Energy Economics 71 (2018) 321–331

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneeco

The welfare impacts of discriminatory price tariffs☆

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ARTICLE INFO

Article history:
Received 23 May 2017
Received in revised form 26 January 2018
Accepted 9 March 2018
Available online 11 March 2018

JEL classification:
D42
D61
I31
I38
L12
L51

Keywords:
Monopoly
Asymmetric regulation
Tariffs
Welfare

ABSTRACT

This paper examines the use of asymmetric tariffs as a regulatory instrument. A monopoly setup is adopted in which the firm sells in two markets but price controls are introduced in just one. The regulator's objective is to increase consumer welfare through this price discriminatory practice, with the firm operating under a profit constraint. We consider cases where consumer welfare in the two markets is weighted both equally and unequally and also cases where the cost of supplying the two retail markets is determined in a monopsonistic input market. The results suggest that in certain situations controlling prices in only one market could be a desirable option from a welfare perspective.

1. Motivation

In the 1980s and 90s the UK energy market was subject to radical deregulation and restructuring. However, subsequent attempts to internalise environmental costs and capital market reconfiguration have led to higher prices, a focus on energy company profits and a continuing concern over affordability (Department for Business, Energy and Industrial Strategy, 2017). Questions regarding the optimal extent and nature of energy markets regulation are politically salient because of the degree of monopoly power suppliers enjoy whilst delivering a commodity considered by consumers and policy makers as a necessity (Joskow, 2005; Joskow and Tirole, 2000, 2006). The trilemma of simultaneously achieving security of supply, affordability and environmental aims poses particular problems (Ang et al., 2015).[1]

In early August Ofgem (2016), Britain's energy regulator, announced proposals to introduce a price cap in just one segment of the market. This was for households using prepayment meters, generally the most vulnerable consumers. Price caps are widely used instruments of regulation (Braeutigam and Panzar, 1993; Brown et al., 2017; Cowan, 2002; Dobbs, 2004; Parker, 1997; Simshauser, 2014) and these proposals have become part of the active debate on the operation of the UK electricity market. They have subsequently been implemented for a subset of customers (Ofgem, 2017).

The present paper models, in a stylised way, the imposition of a price tariff that covers just one segment of the whole market and uses as an example the energy market. The aim is to identify the likely welfare implications of implementing such a policy. Whilst the focus is on energy, this analysis has wider application as selective price controls are adopted in other markets to restrict monopoly power and to affect desirable distributional impacts. For example, in the UK 45% of rail fares are currently capped (Butcher, 2017), the fees charged in English Universities for undergraduate study is capped, whilst post-graduate fees are not and property companies are also often required to provide a certain proportion of dwellings at controlled (affordable) prices as part of planning permission for larger property developments. Whilst this form of symmetric price regulation is common, its practical effectiveness and accuracy in targeting policy support has been questioned (Simshauser, 2014; Simshauser and Nelson, 2014; Simshauser and Whish-Wilson, 2017).

We investigate this partial application of price controls in a model in which a monopolistic/monopsonistic firm purchases in a unified

☆ Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
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[1] In some cases energy policy also becomes an element of industrial policy. For example, the Scottish Government (2015) identifies energy as one of its growth sectors.

https://doi.org/10.1016/j.eneco.2018.03.011
0140-9883/

wholesale market and sells in two retail markets. We focus on the outcomes when one of the retail markets operates under price controls, whereas the other faces no regulation. A key constraint is that the firm bears an obligation to meet the market demand in the controlled market, meaning that quantity rationing is not experienced in that market.[2] By implementing this asymmetric price control, the regulator effectively imposes price discrimination in the energy retail market which results in indirect income redistribution, facilitated by cross-subsidisation between the markets. The analysis proceeds using both algebraic and, more especially, geometric methods.

An important element of the model is that the two markets are not only served by the one firm but they are also potentially interconnected through their input prices. This is because the output sold to each retail market is supplied using an input purchased in a common wholesale market. Where the wholesale price is an increasing function of output, the two retail markets are interrelated, in that higher levels of activity in one increase costs for the other. Whilst the model uses linear demand and cost functions, it has generality in that it does not otherwise impose specific, or restricted sets of, parameter values.

In this asymmetric regulatory approach, the tariff is only introduced in one segment of the market. But if differential prices are appropriate, then imposing differential tariffs would seem the optimal solution.[3] However, we are arguing that constraints on the operation of the regulator could make the imposition of price controls in only part of the market a more realistic and sensible option. First, the government might want to retain unrestrained market activity in part of the market for practical or ideological reasons. Second, the government might not have enough political capital to introduce differential tariffs in all sections of the market, especially if this involves explicit cross-subsidisation. These restrictions could constrain the regulator either to impose equal treatment in all sections of the market or introduce regulation in only one section. The welfare implications of these two options are compared in this paper.

The paper presents results which are generally favourable to the imposition of such tariffs. However, it is important to sound a note of caution. To begin, for analytical clarity the model we adopt is extremely stripped down and sparse. We therefore do not deal with the practical problems of introducing, implementing and monitoring the policy (Brown et al., 2017). For example, it is important to be able to separate the markets in an efficient manner, plus there is the question of whether subsidising fuel use is the most effective way of dealing with the difficulties faced by low income households (Felder, 2010; Simshauser and Nelson, 2014). There is a risk of producing a new batch of fuel poor household not captured and gifted with first round benefits. Also energy policy attempts to achieve a number of goals and in the UK is accompanied by extensive legislation and regulation. In this paper we focus solely on the potential interaction between two issues: the control of market power and affordability. We implicitly treat the instruments to achieve other goals of energy policy, and also other elements of government policy in general, as constraints.

Further we do not deal with issues surrounding imperfect information and strategic interaction. In regulating utilities in general, and energy markets in particular, the impact that the decisions of the regulated firms has on the market depends on the regulatory setup and on the way in which the market responds to price incentives (Hviid and Waddams Price, 2012; Waddams Price, 2005). This has implications for actual or potential competition. For example, there has been extensive discussion of the difficulty involved in determining the appropriate treatment of third degree price discrimination in the regulation literature (Armstrong, 2008; Stole, 2007). In the UK this applies particularly to attempts to eliminate geographic price discrimination (Hviid and Waddams Price, 2012).[4] Kennedy (1994) and Ulph (1996) address the strategic effects of environmental regulation in a different context to the present paper and for the regulation of the UK energy market in general, the work of Littlechild (2014, 2016, 2017) is particularly relevant.

Section 2 outlines the basic model. As in the rest of the paper, this consists of a monopolist/monopsonist that purchases electricity in the unified wholesale market and sells in two identical retail sectors. In the basic case separate tariffs in the two retail markets are introduced. Section 3 describes the construction of the iso-welfare and iso-profit functions. Section 4 analyses the welfare-maximizing operation of tariffs under the most straightforward conditions. This is where we impose a zero profit constraint, constant wholesale prices and equal welfare weights between retail markets. Section 5 introduces differential welfare weights. Section 6 extends the analysis to investigate the impact of restricting the intervention to imposing a tariff in only one of the retail markets. Section 7 shows the effect of introducing a positive profit constraint. In Section 8 the assumption of a constant wholesale price is relaxed and Section 9 is a short conclusion.

2. The basic model

We begin by establishing notation and a number of simplifying assumptions. This will allow the construction in Section 3 of iso-profit and iso-welfare functions, which link combinations of tariffs in markets 1 and 2 to given levels of total profit and consumer welfare respectively. These prove to be effective devices for analyzing the options for the regulator.

A monopoly electricity supplier faces two identical retail markets, each characterized by a linear inverse demand function:

$$p_i = a - bq_i \qquad i = 1, 2 \tag{1}$$

where p_i and q_i are the prices and quantities in market i, and a and b are parameters which take positive values that do not vary across the two markets.[5] The value taken by the parameter a is the maximum price that the monopolist can charge in either market and have non-negative sales in that market. Therefore in all the analysis the tariff is never set above a.[6] The parameter b is the (negative) slope of the inverse demand curve. The firm's total cost, C_T, is made up of a fixed cost, Γ, and the cost of purchasing electricity in the wholesale market, in which it acts as a monopsonist. The wholesale price of electricity, p_W, is again assumed to be a linear function of total electricity supply, q_T. This implies:

$$C_T = \Gamma + p_W q_T \tag{2}$$

where

$$p_W = c + dq_T \tag{3}$$

and

$$q_T = \sum_i q_i = q_1 + q_2 \tag{4}$$

Again c and d are parameters which take non-negative values; c is the minimum price in the wholesale market that would generate a non-negative supply and d is the slope of the wholesale electricity supply curve. Therefore where d is zero, there is a constant wholesale price

[2] The requirement that the firm must meet demand at the tariff means that the regulator effectively simultaneously sets both price and the output level in any market in which a tariff is set.

[3] The welfare and competition arguments concerning the control of 3rd degree price discrimination are outlined in Armstrong (2008) and Stole (2007). Under certain circumstances allowing 3rd degree profit maximizing price discrimination can be welfare enhancing. However, the discussion here involves a slightly different situation where the regulator is imposing a specific form of price control.

[4] We plan to do work in the future explicitly on the impact of price controls on new entry.

[5] The basic equations for an analysis where the demand parameters for individual retail markets vary are given in Appendix B.

[6] Of course, the politically-feasible maximum price cap is likely to be lower.