



Agent-based retail competition and portfolio optimization in liberalized electricity markets: A study involving real-world consumers[☆]

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ABSTRACT

The liberalization of energy markets brought full competition to the electric power industry. In the wholesale sector, producers and retailers submit bids to day-ahead markets, where prices are uncertain, or alternatively, they sign bilateral contracts to hedge against pool price volatility. In the retail sector, retailers compete to sign bilateral contracts with end-use customers. Typically, such contracts are subject to a high-risk premium—that is, retailers request a high premium to consumers to cover their potential risk of trading energy in wholesale markets. Accordingly, consumers pay a price for energy typically higher than the wholesale market price. This article addresses the optimization of the portfolios of retailers, which are composed of end-use customers. To this end, it makes use of a risk-return optimization model based on the Markowitz theory. The article presents a simulation-based study conducted with the help of the MATREM system, involving 6 retailer agents, with different risk preferences, and 312 real-world consumers. The retailers select a pricing strategy and compute a tariff to offer to target consumers, optimize their portfolio of consumers using data from the Iberian market, sign bilateral contracts with consumers, and compute their target return during contract duration. The results support the conclusion that retail markets are more favourable to risk-seeking retailers, since substantial variations in return lead to small variations in risk. However, for a given target return, risk-averse retailers consider lower risk portfolios, meaning that they may obtain higher returns in both favourable and unfavourable situations.

1. Introduction

The liberalization of energy markets brought full competition to the electricity supply industry (see, e.g., [1–4]). Market participants have now the possibility to trade electricity in several different types of markets, notably mediated and bilateral markets [5,6]. In mediated markets, participants can submit bids to electricity pools and/or power exchanges. Such markets are public, centralized markets, where buyers and sellers can trade energy indirectly. In bilateral markets, players can sign standard financial or physical contracts to hedge against the price volatility typical of mediated markets. Such markets are private, decentralized markets, that typically provide more flexibility, although they may be more expensive. Worthy to mention is also the possibility to sign tailored or customized bilateral contracts, in non-organized, decentralized markets, where buyers and sellers can privately negotiate the terms and conditions of the final agreements according to their own preferences. The trading parties can specify any contract terms they desire, but this flexibility comes frequently at a price, since negotiating and writing contracts may be expensive. Also, the network

usage resulting from such contracts need to be approved by the system operator.

In terms of structure, power markets are typically divided into several sectors (or structural components), notably a wholesale sector and a retail sector. In the wholesale sector, competing generators offer their electricity output to retailers and possibly other players. In the retail sector, end-use customers have the possibility to choose their suppliers from competing electricity retailers and possibly other market participants [5]. Retailers operate in both wholesale and retail markets—they buy energy from producers and sell energy to end-use customers. Specifically, in retail markets, retailers compete to sign bilateral contracts with end-use customers, to cover their needs, resulting in a private portfolio to manage. And to satisfy such needs, retailers participate in wholesale markets, submitting bids to both day-ahead and intra-day markets, and also signing bilateral contracts with producers and possibly other market participants.

Typically, retailers follow a “business as usual” strategy, meaning that they offer high tariffs to clients, which are equal for customers

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