# Consumer welfare and the strategic choice of price cap and leverage ratio

Sudipto Sarkar[*]

*DSB 302, McMaster University, Hamilton, ON L8S 4M4, Canada*

## ARTICLE INFO

## ABSTRACT

It is still an open question whether (or when) price regulation leaves consumers better off, with some papers claiming that regulation increases consumer welfare and others claiming just the opposite. We examine this issue using a contingent-claim model that explicitly considers long-run consumer welfare under uncertainty, incorporates indirect effects of regulation via corporate investment decisions and strategic behavior of corporations in their leverage decisions, and considers the possibility that the regulator safeguards not just consumer interests but also corporate interests. The main conclusion is that regulation can increase or reduce consumer welfare, depending on the circumstances. Paradoxically, having a more consumer-friendly regulator might actually result in a lower level of consumer welfare. Comparative static analysis helps identify situations when regulation is more likely to increase consumer welfare (e.g., high price sensitivity of demand, low demand growth, or low demand volatility). This analysis is helpful when trying to decide if regulation would be desirable for a particular industry or market.

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## 1. Introduction

The objective of this paper is to investigate whether consumer welfare is increased by price-cap regulation. This is an important issue because of the recent trend toward deregulation and also because the main reason for regulation (at least in principle) is to safeguard consumer interests (Baldwin, Cave, & Lodge, 2012; Viscusi, Vernon, & Harrington, 2000). Despite the substantial literature on price regulation, there is no consensus on whether consumers benefit from it (see Section 2).

Clearly, the direct effect of a price cap is to raise consumer welfare, because consumer surplus is increased by a price cap. On the other hand, a price cap will have a negative effect on corporate investment, which will reduce long-run consumer welfare by restricting supply. The combined effect is therefore not clear; if the "investment" effect is quantitatively more (less) important than the "consumer surplus" effect, then regulation will reduce (increase) consumer welfare. Further complicating the issue are a couple of points: (i) companies behave strategically in their capital structure decisions, by increasing leverage ratio in order to pressurize regulators to set higher price limit (Bortolotti, Cambini, Rondi, & Spiegel, 2007; Cambini & Spiegel, 2011; Dasgupta & Nanda, 1993), which

will have a negative effect on consumer welfare; and (ii) regulators tend to balance the interests of consumers and corporations, and the relative importance of consumer and corporate interests varies widely (Baldwin et al., 2012; Dasgupta & Nanda, 1993; Florio, 2013; Spiegel & Spulber, 1994; Veljanovski, 2010a, 2010b).

This paper examines the effect of price-cap regulation on consumer welfare, using a real-option model that incorporates all the above-mentioned features. The direct effect of regulation is captured by using a contingent-claim measure of consumer welfare derived from the consumer surplus stream (as in Sarkar, 2015); this measure is appropriate because it takes into account uncertainty, possibility of bankruptcy, and capacity constraints. The regulator's predisposition is incorporated by assuming he/she maximizes a weighted combination of consumer welfare and company welfare, where the weights depend on how pro-consumer the regulator is. The investment effect is incorporated by allowing the firm to choose the investment size and timing optimally, in a "lumpy capacity" model as in Bar-Ilan and Strange (1999). Finally, the strategic interaction between regulator and firm is incorporated by allowing them to simultaneously choose, respectively, the price limit and the leverage ratio (taking into account the other party's response); and the resulting Nash equilibrium is explicitly identified in the model.

Our main result is that price-cap regulation may increase or decrease consumer welfare, depending on the economic variables. Hence there is no guarantee that consumers will be better off under

regulation. An important determinant of the above effect is how strongly pro-consumer the regulator is. It is shown that, as the regulator becomes more consumer-friendly, consumer welfare initially falls and then rises; thus, paradoxically, consumers might actually be worse off with a more consumer-friendly regulator. We also identify the conditions under which a price cap is more likely to make consumers worse off (e.g., when company has less market power, demand growth is higher and more volatile, interest rate is lower). Finally, we show that, in spite of the higher leverage ratio under price-cap regulation, bankruptcy risk is actually lower, contrary to the prevailing wisdom.

The paper is organized as follows. Section 2 provides a brief literature review, Section 3 introduces the model, and Section 4 values the company's securities and identifies the optimal debt level. Section 5 derives an appropriate measure of long-run consumer welfare, Section 6 identifies the Nash-equilibrium price cap and debt level, and Section 7 identifies the optimal plant capacity. Section 8 presents and discusses the results, and Section 9 summarizes and concludes.

## 2. Background and literature review

There is a substantial literature on various aspects of the price regulation of monopolies. For a brief general summary, please refer to the books by Baldwin, Cave, & Lodge (2010), Baldwin et al. (2012), Florio (2013), Laffont and Tirole (1993), and Viscusi et al. (2000) and the various papers cited therein.

When there is a monopoly in any industry, the public interest is not served. In such cases, the government can encourage competition between firms to improve consumers' well-being. However, in a "natural monopoly" (when the industry has increasing returns to scale, so that the average production cost is a decreasing function of output level) competition is socially costly, and there is a conflict between production efficiency and allocative efficiency (Viscusi et al., 2000). In such situations, the usual solution is for the government to regulate output prices. In the case of a privately held monopoly (e.g., electricity or telecommunication firm) the price-control regulation generally strikes a balance between consumer interests and investor interests. Regulators attempt to protect consumers from exploitative pricing and at the same time ensure that investors have the incentive to invest in and maintain production facilities. The relative importance placed on consumer versus producer interests varies across jurisdictions and regulators (Dasgupta & Nanda, 1993; Evans, Levine, & Trillas, 2008; Florio, 2013).

The traditional approach to price regulation has been rate-of-return (ROR) regulation. However, because of its drawbacks (e.g., it provides no incentives for firms to increase production efficiency), ROR has largely been replaced by "price-cap regulation," first popularized in the UK as a way to regulate newly privatized utility and telecommunication firms (Chen, 2005; De Fraja & Stones, 2004; Littlechild, 1983; Roques & Savva, 2009). For instance, in US utility regulation, in 1983 all states used ROR regulation whereas by 2007 only 8% of the states used ROR, the rest using price-cap regulation (Hauge & Sappington, 2010). Given its predominance in today's regulatory landscape, this paper focuses on price-cap regulation.

It is widely recognized that price regulation will affect investment and capital structure decisions of firms (Hauge & Sappington, 2010), which in turn will affect consumer welfare. A number of studies have investigated the effect of regulation on corporate investment decisions (Dixit, 1991; Dobbs, 2004; Roques & Savva, 2009) and the resulting effect on consumer welfare (Dobbs, 2011; Evans et al., 2008). But these studies are limited to unlevered firms, hence they ignore the important role played by firm leverage in the regulatory process. The process of regulation is often viewed as a bargaining game between regulator and firm, where the former

uses price cap and the latter uses leverage ratio to bargain (Cambini & Spiegel, 2011; Dasgupta & Nanda, 1993).

A few papers have examined the interaction of regulator's price-cap decision and firm's leverage decision (Bortolotti et al., 2007; Cambini & Spiegel, 2011; Dasgupta & Nanda, 1993). However, there is not much work on the joint effect of corporate investment and leverage decisions and their interaction with the regulator's price-cap decision, and how this interaction affects consumer welfare in equilibrium. Dasgupta and Nanda (1993) and Spiegel and Spulber (1994) examine the interaction of leverage and price regulation decisions, but both papers model the interaction sequentially (rather than simultaneously); that is, the firm first makes its investment and leverage decisions, after which the regulator makes the price decision. Their argument for the sequential decision-making is that the regulator has more flexibility in setting the price than the firm has in its capacity and leverage decisions, hence it is more difficult for the firm to change its production capacity and leverage ratio than for the regulator to change the price.

While it is true that it is much more difficult to change the capacity decision than the price or cap (hence our model also treats the capacity choice as a one-shot decision), it is also true that the firm's leverage ratio can be revised fairly easily. Therefore, when the regulator takes the price decision, he/she cannot treat the firm's leverage ratio as a fixed parameter; in fact, the regulator will have to consider the possibility that firm might subsequently adjust the leverage ratio. Therefore, both regulator and firm must take into account the other party's incentives and responses. To incorporate this reality, we allow these decisions to be made simultaneously rather than sequentially, and identify the resulting Nash equilibrium. A contribution of our paper is to explicitly incorporate strategic or game-theoretic interactions between firm and regulator, and the resulting Nash-equilibrium outcome. Although it is recognized that such game-theoretic behavior or "gaming the system" is commonplace in practice (Veljanovski, 2010b), this aspect was neglected in the earlier literature which examined unlevered firms, and also in the papers by Dasgupta and Nanda (1993) and Spiegel and Spulber (1994) which looked at sequential equilibrium.

There are other key differences between these two papers and ours. First, both these papers consider ROR regulation (hence regulator sets price, not price-cap), whereas our model examines price-cap regulation. Second, both papers look at fixed-capacity investment where capacity or size is not a choice variable. Inasmuch as consumer welfare is strongly affected by output level (hence capacity), capacity choice is an important variable; hence, in our model, the firm is allowed to choose the investment capacity optimally. Three, both papers are essentially single-period models, hence their objective function consists of consumer surplus and firm profit, whereas ours is an infinite-horizon model where the regulator's objective function consists of consumer *welfare* and firm *value* instead. Finally, unlike these two papers, our model includes corporate taxation, which is of first-order importance in leverage decisions; this is relevant because regulated companies use leverage strategically to induce the regulator to raise the price cap.

Despite the substantial literature on price regulation, there is no unanimity on whether consumers benefit from regulation. Armstrong and Vickers (1991) show that regulation increases consumer welfare with a single product, and Kang, Weisman, and Zhang (2000) show the same for multiple products (under certain standard conditions). Cowan (1997) and Law (1995) show that a low enough price cap can result in aggregate consumer welfare being lower than the unregulated level, in a multi-market model with differing marginal costs; this is caused by pricing distortions resulting from variation in the marginal cost across markets. Matsushima (2008) shows that, with a two-market firm (one market regulated, the other unregulated), a price cap might reduce aggregate consumer welfare by distorting the company's location