"COMPUTER-BASED SIMULATION OF AUCTIONS OF OPTION CONTRACTS AND OF FUTURES CONTRACTS IN THE COLOMBIAN WHOLESALE ELECTRICITY MARKET"

Final Report – Chapter 8

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1. CONCLUSIONS

1.1. INTRODUCTION

In this chapter we summarize the most relevant conclusions of the study.

From a conceptual point of view, we agree with most of the conclusions of the TERA study. Particularly we share the idea that there are clear advantages of substituting the present methodology of capacity payments (CxC) with a futures and options market (FOM).

The objective of this study was to simulate a hypothetical FOM. The results of our simulations confirm with numerical information the advantages foreseen by TERA. The results also allowed us to identify some other benefits for the Colombian electricity market.

Since enough information[1] to carry out the simulations did not exist, we found it necessary to pose a set of assumptions on the behavior of market participants. It is important to highlight that if some of the assumptions were objected or further studies prove that they are not realistic, in some cases some of the conclusions of our study may change. However, we deem that the most important conclusions on the benefits of the FOM are not sensitive to changes in the assumptions, since they are based on studied behavior of market participants in international financial or commodity markets.

Despite of these difficulties, we were able to carry out the numerical simulations of the FOM. The results from these simulations were used to select the most important characteristics of the market such as: as strike prices, performance periods, and type of options.

During the study, after presenting Report #1 we agreed with the CREG that only financial options would be considered in the study..

1.2. THE CONCEPTUAL ADVANTAGES OF THE MARKET

Our conceptual analysis of the proposal of TERA coincides with the idea that the implementation of the FOM will allow to achieve the following goals :

- Establishing a system of competitive prices with suited signals to efficient investments in generation,
- Provide to market participants with financial instruments for risk hedging related with volatility of prices in the spot market. Therefore the FOM reduces the risk for investors in generation projects, making possible to expect that investors will require lower rates of return, and consequently, lower long term marginal costs,
- Establishing a system that encourages the efficient and reliable use of the existing resources,

[1] The information necessary for simulation would require the previous existence of a liquid market of futures.

- Making possible, when the FOM reaches maturity, to release the rules focused on reliability like "rationing rules" of "intervención de los embalses".
- Switching from administrative capacity payments to market oriented options and futures.

1.3. THE SIMULATION OF THE FOM

Our analysis showed that it is not necessary to consider separately a market of futures from a market of options. Furthermore, the futures can be considered (mathematically) as options with strike price zero.

Thus, we simulated a market where participants may choose to hedge risks buying / selling among a wide range of options, or to operate only in the spot market.

The model assumed a centralized market with a clearing house. Auctions are performed for all the types of financial instruments simultaneously. It was assumed that the market is perfectly competitive, therefore the participants are not able to influence on clearing prices, and they are encouraged to bid their indifference costs. Indifference costs are those that yield the same utility (computed taking into consideration risk tolerance of each participant) that the operation in the spot market.

For the simulations we also assumed different risk profiles for the market participants. As there is not information available that can be used to estimate such risk profiles, a wide range of values was used. Individual risk tolerances were randomly generated. We also analyzed the sensitivity of the results to different ranges of risk profiles.

Simulation results are consistent with the assumptions performed on risk profiles. The most useful results are the clearing prices and the capacity sold / bought by different power plants and consumers for every type of financial instruments.

The general trend is that in scenarios with high risk tolerance, the clearing price of every type of options is consistent with the costs / revenues obtained by the participants in the spot market.

But when it is assumed that the participants have low risk tolerances, the clearing prices results lower than the indifference price (respect the operation in the spot market). This is not a general conclusion, and is mainly related with the data on load profiles adopted.

The total social welfare was used as general criteria to compare different alternatives of design of the FOM. Even though the absolute value of the social welfare is not meaningful, the relative values are useful to identify the best alternatives. It is advisable to consider that the total social welfare depends on the utility function that was assumed.

The alternatives analyzed included:

- Strike prices of the options
- Performance period of the options
- Type of options

There is a trade off between social welfare and liquidity of the market. Therefore we assumed a number of strike prices lower than the ones that would maximize the social welfare.

The alternative that we considered the optimal is:

- Strike prices: 0 (futures), 10, 30, 70 us$/MWh

- Performance periods: 1, 2 5 years. If it does affect liquidity of the market, it could be advisable to adopt lower performance periods, like 1 week, 1 month and 6 months.
- Type of options: base (24 hours each day) and semi-peak (10 hours of maximum load from Monday to Friday).

The social welfare increases only marginally with a greater number of strike prices. There is not a significant increase in the social welfare if peak options with a performance period of one hour each day, are also included.

1.4. COMPARISON BETWEEN THE CxC AND THE FOM

The following conclusions arise from the numerical comparison between the CxC and the FOM:

- In order to compare both alternatives it is necessary to forecast, for each method, prices and their associated volatility in the spot market. The results are influenced by how these assumptions are posed. To forecast the prices and their volatilities, we used spot market simulations.
- The main assumption posed for comparison is that in both cases, the average revenues of new base generators are the same, and equal the long term marginal price (LRMP). This means that energy prices and volatilities are different. In the case with the CxC method, energy revenues + (plus) capacity revenues should be equal to the LRMC. In the case of the FOM, energy prices should be equal to the LRMC. The consequence of these assumptions is that volatilities of prices are higher with the FOM alternative.
- The comparison was performed for some selected thermal plants. The variables compared were net revenues (revenues minus variable costs), volatilities (standard deviation of revenues) and utility, using the function presented in chapter 3 of this Report.
- The analysis was performed for four scenarios of risk tolerance of the plants analyzed and of the market (average risk tolerance of all the market participants).
- Net revenues of the plants are of the same order, with differences of about 20%, for the four scenarios.
- Volatilities in the scenarios with the same risk tolerances for the plants selected and the market, are lower for the CxC method.
- In the scenario with low risk tolerance of the plants selected and high risk tolerance for the market, volatilities of the selected plants are practically zero. This means that the market is effective for hedging risks of participants with low tolerance.
- The utility function with the FOM are on average higher than for the CxC, but not for every plant.
- The methodology used does not take into consideration that when market participants have alternatives to hedging risks, the expected return and cost financing of investments are lower, and consequently, market prices could be lower.

Thus, the main conclusion is that the FOM approach has some advantages with respect to the CxC, basically because it allows the market participants to hedge their risks according to their risk profiles.

1.5. MARKET SUMMARY

The following is a summary of the contract terms and market conditions recommended by The Consortium in this document.

1.5.1. PARTICIPATION

- Minimum credit quality will be determined based on the minimum credit quality of the 10 – 20 largest participants in the Colombian electricity market.
- Any participants with equal or better credit rating should be allowed to participate, and participants with lower credit quality should be allowed to post cash (or cash equivalent) or obtain letters of credit or reinsurance to participate.

1.5.2. AUCTION

- Auction will be iterative, held quarterly, and administered by MEM (or other regulatory group).
- Both generators and consumers must sell (purchase) 5% of their expected load or demand requirements in the first year.
- A master contract (like an ISDA) should be created to address legal questions such as payment periods, dispute resolution, etc… These contracts should be signed by all participants to reduce the contracting costs associated with transacting in the auction and provide a base for secondary market trading.

1.5.3. CONTRACT DETAILS

- **Trading Unit -** Forward/Futures contracts and Options to begin trading in units of 1MW per hour over the delivery period.
- **Delivery Period** – Baseload Forward/Futures contracts and options delivered 24 hours per day, seven days per week. Peak options will deliver 10 hours per day Monday through Friday between the hours of 12:00.00 and 21:59.59
- **Reference Price** – Contracts will be settled versus the price in La Bolsa at a switching station or central hub to be determined by the CREG.
- **Trading Months** – Contracts will be for monthly settlement over periods of one year, two years, and five years.
- **Price Quotations** – Prices will be quoted is US Dollars per MWhr.
- **Exercise** – Options may be exercised daily over the delivery period, with the option buyer notifying the seller not later than 15:59.59 of the prior day.
- **Option Premiums** – Premiums will be amortized over the life of the contract, and paid monthly beginning on the transaction date and ending the last business day prior to the performance period.

1.5.4. SECONDARY MARKET

- Trading in the secondary market would be performed bilaterally (directly between counterparties).
- No limits on minimum maintained contract quantities would exist in the secondary markets. Producers and consumers would be free to adjust their positions to their desired risk profile.

- A centralized organization would manage collateral from different counterparties.

1.5.5. CLEARING AND COLLATERAL MANAGEMENT

- A formal exchange with central clearing would likely be too expensive for the Colombian electricity market, due to the massive costs associated with a large player becoming insolvent.
- Instead, a central collateral management agency (CCMA) would be formed and administered by an outside party (i.e. regulatory agency or outside exchange).
- The CCMA would determine levels of collateral for long and short positions in the Colombian market.
- Each participant could receive a credit toward the collateral requirement based on its credit rating.
- The CCMA would keep collateral funds in escrow for the companies, so that troubled companies would not be tempted to spend collateral funds in times of financial distress.
- The CCMA would administer collateral netting and rehypothication.[2]
- The CCMA would also collect an "insurance" premium to put into a fund to act as second loss protection in the event of default.

The Consortium feels that the market structure summarized above and described in detail in this document provides an alternative that will minimize transaction costs and financial strain on participants (thus promoting acceptance liquidity) while providing a reasonable amount of protection that many power markets have lacked in the past.

[2] Rehypothecation means that a company can use collateral that has been posted to it to cover its own collateral obligations.