DERIVATIVE FINANCIAL INSTRUMENTS ON THE ELECTRICITY MARKET AND THEIR SIGNIFICANCE FOR INSURANCE CORPORATIONS

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Abstract: In the last thirty years, the main motive concerning reforms in the electricity industry around the world is to increase efficiency in the production, transmission, distribution and supply of electricity to final consumers. The reforms of electric power systems consist of production restructuring, improvement of competition, deregulation and ownership transformation. Restructuring included the separation of production, transmission, distribution and supply of electricity. Market competition meant the development of the wholesale electricity market and the growth of competition in retail. Deregulation represented the process of establishing independent regulatory bodies, as well as free access of third parties to the network infrastructure. Finally, the process of ownership transformation enabled the privatization of the existing state-owned power companies.
It can be stated that in this century, in the largest number of world economies, there has been a strong development of the electricity market, which is significantly different from other markets in terms of its characteristics. The main reason for this is the fact that there is no possibility of storage on the electricity market, that is, simultaneous production and consumption is not possible. However, supply and demand in a given electrical network must always be in balance. The imbalance between the supply and demand of electricity causes the frequency in the system to deviate from the standard frequency.
Electricity prices, in the period before the latest reform activities in the power sector, were regulated and therefore stable and predictable. However, deregulation and market liberalization have led to increased price volatility and increased risk. One of the most significant challenges in risk management in electricity markets is maintaining the energy balance. Deviation of production from consumption leads to disturbances that can lead to interruption of electricity supply and have severe financial consequences. In order to keep the system in balance, transmission system operators are obliged to organize a balanced energy market. The balanced electricity market is essentially a spot market for a very short period of time.
Derived financial instruments are more present on the electricity market and the following stand out due to their importance: forward, futures, option and swap contracts. These instruments are efficient in reducing the risk in the electricity market. It is especially important to keep in mind the fact that derivative instruments can be used based on the principle of hedging operations.
The devastating importance of derivative instruments in the trading of electricity and many other goods can be judged by the investment portfolios of insurance corporations. The expansion of the use of derivatives in the insurance industry is connected with the elimination of the shortcomings of the corresponding indices, as well as the presence of the possibility of multi-year coverage.
Keywords: risk protection, forward, futures, options, swap arrangements, insurance

1. INTRODUCTION

The main driver behind the reforms in the electricity industry around the world that occurred during the previous decades is the desire of the electricity sector and other participants in the electricity market for greater efficiency. Until the beginning of the eighties of the previous century, the electricity industry was dominated by state monopolies with price regulation (Filipović, & Tanić, 2010). In the last decade of the previous century, the electricity sector in many countries around the world began to move from a monopolistic to a market model, thanks to the deregulation and privatization of state-owned companies in the electricity sector (Latas, 2020).
The basic assumption of the deregulation of the power sector is the separation of the activities of the vertically integrated power companies thatonce performed all activities in this sector, starting from production to supplying final consumers. Liberalization and deregulation of the electricity market was possible in the production and supply of electricity, while it was not possible in the areas of electricity transmission and distribution, which essentially represent natural monopolies. The implemented reforms of the energy sector made it possible to establish general measures that must be taken in order to establish functional and market-oriented companies in this sector (table 1).

Table 1: Areas and steps of reforms in the electricity industry

Areas of reform	**Steps of reform**
Restructuring	Separation of production, transmission, distribution and supply Horizontal separation of production from supply
Market competition	Wholesale market and competition in retail Allowing entry of new manufacturers and distributors
Deregulation	Establishment of independent regulatory bodies Free access of third parties to the network infrastructure Incentives for the regulation of transmission and distribution networks
Ownership	Enabled access to private capital Privatization of existing state-owned power companies

Source: Jamasb, & Pollitt, 2005).

With the introduction of competition in production and supply, electric power companies were increasingly exposed to market-based business criteria. Now the market, based on supply and demand, determines the success of the company, as well as the level of investment in new production facilities. The company's exposure to the market, as well as the pronounced volatility of electricity prices, have contributed to the fact that risk management in the electrical energy sector is beginning to receive increasing attention. By using derivatives for hedging, users can have multiple benefits: to avoid unfavorable price movements, to ensure safe buying or selling, to ensure safe long-term cash flows. In the electricity derivatives market, unlike the spot market, deliveries are contracted for a longer period of time, prices reflect future expectations of spot prices, so these markets are much larger in terms of trading, with relatively low volatility. Prices are formed under the influence of numerous factors: spot price (weather, availability, season, time of day, operating costs, foreign bidders), economic growth, situation in other markets, special events (moratorium on power plants), political situation. Trading of financial derivatives on electricity can be organized on the stock exchange and on the over-the-counter (OTC) market. This term refers to the process of trading securities through an intermediary of a network of brokers. This type of trading is completely different from a centralized exchange. Standardized financial derivatives are traded on the stock exchange, while on the OTC market it is possible to shape a financial derivative according to the needs of clients (Latas & Jeremić, 2019).
Starting from the previous general statements regarding the key areas of power system reforms, we determine the aim of the work as an attempt to understand: a) the specifics of modern electricity markets, b) showing the importance of derivative financial instruments for the development of the electricity market and c) pointing out the importance of derivative financial instruments present on the electricity market that are used in shaping the investment portfolios of insurance corporations.

2. ELECTRICITY MARKET

The electricity market is a specific market, because electricity as a commodity has certain technical characteristics that condition the functioning of the market itself. On the other hand, certain phases in the life cycle of electricity in many countries are not left to free functioning on the market itself, but belong to regulated activities. In this sense, the analysis of price movements on this market becomes more complicated and requires knowledge of both economic relations and legal acts and institutional solutions that regulate this market (Jakšić & Ješić, 2021, 15).
The elements of the electricity market, like any other market, are supply, demand and prices.
Electricity production is an activity of general interest, but the product itself cannot be treated as a public good. Namely, electricity is an industrial product that requires huge capital investments. In addition, the problem of public goods would have the effect that the costs arising from the irrational consumption of electricity exceed the benefits that society has from the use of electricity.
Electricity producers are companies that are engaged in the production of electricity. They may own one or more power plants that use different technologies of electricity generation. Distribution companies own and manage the distribution network. In the traditional environment, they have a monopoly over the sale of electricity to all customers connected to their grid. In a fully deregulated market, distribution companies are separated from suppliers. Retailers are companies that buy electricity on the wholesale market and sell it to consumers who do not want or are not allowed to buy electricity on the wholesale market. Retailers do not have to own production units, nor transmission and distribution systems. A supplier may have customers who are connected to different distribution networks. The market operator manages the computer system that matches the offers of buyers and sellers for electricity. It also takes care of settlement of accepted offers and execution of payments. The independent system operator (ISO) has primary responsibility for maintaining the security of the power system. It is independent because, in a competitive environment, the system must function in a way that does not favor one market participant

over another. ISO usually owns only the equipment and communication means needed to monitor and control the power system. ISO usually combines responsibility for the operation of its system with the role of market operator. Transmission companies own the transmission network. They manage the high-voltage network according to the instructions. An independent transmission company (ITC) is a transmission company that does not own generating facilities and also acts as an independent system operator. A government body is the regulator responsible for ensuring fair and efficient management in the energy sector. It establishes or approves electricity market rules and investigates suspected cases of abuse of market power. Besides this, it determines the prices of products and services provided by monopolies.

When it comes to the production of electricity, as the process of converting other forms of energy into electricity, it is directly dependent on the installed capacity. However, the capacities are not usedall the time. Capacity utilization varies not only during the year but also during a day. But, the start-up of electricity production capacity also depends on the type of source, so some sources generally contribute continuously to production, while some according to needs.

On one hand, it is considered that the demand for electricity is not price elastic in the short term, and on the other hand, the physical characteristics of the electricity grid require that supply and demand are constantly in balance. The fact that demand is not price elastic does not mean that demand does not vary. On the contrary, electricity consumption varies a lot in one day, but also in seasons during one year. This very moment implies that the installed capacities follow that demand so that the same demand is satisfied even at peak load.

Since electricity, as a commodity, in principle has the characteristic that it cannot be stored, electricity prices are driven by demand and supply on the spot market, more than any other commodity. The movement of prices on the spot market and the description of that movement is an important and necessary tool for the purpose of electricity trading, as well as for the optimal design of contracts in the electrical energy domain. Electricity prices have several characteristics. First, the price of electricity, like any other commodity, returns to its mean value, to the level that represents marginal costs. Second, there are small random movements around the trend, representing occasional supply and demand imbalances in the network. The third characteristic is the presence of sudden jumps and falls (spikes), i.e. one or more jumps followed by falls. Since regulation is present in one segment of this market, the correct formation of electricity prices is not at all a simple process. Actually, if certain parameters of social policy and incentive policy towards certain economic activities are taken into account, then often the price of electricity that is underestimated will lead to irrational consumption of electricity, consumption of national resources and finally damages that may occur as a result of environmental pollution. The unsustainability of such a policy has its price. Otherwise, overestimated electricity prices can have a negative impact on the standard of the population, as well as on the competitive position of the economy.

The movement of prices on the electricity market is determined by the supply and demand for electricity, but also by other factors, such as tax policies, regulation, foreign factors, etc. The movement of final prices, no matter how they are determined, represents an economic shock concerning the supply, and its effect can sometimes be significant and difficult to control. Certain activities in the power sector in the process from production to final consumption of electricity are regulated, while some are left to the free market. Those activities that are regulated most often meet the conditions for the existence of a natural monopoly due to their economic characteristics.

Electricity prices, in the period before deregulation and market liberalization, were stable and predictable. Deregulation and market liberalization led to an increase in price volatility and an increase in risk. Ever since electricity was left to market conditions, its price has a very high volatility and is conditioned by numerous factors. Certainly, the most significant factors affecting the price of electricity are the high volatility and uncertainty affecting the supply. On the supply side, these are the availability of production and transmission capacities, and on the demand side, consumption conditioned by consumer habits, weather conditions and economic activity, is combined with the problem of maintaining the energy balance. Any change in end-user demand together with changes in weather conditions, such as temperature, precipitation, water reserves, play a key role in the behavior of electricity prices. External influences such as power plant outages or transmission system unreliability will result in a significant impact on electricity prices (Girish & Vijayalakshmi, 2013). The volatility of prices is significantly influenced by the relationship between supply and demand, energy prices for the operation of production facilities, climate changes, and occasional stoppages, outages and overloading of the power system.

The electricity market is directly connected with other energy markets, bearing in mind that other energy products can be in some part substitutes for electricity (e.g. gas, - if gas prices fall, part of electricity buyers will switch to gas), as well as the facts that the majority of electricity is still produced from fossil fuels, and these have a significant impact on the price of electricity. Instability in other energy markets is transmitted to electricity markets. The change in the price of natural gas has a particularly significant impact on the price of electricity, bearing in mind that gas-fired power plants are mostly peaking, and that their marginal costs have a large impact on the volatility of

electricity prices. In addition to gas prices, the price of CO2 emissions also has a major influence on the price of electricity in Europe, due to the fact that CO2 certificates make the production of electricity from coal more expensive.

It is common for electricity markets to experience occasional peak electricity prices. They arise as a result of exposure to large and sudden changes, for example due to forced outages of power plants, interruptions in the transmission of electricity, etc. Their value at one point reaches a very high level, and then they return to the average again. They are common for periods of high tariffs when the demand for electricity is high, that is, when the power system is overloaded. Peak price values are characteristic of prices that appear during the day. High volatility in the short term is lost in the long term. In the short term, the price is determined by current supply and demand, while the long-term price is determined based on forecasts of production and consumption in the future. The general rule is that the price of electricity on the day of delivery is the same for all market participants, all producers charge the same price and all consumers pay the same price per megawatt. This is called the clearing price for electricity. In a deregulated market, the prevailing price is based on the offers of electricity producers. Those offers contain price schedules that compare the volume of electricity with the price. Power plants are ranked from the lowest cost plant to the highest cost plant, until demand is met. The prevailing price is the price achieved by the most frequently used power plant. The price at which the last unit entered the market is called the marginal price of electricity.

3. TYPES OF ELECTRICITY MARKET

The electricity market can be divided according to different criteria. Thus, for example, depending on the method of delivery, it is possible to distinguish between the physical and financial markets. According to the delivery period, spot and forward electricity markets are distinguished, while according to the trading method, a distinction is made between bilateral markets and stock exchanges.

The characteristic of the physical market is complexity, which is reflected in the complexity of the physical characteristics of electricity as a commodity. As with other commodity markets, a large part of trade involves the physical delivery of goods. Physical contracts are based on the physical transfer of goods from one owner to another. Trade on the spot market implies the physical delivery of the agreed quantity, of standard quality at the agreed price. Spot transactions are used mainly by consumers who buy small amounts of electricity to meet immediate needs. Trading on the electricity spot market is limited to participants who can promptly deliver or use electricity. The spot market represents a day-ahead market with physical delivery, and a relatively small number of products are present on it (basic, peak and night charts are usually traded). The complexity of physical spot markets in fact defines electricity trading.

The most liquid energy markets are financial spot markets. Financial contracts are used by investors who do not want to receive physical delivery of goods, but are exposed to market price risk. The spot market is a market for prompt delivery. Futures markets allow buyers and sellers to agree on a transaction in advance. For physical contracts, they leave enough time for both parties to prepare for the transaction. Trading on the futures market is mainly determined by the following factors: the type of goods traded and their quality, quantity, price, delivery time, place of delivery. From an economic point of view, allowing buyers and sellers to agree to sell or buy in advance reduces price volatility. The futures market can be a market for short-term and long-term deals. Also, it can be stock and over-the-counter.

Bilateral markets mean direct trade between two participants over the counter - OTC. OTC trading is done either directly with the other party or through a broker. It is essentially a direct contract between two parties, who sign a contract for each particular trade. OTC contracts can be very complex. There is a large number of different contracts, from spot contracts, forwards, through swing options, to contracts with the possibility of trading on a bilateral basis. Due to difficulties related to direct contracting, the number of participants that can appear on the OTC market is very limited. In order to make the market more accessible to a larger number of participants, it is often done through the stock exchange. The stock exchange trades directly with all registered participants, i.e. buyers or sellers trade directly with the stock exchange. Standard products are traded on it, in such a way that their price is determined by auction, that is, by public bidding by brokers who represent their clients. The main advantage of trading on the stock market is the liquidity and security of trading. Liquidity allows each stock market participant to close its position. The stock exchange assumes the risk of the other party and must settle the obligation towards the seller in case the buyer has not done so. The stock exchange protects its business through a deposit called margin. This is about securing the position taken by the investor and the guarantee that he will fulfill the obligation assumed by the contract. The main limitation of the exchange is that it does not offer a large selection of contracts. In order to deliver the offer to a large number of interested parties, it must be limited, and there are usually only a few types of contract for each commodity.

4. FINANCIAL DERIVATIVES ON THE ELECTRICITY MARKET

The company's exposure to the market, on the one hand, as well as the high volatility of electricity prices, on the other hand, have contributed to increasing attention being paid to risk management in the electricity sector. Electricity market participants, in order to protect themselves from the risk of price changes, most often use the following financial derivatives: forwards, futures, options and swaps.

Forwards contracts represent an agreement confirmed by a contract for the purchase and sale of certain goods, that is, certain related assets at a certain future time, or in other words, the maturity of the forward contract at a certain price (Orsag, 2006, p. 38). The price of a forward contract at the time of its creation is equal to zero, that is, the forward price is equal to the current market price. At the time the contract is drawn up, neither party realizes a profit or loss, but later as the delivery price deviates from the spot price of the related property, certain profits and losses of the contracting parties are realized. A forward contract is calculated upon its maturity, when one party delivers the related property, and the other party pays the agreed price for it. If the spot price at maturity is higher than the delivery price, the buyer makes a profit, if the spot price at maturity is lower than the delivery price, the seller makes a profit. A forward contract on the electricity market is a contract that represents an obligation to buy or sell a fixed amount of electricity at some point in the future at a predetermined price. Electricity forwards are traded from a few hours to a few years in advance, with the fact that markets over two years are not liquid. Usually, forward contracts are related to physical markets (contracts with physical delivery of electricity that can be short-term, medium-term, long-term), although they can also be traded on financial markets. Since forward contracts are not standardized, they are usually traded over the counter.

Futures contracts are one of the most widely used derivatives on the electricity market. Electricity market participants most often use futures contracts to protect themselves from losses due to constant changes in spot prices on the electricity market. The futures contract defines: total amount of electricity, price, place of delivery, duration of delivery, amount of electricity during the delivery period, and the last day for trading. Electricity futures are traded in continuous trading. Standard futures products are base chart and peak energy. The maturity of electricity futures is from an hour to a year. Futures have an average spot price and can be with financial or physical settlement (in practice, they are more often used with financial settlement). Typically, contracts that mature within an hour or a day are mostly settled physically, while contracts that mature within a week or longer are mostly settled financially. Contracts with physical settlement oblige the buyer to purchase the agreed amount of electricity at the agreed price in a certain time period, and the seller to deliver the agreed amount of electricity for the agreed price in the same time period. In contracts with financial settlement, there is no obligation of physical delivery, and the calculation of profit or loss is made on the basis of the difference between the average spot price at the time of delivery and the contract price of futures. Most of the futures are with financial settlement, and the holders of futures who also need the delivery of electricity buy it on the spot market, and their total position is the sum of the financial and physical position, which means that the price of buying or selling on the spot market in combination with futures is exactly as much as the contract price (Jeremić, & Terzić, 2019).

Options, as a financial instrument, provide the buyer of the option with the right to buy or sell a certain amount of assets until the maturity date or on the option's maturity day (exercise day) at a fixed, predetermined price (strike price). The exercise price is the price fixed in the option at which its owner can buy or sell securities or other related assets that are the subject of the option. It is the price on the basis of which the buyer of the option speculates on the increase or decrease in the price of securities. On the electricity market, options are derived based on the future price, which is determined based on the concluded futures contract. The buyer of the option (option holder) can exercise the option until its maturity date. The seller of the option (option writer) is obliged to comply with all items from the option contract. (Latas & Jeremić, 2017). Options on electricity on the stock exchanges are derived from futures and, accordingly, are executed through futures, which means that, if held until maturity, they are realized by physical delivery. The swap contract does not include the physical exchange of electricity, but the contracting parties fulfill their obligations by transferring money.

Electricity swaps are financial contracts that allow their owners to pay a fixed price for the basic electricity, regardless of the fluctuating price of electricity or vice versa during the agreed period of time. These contracts are typically concluded for a fixed amount of electricity related to a variable spot price at any producer or consumer location.Electricity swaps are widely used to provide short- and medium-term price certainty of up to several years. They can be seen as electricity futures contracts with the same strike price and expiration date, with multiple settlement dates and an identical fixed price for each settlement (Božić, 2021).

5. DERIVATIVE FINANCIAL INSTRUMENTS IN INSURANCE

Insurance is a mechanism that reduces and eliminates risk by combining a sufficient number of homogeneous risk exposures into a group, which turns the losses of the group as a whole into predictable ones. By transferring the risk

to insurance corporations as professional risk carriers, insurers have more funds available to invest in profitable alternatives. In other words, insurance represents the exchange of a small certain cost of an individual (enterprise) for a large certain loss. In other words, insurance is a mechanism for reducing and eliminating risks through association.

When forming its own investment portfolio, the insurance company follows the principles of safety, profitability and liquidity. The principle of security refers to the timely fulfillment of obligations towards the insured by insurance companies. The principle of profitability guarantees the preservation of the real value of the invested funds and the collection of current liquidity. The liquidity principle of portfolio insurance companies implies that a part of the portfolio can be quickly and without losses converted into money.

The placement of free funds of insurance companies can be realized in different ways: by purchasing real estate and by providing mortgage loans, by depositing funds with banks and other financial institutions and by purchasing derivative financial assets. The application of these instruments has multiplied the flexibility of obtaining the necessary capital to ensure the realization of a return corresponding to the investment return. "For investors, financial derivatives provide an additional opportunity for portfolio diversification, as well as a number of advantages in the form of tax benefits, revitalization of leverage effects, etc. Financial managers use these securities in order to insure against unfavorable developments in the company's environment, i.e. for managing different types of risks. Various studies have shown that securities contribute to reducing the risk of instability of interest rates and exchange rates and affect the stability of business in the long term" (Avdalović et al, 2016, p. 466).

In the capacity of protection against the insurance risk that exists on the basis of already assumed obligations by transferring the risk to the other contracting party, derivative instruments have established themselves as a very effective instrument. The value of the derivative is insured in functional dependence with market indices that represent indicators of occurrence of harmful events covered by insurance coverage. Futures options can be traded on the stock market. In OTC markets, the most common insurance derivatives are swaps.

6. CONCLUSION

Supply and demand in a certain electrical network must always be balanced. The imbalance between the supply and demand of electricity causes the frequency in the system to deviate from the standard frequency. In addition, unlike traditional markets, electricity markets are segmented both geographically and according to delivery conditions. The main reason for such segmentation is the impossibility of storage. The main characteristics of the electricity market are the return to the average - the price of electricity returns to the mean value in a period of several days or weeks and can be explained by neutralizing the causes that evoked it (generator outage, change in weather conditions). There are significant differences in the price of electricity between different regions, which are a consequence of different levels of production and capacity of the transmission network. Data on electricity prices show volatility, which appears as a consequence of seasonality that distorts the time series.

As an element of every financial system, insurance through various financial instruments, in addition to derivatives, is growing into an increasingly important subject in electricity trading. Derivative financial instruments are increasingly used as protection against insurance risks that exist on the basis of already assumed obligations by transferring the risk to the other contracting party. Derivative instruments have similarities with catastrophic bonds. The reason for this is the fact that the use of derivative financial instruments results in the transfer of risk to the capital market, that is, from insurers and reinsurers to investors.

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