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## Price caps with capacity precommitment<sup>☆</sup>



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### ABSTRACT

We examine the effectiveness of price caps to regulate imperfectly competitive markets in which the demand is uncertain. To that effect, we study a monopoly that makes irreversible capacity investments ex-ante, and then chooses its output up to capacity upon observing the realization of demand. We show that the optimal price cap must trade off the incentives for capacity investment and capacity withholding, and is above the unit cost of capacity. Moreover, while a price cap provides incentives for capacity investment and mitigates market power, it cannot eliminate inefficiencies. Capacity payments provide a useful complementary instrument.

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## 1. Introduction

Since Littlechild (1983)'s report, price cap regulation is regarded as an effective instrument to mitigate market power, foster cost minimization, and ultimately enhance surplus: When precise information about cost and demand is available, the introduction

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of a binding price cap raises firms' marginal revenue near the equilibrium output and leads to an increase of the equilibrium output and surplus, and to a decrease of the market price. Moreover, under broad regularity conditions on the demand and cost functions, for any price cap above marginal cost both output and surplus decrease, and the market price increases with the price cap. Further, in the most favorable conditions (e.g., when firms produce the good with constant returns to scale), a price cap equal to marginal cost is able to eliminate inefficiencies. (In contrast, rate-of-return regulation, used for most of the 20th century to regulate public utilities, distorts incentives for cost minimization – see, e.g., [Joskow, 1972](#) – or cost reduction – see, e.g., [Cabral and Riordan, 1989](#).)

We study the effectiveness of price cap regulation under demand uncertainty and capacity precommitment and withholding. Demand uncertainty may be interpreted also as variations of demand over time – see [Green and Newbery \(1992\)](#) for a discussion of this interpretation in electricity markets. Capacity withholding is common in markets such as sport events, hotel accommodation, agricultural products, or electricity. In markets for agricultural products, farmer associations sometimes destroy part of the output. In electricity markets firms may declare some of their generators to be unavailable – data for the California electricity market during the time period May 2000–December 2001 show that at the price cap some generators did not supply all of their uncommitted capacity – see [Cramton \(2003\)](#) and [Joskow and Kahn \(2002\)](#).

It is easy to show that in the absence of capacity precommitment, e.g., when the good can be produced instantly upon the realization of demand or there is slack capacity, the effectiveness of price caps and their comparative static properties with respect to the expected output, expected price, and expected surplus remain the same as when the demand is deterministic. The only effect of uncertainty is smoothing the non-differentiability at the lowest non-binding price cap arising when the demand is deterministic. In particular, a price cap equal to marginal cost maximizes the expected surplus. The intuition of these results is analogous to that of the deterministic demand case – see [Lemus and Moreno \(2015\)](#). The analysis of this case is relevant for, e.g., the Spanish or California electricity markets, in which firms have excess capacity (at least in recent times), and their bids are short lived (firms compete to serve the demand for only hourly or half hourly periods). Of course, price cap regulation has an impact on firms' capacity investments, which are long run decisions made prior to the realization of demand. Thus, endogenizing firms' capacity investment decisions seems a natural next step to take.

In order to tackle this issue, we consider a setting in which a monopoly makes irreversible capacity investments *ex-ante*, and then chooses its output up to capacity upon observing the realization of demand. Thus, the monopoly may withhold capacity if it is beneficial to do so. In this setting, inefficiencies arise both because the monopoly installs a low level of capacity in order to precommit to high prices, and because the monopoly withholds capacity for low demand realizations in order to keep prices from falling too much.

Focusing on the monopolistic case allows us to avoid some potential conundrums that arise in oligopolistic settings, which are distractions from the issue under scrutiny – the

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