



## Retail consumers and risk in centralized energy auctions for indexed long-term contracts in Chile



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### ABSTRACT

Centralized energy auctions for long-term contracts are commonly-used mechanisms to ensure supply adequacy, to promote competition, and to protect retail customers from price spikes in Latin America. In Chile, the law mandates that all distribution companies must hold long-term contracts—which are awarded on a competitive centralized auction—to cover 100% of the projected demand from three to fifteen years into the future. These contracts can be indexed to a series of financial parameters, including fossil fuel prices at reference locations. Drawing from portfolio theory, we use a simple example to illustrate the difficulties of selecting, through the current clearing mechanism that focuses on average costs and individual characteristics of the offers, a portfolio of long-term energy contracts that could simultaneously minimize the expected future cost of energy and limit the risk exposure of retail customers. In particular, we show that if the objective of the regulator is to limit the risk to regulated consumers, it could be optimal to include contracts that would not be selected based on individual characteristics of the offers and a least-cost auction objective, but that could significantly reduce the price variance of the overall portfolio due to diversification effects between indexing parameters.

### 1. Introduction

Chile was the first country to restructure its electricity market in the 1980's (Raineri, 2006). Today, all generation investments are made by private firms, which can engage in long-term contracts with large customers or distribution companies and sell their power in an audited cost-based spot market managed by an independent system operator. Further Latin-American countries followed a similar path such as Peru, Brazil, and Argentina. As in many other restructured markets, both transmission and distribution companies remain operating as regulated monopolies; however, unlike markets in the US, Europe, New Zealand, and Australia that present a competitive retail sector (Defeuilley, 2009), small consumers in Chile (with less than .5 MW of power) have no retail choice. In this context, the regulator mandates auctions where generators can make offers to obtain regulated long-term contracts to supply future demand of small consumers (Moreno et al., 2010). Such contracts are signed between awarded generators and distribution companies, which then pass through the contract price to consumers. In contrast, large consumers, such as mining companies, can negotiate bilateral contracts or Power Purchase Agreements (PPA) directly with generation companies.

In contrast, in electricity markets that allow for retail competition, consumers have the freedom to engage in alternative deals with a number of retailers. All the procured power is offered to customers as a menu of products that can be differentiated by price and risk—and, in theory, even by service quality levels—which are endogenously determined through consumer preferences and competition among all retailers available in a geographical region. Just as with internet cable providers, in competitive retail markets consumers are free to choose the retailer that offers the products and services that best suits their needs. In the UK market, for example, large retailers have historically offered hedged products while smaller retailers have offered more exposed/volatile ones (Vaughan, 2017). In this context, risk-averse consumers for whom electricity costs may represent a larger proportion of their budgets are more likely to choose hedged products at higher (fixed) prices than unhedged one. In contrast, there are consumers who prefer more exposure, seeking a less costly electricity supply in the longer term (note that hedged products include the cost of insurance) (Smith, 1989; Strauss and Oren, 1993).<sup>1</sup>

Clearly, customers in electricity markets where there is no retail choice—such as those in Chile—are captive. Hence, a customer that is unsatisfied with the particular mean-risk ratio offered or any further

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<sup>1</sup> Borenstein et al. (2007), for instance, discusses different hedging strategies for customers that are exposed to real-time electricity prices.

aspects associated with the service provision by a franchised retailer has very limited options (e.g., producing part of their own power consumption through rooftop solar generation).

Despite the benefits of competitive retail markets, explained in detail in Littlechild (2000), there is no conclusive evidence that retail competition can actually benefit small customers in restructured electricity markets (Joskow, 2008). Furthermore, Green (2004) demonstrates that if prices are sufficiently volatile from year to year, the transition to retail competition in the electricity industry could lead to a significant reduction in long-term contracting, and higher prices overall. There is further empirical evidence that shows mixed levels of success in implementations of competitive retail markets (Defeuilley, 2009). Finally, in small systems such as those of interest in this paper, the exercise of market power and price manipulation are common concerns where mandated auctions of electricity contracts can represent a reasonable alternative.

In the particular case of Chile, auctions for long-term contracts, implemented for the first time in 2006, replaced the centralized retail price calculation based on mathematical models. In fact, prior to 2006, the regulated price was calculated by the authority every 6 months as the average value of future marginal costs in every node obtained through an SDDP-like model (Pereira and Pinto, 1991), plus the regulated costs of distribution companies that provided both network and retail services. In other words, generation and distribution companies signed long-term contracts that were priced by the authority on a 6-month basis; thus contract prices were passed through to the end consumer, on top of the regulated cost of service of distribution companies. Hence, retailed prices reflected the authority's (rather than the market) expectation of system marginal costs in the near future (average over a time horizon of 4 years), which also aimed at mitigating the potential exercise of market power and therefore reduce the overall price to the end consumer. Although this method worked reasonably well during the 80s and 90s, it presented major problems since 2004 due to the reduction of natural gas imports from Argentina that increased the actual (but not necessarily the modeled or foreseen) system marginal cost. This created a significant barrier for new (regulated) long-term contracts and thus generation investments that, during 2005, led to changes in the regulatory framework. It was then that the government decided to implement a new mechanism of auctions for long-term contracts that addressed the aforementioned problems by incorporating real cost expectations from actual market participants in the retail price, fostering the needed generation investments in the Chilean market.

For more than 10 years since their implementation auctions have been used to clear prices for regulated consumers through long-term contracts. These have been iteratively improved by the regulatory authority and, although auctions have presented several problems in the past (Moreno et al., 2010), they have represented, overall, a reasonable alternative to hedge retail prices, to promote generation investment and therefore ensure adequate capacity, and to make the market more contestable with substantial international attention from investors. These improvements, coupled with reductions in the cost of renewable energy technologies, have led to a significant decrease in the cleared prices of electricity in the last few years. In fact, in the last auction carried out in 2016, the average price was equal to 47 \$/MWh with a minimum offer price of 28 \$/MWh, offered by new solar power plants.<sup>2</sup> An additional benefit of the auction mechanism has attracted new generation firms to join the Chilean electricity market, which has reduced its concentration.

Although the success of the auction mechanism has been material, especially in the latest processes, there are various aspects that need to be improved, including the selection of an efficient portfolio of indexed long-term contracts while facing an uncertain future. In this vein, our

goal is to demonstrate that a centralized auction mechanism for indexed long-term energy contracts, as implemented now in Chile, is not necessarily efficient when attempting to limit the risk exposure of retail customers. Note that, as explained earlier, limiting risks is critical for energy-intensive consumers, which are not necessarily large consumers, and thereby is an expected output from competitive retail markets. Therefore, we argue that not being able to properly balance expected costs and price risk is a major drawback of the current auction mechanism that requires immediate action. The problem arises given that the auctioneer determines the optimal portfolio based on individual characteristics of offers (e.g., expected present cost of it) that are indexed to a series of financial parameters. We quantify this effect using a simple model that emulates the current selection methodology in the Chilean long-term energy auctions. Our results indicate that ignoring uncertainty and correlations among offers that have synergistic effects in terms of diversification may significantly increase the risk exposure of retail consumers.

To our best knowledge, this is the first study that quantifies the limitations of selection mechanisms that solely focus on minimizing expected costs and compares their performance to more sophisticated approaches that explicitly consider price risk. Apart from Chile, auction mechanisms for long-term contracts applied in Latin America and beyond (e.g., Peru, Brazil, Colombia, Panama, South Australia, Vietnam, Philippines, Thailand, etc.) (Maurer and Barroso, 2011) present similar problems and thus the concepts and models analyzed in this paper can be of particular interest for regulators and policymakers who look for risk-averse portfolio solutions in these markets. Table 1 illustrates that, although the targeted markets present no retail competition, they can differ in many other characteristics. Furthermore, regardless of the market features and implementation details of auction mechanisms across jurisdictions (see Table 1), this paper discusses fundamental aspects to support authorities (as public auctioneers) find the most convenient portfolio solution for a desirable level of risk exposure, rather than selecting the one with the best “average” performance, but with the potential to negatively affect end consumers under the realization of adverse conditions.

We structure the rest of the paper as follows. In Section 2 we summarize some of the existing literature on risk allocation in competitive markets, contracts, and public-private partnerships. In Section 3 we provide a brief overview of the Chilean power system. In Section 4 we present different selection methods to construct a portfolio of indexed contracts. In this section we also describe a simple stochastic model of energy commodity prices that we later on use to compare the performance of different selection methods. In Section 5 we specify the data and framework used to test the methods, which is inspired in the current Chilean auction. In Section 6 we compare the performance of the selection methods both in terms of expected costs and price volatility. Finally in Section 7 we conclude and provide some policy recommendations.

## 2. Risk allocation in competitive markets, contracts, and public-private partnerships

Economic theory states that if a market is complete and agents are risk averse, then the final allocation of risk is efficient (Arrow, 1964). A market is complete if there exist insurance options (i.e., Arrow-Debreu securities) for every possible state of nature, which means that all market participants can adjust their risk exposure by trading these securities. Consequently, the price of these securities and the final allocation of risk is endogenous (i.e., a result of the interactions among all market participants). However, if some securities do not exist due to information asymmetries, transaction costs, or enforceability issues, then a market is incomplete and the final allocation of risk is inefficient (i.e., some agents might bear too much or too little risk compared to an efficient allocation in a complete market) (Mas-Colell et al., 1995).

Naturally, market completeness is a rather strong assumption in the

<sup>2</sup> In this paper the currency is in US dollars.

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