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Risk assessment of new pricing strategies in the district heating market A case study at Sundsvall Energi AB

Olof Björkqvist [a,*], Jim Idefeldt [b], Aron Larsson [b]

[a] Department of Natural Sciences, Engineering and Mathematics, Mid Sweden University, SE-851 70 Sundsvall, Sweden
[b] Department of Information Technology and Media, Mid Sweden University, SE-851 70 Sundsvall, Sweden

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ABSTRACT

The price structure of district heating has been no major scientific issue for the last decades in energy-related research. However, today trends in district heating pricing tend to move towards a more customer-oriented approach with predetermined prices under a longer periods, leading to a more complex price structure. If a district heating supplier offers district heating with predetermined prices in order to compete with similar electricity offers, the financial risk of the new price structure is significantly higher than the risk of an ordinary variable cost offer based on short-run marginal cost. In contrary to an electricity seller, the district heating company cannot transfer all of the risk of predetermined prices to the financial market, instead the company is thrown upon its own ability to handle the risk by, e.g., hedging its own energy purchase. However, all uncertainties cannot be coped with in this manner. Thus, there is a need for a methodology that can be used to estimate the financial risk of different price structures and to value different opportunities to reduce the risk. In this article, we propose a methodology, implemented in prototype software, to evaluate the risk associated with new price structures in district heating.

1. Introduction

The price structure of district heating has been no major scientific issue in energy-related research for the last decades. There is a general consensus that efficient price structure should reflect the short-run marginal cost and that the tariff could contain both fixed and variable fees (see e.g. Andersson and Bohman, 1985; Bohman and Andersson, 1987; Della Valle, 1988; Frederiksen and Werner, 1993; Sjödin and Henning, 2004). According to Frederiksen and Werner (1993), an effective price structure shall:

- give correct price information to the costumer
- be competitive
- be understandable in terms of simplicity
- give reasonable rate of return
- be settled beforehand

A price structure based on short-run marginal cost will give correct price information to the customer and hence stimulate to optimal balance of energy supply and energy efficiency measures in the buildings. (Sjödin and Henning, 2004; Gellings and Chamberlin, 1993) If district heating dominates the low temperature heat market in a specific area, the supplier has a good opportunity to define such a price structure. Normally, the price structure has one fixed component of an annual fee per installed kW or year and one variable component where the price per energy unit varies with the season. The variable fee is based on the short-run marginal production cost. This price structure is one traditional way of reducing price risks in the district heating business. For example, a winter that is colder than normal will cause increased production in boilers that are expensive to run. The increased production cost will be covered by the increased revenue as the winter price is based on the short-run marginal cost of that season.

Today district heating pricing tend to move towards a more customer-oriented approach, leading to a more diversed pricing structure than the common two-tier price model with both fixed and variable price component described above. When the district heating company tries to expand its sale into new markets, especially into residential districts, other energy suppliers dominates the market and the district heating business will be a price taker instead of price setter, meaning that the company must respond to price-level and structure defined by its competitors. Besides, the company need to cope with the fact that this customer segment is very heterogeneous. One strategy is to offer the customers a variety of price structures (Mårtensson and Frederiksen, 2006).

* Corresponding author.
E-mail address: olof.bjorkqvist@miun.se (O. Björkqvist).

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In Sweden, district heating is expanded into the new market segment of single-family houses, currently heated by oil or electricity. In this segment, there is a competition among district heating, electricity-based heating including heat-pumps, and bio-fuel, especially wood pellets boilers. The electricity price-level and structure has great influence on this market and some customers wish to buy district heating with a similar price structure as that of their electricity purchase.

The Nordic electricity market is de-regulated. All customers are free to choose their power supplier. The price is settled on the Nordic spot market "Nord Pool" where power is traded on the spot market as well as futures and forwards on the financial market. The electricity customer can buy electricity with variable or predetermined price per kWh. Normally, the variable prices is revised every 3 months. The predetermined price period can be up to 5 years (http://www.elprisguiden.se).

If a district heating supplier offers district heating with long-term predetermined prices in order to compete with similar electricity offers, the financial risk in heat-generation cost will increase compared to that of an ordinary variable price offer based on the short-run marginal cost. In contrary to an electricity seller, the district heating company cannot transfer all of the risk of predetermined price offers to the financial market; there is no district heating commodity exchange similar to, e.g. Nord Pool. The company is thrown upon its own ability to handle the risk by, e.g., hedging its own energy purchase. However, all uncertainties cannot be coped with in this manner.

Thus, there is a need for a methodology that can be used to estimate the financial risk of different price structures and to value different opportunities to reduce the risk. In this article we propose a way to handle the risk associated to new district heating price structures.

2. Case background

Sundsvall Energi AB is the district heating public utility in Sundsvall, a city with 100 000 inhabitants situated at the north coast of Sweden. In 2005, Sundsvall Energi delivered 579 GWh district heating and produced 178 GWh electricity in co-generation with district heating. The district heat production is based on refuse incineration, biofuels, industrial waste heat and oil. With a turn-over of about EUR 50 million. Sundsvall Energi is a mid-sized district heating company in Sweden.

District heating is the dominating energy source in multi-family houses and service buildings in the city centre. The market share in the one-family house sector is still rather small. However, selling to this segment is rapidly increasing and the number of customers has increased from 286 in 2003 to 538 in 2006.

Due to increased consumer prices of electricity and oil, the market for district heating in single-family houses outside the city centre of Sundsvall is expanding. In this market, district heating primarily compete with present electric heating or oil boilers and new heat-pumps in combination with electric heating or wood pellets fuelled boilers. The district heating pricing must adapt to the price structures and levels of electricity and wood pellets. Thus, district heating with fixed prices is regarded as a promising strategy in order to compete with electricity-based heating and individual boilers.

The broader time horizon, up to 3 years instead of the present 1 year contracts, is affecting the risk situation. The sensitivity regarding uncertainty in different factors is based on the discrepancy between the predicted price-level and the actual costs.

2.1. Risk factors

Risk factors are uncertain events within a process such that outcome of these events, directly or indirectly, affects the final result. The risk factors should be defined to a level such that the risk and causes are understandable and can be accurately assessed in terms of likelihood/probability and consequence to establish the level of risk. For business processes, risk factors are assessed in terms of process variance from known best practices and potential consequences of the variance.

The identification of the relevant risk factors is a crucial task. In this respect, Sundsvall Energi is exposed to a number of uncertain parameters, such as:

- electricity prices that affect the value of the produced electricity
- oil prices
- currency rates of USD and EUR
- outdoor temperature during the heating season that affects the district heat demand
- the price of emissions quotas and green electricity certificates
- energy taxation

Other uncertainties, e.g. the price of refuse fuel and industrial waste heat are fixed by long-term contracts and are hence not uncertain in the studied time period.

In this study, the first four uncertainties are regarded as crucial and are treated below, and they were measured using the following units:

- delivered volume, district heating (temperature) in GWh/yr
- oil price in USD/barrel
- dollar price in SEK/USD
- price of electricity in EUR/MWh
- Euro price in SEK/EUR

The levels and uncertainties in these factors have direct affect on the result divergence and therefore the risk premium. In this paper, the *risk premium* is defined as the increase in price needed in order to (1) yield positive gross margins in the long run, and (2) yield positive gross margins in a certain percentage of the outcomes, i.e. the risk premium should be high enough for Sundsvall Energi motivating their role as risk taker. As the uncertainty is increasing, due to the longer time period, Sundsvall Energi requests a formal method to analyse the impact of uncertainty in the risk factors and based on this analysis decide upon an adequate risk premium.

A common strategy to manage uncertainty in the business of Sundsvall Energi is by means of hedging. For example, the risk in the uncertain factors of oil price, electricity price, US-dollar price, and Euro price are reduced by hedging, but not eliminated. However, using purely financial instruments, such as, e.g., hedging is not applicable in this case, since the uncertainty of the delivered volume cannot be hedged. Instead this is what Sundsvall Energi will offer to the customers, getting the customers to pay a risk premium in order to receive a fixed price over 3 years. The question is how low this premium may be, since a low premium will attract more customers, still not exposing Sundsvall Energi of a negative result in the long run. Hence, Sundsvall Energi sees two major rationales with the new price structure: (1) attract more long-term customers, and (2) increase their revenues through the expected margin emerging form the risk premium. The objective of the risk analysis is then to obtain a reasonable level of the magnitude of this risk premium, so that it will yield a high probability of a high enough gross margin.