



Pass-through of wholesale price to the end user retail price in the Norwegian electricity market

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ABSTRACT

In this paper we estimate the pass-through of wholesale electricity price to the end consumer price with *variable price contracts* in the Norwegian electricity market using weekly data. We find substantial asymmetry when retailers pass on the impact of price changes in the wholesale market to the retail prices as price increases are transmitted more quickly than price decreases. By examining the cumulative adjustment function of price change, we identify that some dominant retailers might be exercising market power in the retail electricity market. For an average Norwegian household with variable price contract, the cost of asymmetric price pass-through due to 2.5 Øre/kWh change in the wholesale price over the complete life of pass-through in a year reaches to a high of 2.28 NOK. This cost sums up to 3.8 million NOK for all the Norwegian households on variable price contracts for one time price change. To deal with this asymmetric price setting behavior, end consumers should switch to spot price contracts and make use of “smart grid” technologies.

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1. Introduction

Norway was one of the first European countries to deregulate its electricity market under the Energy Act of 1991. Apart from opening up the market for generation, liberalization of the retail market was probably the most significant development for more efficient utilization of available generation capacity. This regulation changed the face of electricity market from a centralized and vertically integrated structure to a more open and competitive setup. The wholesale spot market with prices being set on hourly basis has become a predominant feature of electricity trade in Norway. This movement towards a deregulated structure however, has been coupled with large fluctuations in the wholesale electricity prices, and sudden spikes constitute a large part in the total variations of spot prices.

Contrary to the structural changes at the wholesale generation level, the underlying structure of the retail market in terms of contract types and electricity metering has not changed much. Low volume retail customers are charged on the basis of their estimated

load profile rather than the actual consumption, and they do not observe short-run time varying differences prices. This limits their ability to react to price signals.² These consumers thus cannot influence their expenditures on electricity even by adjusting their short-term intertemporal consumption profile. Only the producers respond to changes in spot price and alter their production decisions accordingly. This stark difference in the way these markets operate raises a number of regulatory concerns.

Prices act as signals for an efficient resource allocation. Since most of the end consumers exhibit limited responses to recurrent variations in prices, they tend to “over-consume” in the hours with high prices and “under-consume” in the periods with low prices compared to a real time pricing scheme. This represents an inefficient market outcome as the cost of electricity becomes higher than the necessary because high-cost generators remain in operation for too many hours. The retail prices thus fail to convey scarcity in wholesale market to the retail level.

Limited capability of the consumers to respond to price changes also increases the ability of wholesale producers to exercise market

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² Only the large industrial consumers that buy electricity directly from the NordPool market react to day-ahead prices and change their electricity consumption accordingly.

power and artificially raise the prices above the marginal cost of production (Borenstein et al., 1999; Johnsen et al., 1999; Wolfram, 1999). Exercise of market power not only adds to price volatility, but also results in significant wealth transfers from consumers to the suppliers.

On the flipside, wholesale/pool electricity prices are inherently volatile and can vary substantially between hours, days and across seasons. A competitive retail market is the link between the wholesale electricity pool and the end consumers to hedge them against sudden price spikes. Effective retail competition creates a natural protection for consumers by developing different price contracts to mitigate price risk for them. In this regard, the structure of the contracts itself is important in determining the strength of relationship between wholesale and retail prices. If retailers directly pass on the price changes in the wholesale market to end users, the retail market is considered to be efficient. As the prices in the household electricity market are not observed in real time by the consumers, it provides an opportunity to the retailers to pass on the impact of price changes asymmetrically to the consumers. This strategy by the retailers, among other factors weakens the link between wholesale and retail markets. There are a number of factors that affect the transmission of wholesale prices to the retail prices including;

First, it is costly to make price changes at the retail level as the retailers have to notify their customers in advance to the price change occurs. Retailers weigh the adjustment cost towards the profitability of their price change itself (Ginsburgh and Michel, 1988; Johnsen and Oslon, 2008; Lago-González and Salas-Fumás, 2005). Balke and Fomby (1997) suggest that the presence of fixed costs of adjustment might prevent economic agents from adjusting prices quickly and frequently. Only when deviation from equilibrium exceeds a critical threshold and the benefits of adjustment exceed the costs, are economic agents going to change prices to move the system back towards equilibrium. Madsen and Yang (1998) demonstrate that the presence of menu costs implies that prices adjust asymmetrically to nominal demand shocks and the net gain from adjusting prices is positively related to price elasticity of demand in the wake of an adverse nominal demand shock.

Second, frequent upward price revisions by a retailer might lead to the loss of consumer confidence in the retailer and compel them to search for other suppliers. To keep their customer base intact, retailers may therefore avoid making rapid price changes.

Third, several studies argue that prices are sticky downwards and suppliers have more tendency to revise the prices upwards than downwards (Davis and Hamilton, 2004). This is quite intuitive in the sense that cost increases are passed on completely and rapidly to the consumers than retailer cost savings. A number of competing theories have been put forward to explain this asymmetric wholesale-retail price transmission. These include market power, consumer search cost and the behavior of markup during business cycles (Borenstein and Shepard, 2002; Johnson, 2002). Price stickiness has implications specifically for the inactive segment of consumers in the retail market, and it may be profitable for retailers to keep their margins at the higher level. By staying inactive, a consumer signals indifference or resignation about the retail electricity price. Thus, the suppliers may find it possible to maintain a high price without losing many customers. Competition in the market is one of the factors determining the threshold of margins before the supplier starts to lose customers.

Keeping in view the above discussion, this paper explores the relationship between wholesale and retail electricity market for Norway from price pass-through perspective. Using weekly data on NordPool system price and the average retail electricity price by different contract types from 2000, week 36 to 2010, week 34, we seek to answer the following questions:

1) What is the magnitude of pass-through of wholesale price on retail price for electricity?

- 2) Is the wholesale price pass-through symmetric? If asymmetric, what is the extent of asymmetry?
- 3) If the pass-through is asymmetric, what is the financial cost of asymmetry to the end consumers?
- 4) What is the total adjustment lag in full transmission of wholesale prices on the retail prices?

The rest of the paper is organized as follows. Section 2 gives an overview of related literature for retail electricity market, while Section 3 discusses the developments in Norwegian retail electricity market. In Section 4 we first lay out a theoretical model to reflect how a retailer with market power can control the pass-through of wholesale price to the retail price, and then we explain the empirical methodology followed in this paper. Section 5 provides discussion of results while Section 6 concludes.

2. Previous studies

The question of pass-through of wholesale to the retail prices has remained unanswered for the case of most electricity markets in the world. Some of the earlier research on the relationship between wholesale and retail electricity market remained focused on alternatives of market structure that link prices in the two vertical markets; and how should a market structure evolve for maximum social welfare (Blumstein, 1999; Hogan and Ruf, 1994; Littlechild, 2003).

Joskow and Tirole (2004) undertook one of earlier studies to encompass the implication of load profiling for the customers who do not have meters to measure their real time electricity consumption. Under the assumptions of retail competition and load profiling, their results do not suggest second best prices due to non-responsiveness of consumers to the real time prices. Contrary, when consumers have real time meters, and they observe real time prices and consumption, competition in the retail market leads to Ramsey prices even when consumers only partially respond to the real time prices.

Brigham and Waterson (2003) study the strategic behavior of retailers in UK market for electricity. The results suggest that since the liberalization of the market, there has been significant amount of entry but still a substantial gap between prices set by incumbent firms in their area and the prices by the entrants exists. They do not find any evidence of market operating near the perfectly competitive levels.

Johnsen (2002) summarizes the developments in Norwegian retail competition, supplier switching, contract choices and prices from 1991 to 2002. His results indicate that end user prices in the Norwegian electricity market have closely followed the wholesale electricity prices, which has resulted in significant efficiency gains.

Lewis et al. (2004) carry out a detailed analysis of the relationship between wholesale and end user prices in the Nordic electricity market. Their results for Norway suggest that since the liberalization of the market until 2003, there have been significant switching by consumers from standard variable price contract to 1-year fixed price contracts. Similarly, a considerable number of consumers shifted to new retailers, and retailers have been efficient in transferring their costs to end users as retail prices follow wholesale prices closely.

Littlechild (2006) provides an extensive survey of the developments in Nordic retail electricity market from 1998 onwards and finds that the use of the alternative products in the market is increasing over time, and there has been considerable product innovation. He concludes that the market is developing in the way the local customers prefer.

Olsen et al. (2006) find that in Norway and Sweden, a considerable number of households actively engage in the market to switch to low price retailers but the number of active households in Denmark and Finland is very small.

Johnsen and Oslon (2008) estimate the transmission of wholesale prices to retail prices for variable price contracts among the four

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