have employed in product differentiation include the introduction of different sizes of the energy. Initially, the gas producers used to package their gas product in sizes of six kilograms only. After an increase in competition in the market, the gas producers decided to package their gas in sizes of nine kilograms, twelve kilograms and even three kilograms besides the usual six kilograms. The different sizes attracted more customers who could choose the size of their desire with convenience. The sizes also increased demand since they become more affordable even to the low-income earners. The suppliers also differentiated their products using the origin. Adding the origin as an identity mark increased the loyalty of consumers. Some of the buyers stuck in buying from a single supplier and even referred new customers. Referrals and customer loyalty increase demand hence an increase in the benefits. The popular differentiation method that all the energy suppliers have embraced is branding. An association with a particular brand gives the consumers a sense of belong and hence an increase in demand (Petropoulos & Kourentzes, 2015). Consumers will always go for a good brand or one that has a good past reputation.

Product differentiation in the oligopoly market involves an addition of a simple feature that other suppliers do not have. For instance, the gas suppliers have introduced a free burner and grill on top of the gas product. The free burner and grill attract more customers to them compared to the suppliers who have no such feature. An increase in the number of customers translates to an increase in the demand hence profits (Nemfakos et al., 2013). Electricity suppliers have introduced a free token if the consumers pay their bills in time. Offering a bonus also serves as a differentiation method. For example, some energy suppliers like electricity offer an additional bonus if the consumers exceed a given quantity of electricity consumption and clear their bills in time. The bonus helps the consumers to incur reduced costs hence an increase in their savings. Product differentiation can also involve a highlight of a specific feature. For example, the gas energy producers indicate the size of the gas container and the amount of gas in the container by having them on the side or top of the container. Other competitors in the market highlight the weaknesses of the other suppliers. The highlights make the consumers to believe in their brand and not in those of the other suppliers hence an increase in demand.

Most of the energy firms have monopoly powers. Since they supply a large portion of market, they have the control over those markets. The firms can thus manipulate the output and prices as a way of increasing the profits that they earn from their operations. Firms increase prices to an extent of earning abnormal profits (Næss et al., 2015). Since the competitors are not close, the consumers have to buy the product at that high price in the market as they lack other options.

The energy firms are interdependent. Despite the fact that the firms control a large share of the market, the firms rely on each other in terms of price. Most of the energy firms produce almost similar products that they have only differentiated. The firms need to agree on the equilibrium price at which they should sell their products. Any firm that sells below the market equilibrium risks being expelled from the market as its mission is to undercut the other firms or compel them into making losses. The price at which each firm sells its product helps the firms to jointly set a price for the market. When all the firms sell at equilibrium prices, they make profits depending on their output and not the price. A firm that has a high output experiences high profits compared to a firm that has low output (Petropoulos & Kourentzes, 2015). All the energy firms in the oligopoly market are concerned with the actions of the other sellers.

Most of the energy firms face a conflicting attitude based on collusion and antagonism. Some of the energy firms may realize the disadvantages of having a mutual competition and decide to collude as an action of maximizing their joint profits (Mir & Aslam, 2020). Some of the energy companies desire to operate independently and reap their increased profits alone. The firms may end up having a conflict when they raise questions about the size of the market that they control and the distribution of the profits that they earn from their operations.

The number of energy consumers is very high. The increased number of consumers results into increased demand (Næss et al., 2015). The demand in the oligopoly markets is indeterminate since any action that any of the firms undertakes affects the operation of the other firms.

**Estimating Demand**

Demand estimation is an important aspect of any company. It involves a forecast or prediction of the future demand of a product. The involved companies identify the current and future needs of the customers in order to lay a plan of what they should actually produce (Mir & Aslam, 2020). Organizations use real time data or even historical data to make forecasts about the future. The data allows them to make decisions about future productions. Customers determine the demand of commodities. Demand is always dynamic as the tastes, preferences and even income levels keep on changing from time to time. Making predictions about the future demand may be challenging since other unexpected external conditions like the current Covid-19 pandemic cause tremendous changes that affect the demand for some products. The firms need to understand the future demand for them to avoid underpricing or even overpricing some products. Data interpretation is an important aspect in demand estimation. Wrong data interpretation can result into extra costs and loss of customers hence extreme losses.

Economists can estimate demand both in the short-run and in the long-run. They can use the demand elasticities in their estimation. Elasticity is the extent to which a variable is sensitive to a change in another related variable. In economics, the elasticity is the change in price and how it results into the change of other related variables. Financial economists measure how other factors are sensitive to a change in price and other variables. Examples of economic factors that affect the price include the change in supply, change in demand due to change in tastes and preferences, and the changes in income. A good is said to be elastic if a slight change in an economic factor such as price or income results into a big change in the demand of that good (Petropoulos & Kourentzes, 2015). Inelastic goods experience no or minimal changes when the price or income changes. Measuring the elasticity of demand helps the researchers to make predictions about the future. The common demand elasticities include the price elasticity of demand, income elasticity and cross elasticity.

The price elasticity of demand

The price elasticity of demand is the measure of how sensitive or responsive the energy products are to the changes in price (Næss et al., 2015). The measure shows the relationship between the price and the quantity of the energy products demanded at every price level.

To calculate the price elasticity of demand, we take the proportionate change in the quantity of energy that the market demands divided by the proportionate change in the price of the energy products. There are five types of price elasticity of demand which include the: unitary elastic demand, the relatively inelastic demand, the relatively elastic demand, the perfectly elastic demand and the perfectly inelastic demand (Mir & Aslam, 2020). When the ratio of the change in quantity of goods demanded to the change in price is equal to one, then the elasticity is unitary. When the proportion is less than one and near zero, then the demand is relatively inelastic. When the ratio of the change in quantity of goods demanded to the change in price is less than one but far from zero and close to one, then the demand is relatively elastic. When the ratio of the change in quantity of goods demanded to the change in price is more than one, then the demand is perfectly elastic. When the ratio of the change in quantity of goods demanded to the change in price is zero, then the demand is perfectly inelastic.

Income elasticity of demand

Income influences the quantity of the energy products demanded. When the level of income increases, the demand for the energy products also increases (Petropoulos & Kourentzes, 2015). The extent to which the change in income influences the demand of the products is called the income elasticity of demand.

Cross elasticity of demand

Cross elasticity of demand is the measure of the responsiveness of a change in the quantity of one commodity demanded to a change in the quantity of another commodity which they are related (Næss et al., 2015). A product can be related to another as either a substitute or a complement. A substitute is a product that can be consumed in the place of the other. A complement is a product that is consumed besides the other. To calculate the cross elasticity of demand, we take the proportionate change in the quantity of one product and divide it by the proportionate change in quantity of another product. If the change in quantity of one product results into a negative change in another product, then the goods are compliments. If the change in quantity of one product results into a positive change in another product, then the goods are substitutes. The demand of an energy product can be influenced by some marketing strategies like advertising. Advertising increases demand due to the capture of new customers and revelation of new features.

Need for demand Estimation

According to Petropoulos & Kourentzes, (2015), firms need to estimate their future demand for the following reasons:

Customer satisfaction

The needs of customers are the main drivers of demand. The energy suppliers should aim at meeting the needs of the customers. The firms can meet the needs by providing the goods and products in time and increasing the accessibility of the commodities. Demand forecasting helps the firms to produce enough inventory that can effectively meet the needs of the customers.

Inventory optimization

Carrying out a thorough analysis of the market demand for goods and services that a firm offers helps the firm to identify the products that have a high demand and those that sell lowly. The information helps the firm to make a decision on the items that it needs to keep at a higher inventory to avoid cases of stock-outs that can result into customer dissatisfaction. Demand forecasting allows the firm to develop a better plan on when they should order items that have long lead time. The plan helps the firm to ensure that it has enough stock on hand always.

Improved promotions and pricing

Promotions and price changes are a representation of the external factors that can result into an increase in demand for goods and services. Demand forecasting has to incorporate the external factors so that the managers can know if they need to produce or purchase additional products that meet the anticipated surge of demand. Effective promotion and pricing that uses the what-if scenario analysis helps planners to maximize the net revenue that they can collect from the operations of the business.

Cost reduction for the goods that are approaching their expiry.

Demand forecasting is very useful when the products have an expiry date. Poor demand forecasting can result into loss of money if the producer produces in bulk and has to sell the products at a price that is below the market price when their expiry date is near. Production of goods in bulk results into additional costs like storage and conservation costs.

Future demand decreases stock safety requirements

Demand forecasting gives an analysis of the historical data for seasonal and trend patterns. It gives an analysis of the overall demand change and external factors like climate change, competition, promotion campaigns, and price changes. The data about the external factors help firms to determine when to keep more items in stock and when to keep low inventory.

**Methods of Forecasting Demand**

Surveying the intentions of the buyers

Carrying out a survey on the intentions of the consumers is a short-term demand forecasting method that helps the energy firms to know and estimate the demand of the customers (Petropoulos & Kourentzes, 2015). It is a direct demand forecasting method as it gives information on what they intend to buy in the near future that is less than a year. The surveying method helps the producers who produce goods in bulk. Producers usually pass the forecasting burden to the buyers by increasing the price at which they sell the goods in the market. Producers need to give some allowances on the extent to which they rely on the estimates. The surveying method does not hold some better results on the household consumers because the consumers are unable to foresee their choices in the face of alternatives. Carrying out survey on other consumers besides the household consumers makes the method impracticable and costly. The method does not measure and expose variables that are under the control of management.

Sales force competitive or collective opinion method

This method of demand forecasting involves the use of salespeople since they are close to customers and can make judgements based on what they see and the general market. The salespeople understand the reactions of the customers to the sales trends and products of the firm. The energy firms collect the estimates of the different salespeople and predict the sales based on the estimates. Firms need to revise the estimates from one time to another while making changes in product, price, publicity programs, designs, purchasing power, expected competition changes, population, employment and income distribution (Næss et al., 2015). The method uses the wisdom of the salesmen, top executives and departmental heads. Most of the organizations that supply energy employ this method since it is simple and it involves the use of common sense only without complex mathematical calculations. The method is based on direct connection with the sellers and first-hand knowledge of the salespeople. Firms employ this method in selling new products. Despite its advantages, the method is quite subjective and can only be used for short-term forecasting.

Time series or trend projection

Energy firms use the visual or statistical time series to make forecasts about the future trends using the least square method. The economical or statistical analyst makes plausible algebraic relation that can be linear, logarithmic or even quadratic between sales and other independent variables like time and production costs. The analysts then project the trend line into future for extrapolation. The time series method is extensive and simple since it gives a persistent trend on sales. When analysts use the time series method, they make an assumption that the past change rate on a variable will continue being the same even in the future if all other factors remain constant (Hahnel, 2014). The results of the assumption are safe if the time series exhibits a tendency that is persistent and one that projects to one direction. The management has to consider the turning point and the make revisions on projections and sales. In making time series projections, the analysists need to consider the turning points, fluctuations, seasonal variations, cyclical fluctuations, random and irregular forces of the market operations. Time series forecasting method takes the formula;

Observed Data = secular trend \* seasonal factor \* cyclical element \* irregular movement.

The analysts then remove the trend by dividing the observed data by the trend values.

They also remove the seasonal effect by dividing by the seasonal factor. In doing the analysis, the researchers assume that the movements follow the seasonal, trend and cyclical changes and the effects of any of the components do not depend on other components.

Method of executive judgement

Under this method, the responsible authorities seek the opinions of the executives that are in charge of different disciplines like finance, production and marketing and make estimates of the future demands (Petropoulos & Kourentzes, 2015). The process combines, evaluates and averages the views and opinions of top executives. The executive judgement method is advantageous since individuals can make forecasts speedily by analyzing the views and opinions of the top executives. The method is simple and quite easy. The method is cheap and cost saving since it does not involve elaborate collection of data. The method is feasible even in the absence of data. Some of the analysts avoid this method though since the forecast is not based on factual data. The method is not accurate and researchers cannot fix the data accuracy responsibility.

Use of controlled experiments

Controlled experiments help in ascertaining separately the factors that determine demand like advertising, price, tastes and preferences by assuming that the other factors remain constant during the experimentation period (Mir & Aslam, 2020). Researchers assess the effect of the determinants of demand like packaging and advertising by varying the variables over time in the same market. Controlled experiments involve evaluation, combination and carrying out an average of the views and opinions of the customers and top executives.

Use of economic indicators

The common economic indicators that the energy firms use in determining the future demand for their products include the GDP, industrial production, the employment figures, inflation, consumer spending, home building, home sales, the manufacturing demand, and the retail sales. When the GDP of a country increases, the energy products suppliers may predict that the demand for their products will increase in future hence they need to produce more to meet the demand (Nemfakos et al., 2013). A decrease in GDP indicates an economic hardship hence the producers need to cut down on the productivity as the future demand is likely to go down. Energy suppliers carry out research on the general amount of energy products that the industry produces. The research results help the individual firms to determine the amount of each commodity that they need to produce and supply in the market. High rates of employment are indicators that the number of people living below the poverty line has reduced and the living standards of individuals have improved hence the ability to buy the products. Increased ability to buy energy products leads to increased demand. High rates of inflation increase the costs of commodities hence reducing the purchasing power of individuals (Mir & Aslam, 2020). The demand for the energy products is likely to go down when the inflation rates rise. Increased consumer spending translates into increased demand as consumers are willing to spend on commodities that they can afford. An increase in income increases the buying capabilities of consumers hence an increase in demand for the energy products.

Employment of the experts

Firms hire experts that have deep knowledge in the market and trade trends to help them forecast and estimate the future demand for their products. The firms can also seek the help of experts by analyzing the views of experts that are published in journals and newspapers, agencies, distributors, wholesalers, and professional experts (Kyer & Maggs, 2014). The method is advantageous since it is speedily and easy to use. The estimates are almost accurate since they are based on opinions and views of the experts. Firms can use this method even when they do not have records about the past sales. Despite the advantages, firms tend to avoid this method since it is not possible to derive estimates of a market segment. Forecasting is not factual hence unreliable.

**Components of Aggerate Demand**

Aggregate Demand is made up of five main components which are:

* Consumption
* Investments
* Government expenditure
* Imports
* Exports.

Consumption

Consumption is the largest component of aggregate demand (Michaillat & Saez, 2015). It is the total amount that individuals and households spend on services and goods. Goods consist of tangible items that producers put in the market for attention, acquisition or consumption (Samuelson & Marks, 2015). Services consist of intangible items that suppliers put in the market to earn income. In the energy industry, consumption involves the total amount of money that the consumers spend on the energy products and services. Consumption is positively related to aggregate demand. When consumption increases, the aggregate demand increases also. Firms can keep data about the previous consumption levels of products to enable them make future forecasts about demand.

Investments

Investment is the total amount that is employed in services and new capital goods like machinery, changes in inventories, equipment, residential structures, and investments in nonresidential structures (Hahnel, 2014). Samuelson & Marks, (2015) state that the factors that affect investment are: Interest rates, government tax, government subsidies, and future expectations on investments. Investments are directly related to the aggregate demand. When the amount of investments in the energy sector increases, the aggregate demand also increases. An increase in the level of investments indicates a production efficiency. The costs are spread over a large area hence low costs of production per unit. When the production cost per unit decreases, firms charge lower prices for the products in the market and still make good profits. Decreased level of price automatically translates to an increased demand when all the other factors remain constant.

Government Expenditure

Government expenditure is the total amount the government spends on investments, infrastructure, public sector facilities, military and defense equipment, government employees and healthcare services (Hahnel, 2014). Government expenditure does not include transfer payments, subsidies, pension plans, and foreign aid (Samuelson & Marks, 2015). The factors that affect government spending are: national revenue, level of GDP, taxes and general productivity. Government expenditure has a positive correlation with the aggregate demand. When the government spends more on the energy industry like through giving subsidies and reducing the taxes it charges on the products, the firms incur reduced production costs. When the production costs decrease, the prices of the products also decrease hence an increase in demand.

Net exports

Net exports include the difference between imports and exports (Michaillat & Saez, 2015). Exports are the products a country manufactures and sells to other countries. Imports are the goods a country acquires from foreign countries. The level of net exports depends on; Level of diplomacy, the comparative advantage, and the absolute advantage. According to Hahnel, (2014), the major factors that affect imports are: The marketing strategies of a country, foreign Gross Domestic Product, the level of productivity of the country. When the rate of productivity of a country is high, the level of imports decreases and the rate of inflation of a country. When the inflation rate of a country is high, individuals and households tend to buy more energy imports compared to domestic goods since the imports are cheaper. Michaillat & Saez, (2015) state that exports depend on: Political environment of a country, exchange rates, the consumer and social behavior, trade policies, demand, inflation, factor endowment, and productivity.

**Calculating Aggregate Demand**

To calculate aggregate demand, financial economists suggest the addition of consumer spending, private and public spending, investments, and the exports less imports (Mellacher & Scheuer, 2020).

Shape of Demand Curve

The demand curve slopes downwards (Castel et al., 2019). The general condition behind the downward slope of the demand curve is that demand increases when the price of the commodity decreases if the good is normal. When the price tends to increase, consumers tend to lower the amount they spend on consumption hence a decrease in demand. The aggregate demand decreases due to the wealth effect, the interest rate effect and the foreign price effect. For the wealth effect, when the levels of price increase, the purchasing power decreases and also a decrease in the savings. Increase in the level of price reduces the wealth of the consumers hence a reduction in the consumption spending. The interest effect occurs when the price increases and boosts the money demand. When the demand of money increases, the rate of borrowing increases hence an increase in credit levels. An increase in demand for money makes the interest rates to increase and energy businesses decrease their borrowings for investments (Mellacher & Scheuer, 2020). When borrowing decreases, the level of spending also decreases. To encourage borrowing and spending, the central bank and the government puts measures that can lower the interest rates. For the foreign price effect, when the price of the raw materials and other inputs for the production of energy in the foreign country where the producers import from increase, the energy products become expensive since the producers incur more production costs. The producers usually pass the burden of high costs to the consumers hence increasing the price of the products.

The demand for the energy products is inelastic. A change in the price of the products results in a minimal or no change on the demand of the products. The price at which the sellers supply the energy depends on both the internal and external factors. The internal factors include the production costs like labor. The external factors include the competition and the market forces. Since the demand is dynamic, there is need to carry out an estimation to allow the producers to make a decision on the amount to produce and cut down on costs of storage (Benhabib et al., 2015). Effective forecasting involves the use of the correct equipment, the right procedures and the right individuals who have the matching skills.

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