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Consignment auctions

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ABSTRACT

This article investigates pollution permit consignment auctions. In this process firms obtain an initial endowment of permits that must be consigned to the auctioneer for sale. In the auction, firms bid for permits, obtain their equilibrium permit allocations, and receive revenue from their consigned permits. It has been proposed that this auction is politically attractive and generates clear price discovery. We provide the first theoretical analysis of this kind of auction. We show, in most cases, the auction does not provide a clear price signal. Our results have policy implications for many permit markets, including the California Cap-and-Trade Program.

Introduction

Pollution markets are now a popular policy tool to regulate emissions. In these markets the regulator creates a fixed number of pollution permits that can be traded among firms: the process of permit exchange allows the pollution target to be met at the lowest possible cost. Although these markets are now prevalent in the regulatory landscape, a perpetual and controversial debate exists over how these permits are initially endowed to firms (e.g., Goulder et al., 1999; Cramton and Kerr, 2002; Goulder and Parry, 2008). Two broad approaches have been used: (i) free allocation of permits—also known as 'grandfathering'—and (ii) auctioning of permits. The free allocation of permits—usually based on a firm's historical emissions or output—has been advocated as a politically feasible approach to control pollution: firms generally prefer this process as they obtain rents and potential windfall profits. For auctioned permits, the main justifications include the ability to generate revenue as well as the establishment of a clear price signal that will enhance the functioning of the market. As these schemes have distinct relative merits, attention has focused on designing mechanisms that can incorporate the benefits of both approaches. One such mechanism is the so-called *consignment auction*.

A consignment auction combines aspects of free allocation and auctioning into one mechanism. In the first step, permits are initially endowed to firms based on a free allocation rule (such as endowments based on historical emissions). Firms must then consign their initial permit endowments to the auctioneer, who will sell the permits in a forthcoming auction. In the second step, firms submit their demand schedules and the clearing price is determined; firms pay the clearing price for their equilibrium allocation of permits and obtain revenue from their consigned permits sold at auction. Thus all auction revenue is diverted to the holders of the initial permit endowments. This novel initial allocation process has therefore been regarded as being both politically appealing and successful in generating clear price discovery (i.e., convergence of the auction clearing price towards the Walrasian equilibrium) (Hahn and Noll, 1982; Hahn, 1988; Burtraw et al., 2010, 2016; Burtraw and McCormack, 2017). Although the *prima facie* benefits of consignment auctions appear to be substantial, there is,

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however, limited theoretical understanding of this process. Importantly, it is currently unclear how a consignment auction influences firms' bidding behavior and the associated equilibrium of the auction.

In this article we formally investigate the multi-unit uniform-price consignment auction and provide firms' bidding strategies as well as the equilibrium clearing price. In our model, we show that each firm has an incentive to submit a demand equal to their initial permit endowment. Firms are therefore neither net buyers nor net sellers within the auction process and their payoffs are independent of the clearing price: the consignment auction does not induce price discovery and the clearing price may be higher than in a standard uniform-price auction. This framework, then, showcases the underlying incentives for firms to bid in the auction as well as identifying the potential irrelevance of the clearing price in firms' equilibrium payoffs.

We develop our framework to first, compare the consignment auction to a standard uniform-price auction and second, to provide the possibility of proportional consignment. We show that prices in a consignment auction are (weakly) higher than the Pareto dominant clearing price of the standard uniform-price auction. Also we generalize our model to include a proportional consignment auction, where only a proportion of the total permits are initially endowed (and then consigned) to the auction. For a proportional consignment auction, we provide a model where, at the limits, our framework converges to either a full consignment auction or a standard uniform-price auction. In the proportional consignment auction, we continue to observe firms' demand schedules being dependent on their initial endowment but now the Pareto dominant clearing price is equal to the reserve price (similar to a standard uniform-price auction).

To investigate permit consignment auctions, we extend the literature on multi-unit uniform-price auctions by allowing firms to obtain auction revenue from their initial endowments. Uniform-price auctions have been extensively investigated (e.g., Wilson, 1979; Back and Zender, 1993; Wang and Zender, 2002; Ausubel et al., 2014). It is well known in the literature of multi-unit uniform-price auctions that bidders have incentives to shade their bids when they have more than one unit demand: so-called demand reduction. As there is a uniform price in the auction, each firm knows that their bids could affect the clearing price they pay for *all* units. Therefore by shading their bids they can reduce the auction clearing price and increase their payoffs. Back and Zender (1993) show, as a result of demand reduction, that an equilibrium clearing price equal to the reserve price could become the Pareto dominant outcome for bidders. This is, in fact, bad news for the auctioneer since their expected revenue is no better than a case where all units are sold via a posted price equal to the reserve price. Although uniform-price auctions have been extended and analyzed in a variety of formats, there has been no analysis of a uniform-price auction with an initial consignment of goods. We denote this as a consignment auction and provide the first theoretical analysis.[1] As such, our framework corresponds to any sale of multi-unit goods, where the auctioneer directs the auction revenue to initially endowed bidders.

The origin of a permit consignment auction can be found within a discussion by Hahn and Noll (1982), where many of the potential benefits were proposed.[2] First, consignment auctions may facilitate the functioning of the market by requiring all permit holders to consign their permits to the auction; thus, there cannot be any permit 'hoarding' effects. Second, the process can increase transparency and fairness as all initial endowments, and the outcome of the auction, are common knowledge. Indeed, a regulator can take equity considerations into account by adjusting firms' initial permit endowments. Third, by requiring full consignment, there is the potential benefit of early and clear price discovery that can improve the process of the permit market. Importantly, this has been justified as a significant benefit of this process from the outset: "[t]he auction also guarantees that a quick price signal will emerge" (Hahn, 1988, p.47). More recently this argumentation has continued in relation to the recent US Clear Power Plan, where Burtraw et al., (2016, p.51) suggest that "consignment sales ensure that freely allocated allowances enter the market, they help facilitate liquidity and early price discovery". Although there exists many potential benefits of this novel auction format, we show in this article that an auction that consigns all permits may not provide a clear price signal: firms' payoffs are independent of the auction clearing price.

The consignment auction is the main permit allocation mechanism within the California (Quebec) Cap-and-Trade Program, which has an annual auction revenue of over $3.8 bn (CARB, 2016; Borenstein et al., 2015).[3] Although permits are initially endowed to all Californian utilities, consignment rules differ depending of whether operators are either Investor Owned Utilities (IOUs) or Publicly Owned Utilities (POUs). Investor Owned Utilities have to consign all their endowments whereas Publicly Owned Utilities are allowed to retain a proportion of permits from consignment (they must be transferred into a compliance account). Over time the California auction has developed from a pure consignment auction to a proportional consignment auction, where a proportion of auctioned permits have not been endowed to firms. As we show in

[1] Although no theoretical analysis has been undertaken on consignment auctions, there are a limited number of experiments that test aspects of the consignment auction (Franciosi et al., 1993; Güler et al., 1994; Ledyard and Szakaly-Moore, 1994; Dormady and Healy, 2015). A large literature is also associated with double auctions, yet these auctions are distinct from what we consider here. In a double auction, firms can sell permits within the auction by placing an offer of permits. Normally, their choice to offer permits for sale (and their ask price) is decided by the firm and not a requirement of the regulatory process (as is the case within a consignment auction). A key distinction between a double auction and a consignment auction—and the driving force behind the peculiarities associated with a consignment auction—is that firms in the consignment auction are obligated to consign their initial permit endowment and receive the clearing price per permit.

[2] This has also been referred to as a 'revenue-neutral' or 'zero-revenue' auction.

[3] Consignment sales have been a small proportion of the initial endowment process within the US Acid Rain Program (approximately 2.8% of the total annual allocation of permits) (Joskow et al., 1998; Ellerman et al., 2000). Note that the auction system is a double auction, where firms can voluntarily offer permits for sale within the auction; thus, the incentive structures are distinct from a consignment auction (Cason, 1993, 1995).