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Primary auction of slots at European airports

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ABSTRACT

We use the Vickrey–Clarke–Groves auction mechanism to propose a system of primary auctions of slots at congested European airports. The system would ensure allocative efficiency and would be incentive-compatible, flexible, understandable, implementable and transparent. Only 10% of slots would be auctioned per year. The current slot coordination mechanism used in Europe, based on historic use of slots, would thus be phased out and disappear within a decade.

1. Introduction

The air transport industry is of crucial importance for the economy. It links both people and businesses. Worldwide, since the early 1970s air passengers have increased ten-fold and air freight has increased fourteen-fold (International Air Transport Association, IATA, 2011, p. 1). Airport capacity, however, has not kept pace with the growth in airport traffic and demand for air travel (Czerny, 2010) and as a consequence, delays at airports are very common around the world. In Europe, for example, almost 18% of all Intra-European flights leaving from major airports departed more than 15 min later than their scheduled departure time in 2009 (Eurocontrol, 2010, p. 18). Although weather is the most important and common reason for delays, the second reason is traffic exceeding airport capacity (Brueckner, 2002a, p. 1357).

One obvious solution to reduce delays at airports is to invest in new runways, but ‘the long gestation period of such projects means that the benefits lie far in the future’ (Brueckner, 2002b, p. 141). Despite the plans to increase capacity at several European airports, in order to meet projected demand growth, immediate action could be taken that would increase the efficiency of the system in the short-run.

According to basic theory of externalities (see for example, Baumol & Oates, 1988) the two main approaches to reduce the level of externality (in this case, delays) are command-and-control policies (where typically a cap on quantity is set) and incentive-based policies (where economic agents can make choices).

A slot coordination system can be seen as a command-and-control type of policy because it imposes a quantity control and in principle, trading is not allowed. It reduces congestion because it lessens the ‘clustering and randomness of arrivals and departures’ (Forsyth & Niemeier, 2008, p. 63).

Congested airports in the EU are subject to a slot coordination process. Regulation (EC) N° 793/2004 (European Parliament and Council of the European Union, 2004), which amends Council Regulation (EEC) N° 95/93 (Council of the European Communities, 1993), requires member states to appoint an independent entity in charge of slot allocation at an airport, if it experiences excess demand for slots. Thus, all airports in Europe can be classified as non-coordinated airports, schedule facilitated airports and fully coordinated airports.

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Non-coordinated airports are airports that have no excess demand and where slot coordination is not needed. Schedules-facilitated airports are airports 'where there is potential for congestion at some periods of the day, week or scheduling period' (IATA, 2005, p. 7) and where schedules are facilitated by a coordinator. Fully-coordinated airports are airports 'where … congestion is at such high level that … the demand for facilities exceeds availability during the relevant period' and 'attempts to resolve problems through voluntary schedule changes have failed' (IATA, 2005, p. 11). All airlines wishing to land or take off at such airports during the periods for which they are fully coordinated need to have a slot allocated by a coordinator.

Unsurprisingly, slot coordination is not an efficient solution from an economic point of view, as airlines that value slots at peak times and would be prepared to pay for them, are not necessarily given the opportunity to do so.

The process of slot allocation in the EU is described in article 8(1) of Council Regulation (EEC) N° 95/93 (Council of the European Communities, 1993). Basically, 'a slot that has been operated by an air carrier as cleared by the coordinator shall entitle that air carrier to claim the same slot in the next equivalent scheduling period', which means that airlines are typically able to keep their slots.[2] This set of rules is usually known as 'grandfather rights'.

At the same time, Article 8(4) specifies that slots can be 'freely exchanged between air carriers or transferred by an air carrier from one route, or type of service, to another, by mutual agreement or as a result of a total or partial takeover or unilaterally', as long as the exchange is agreed by the coordinator. Although money payments are not legislated, a gray market, with secondary trading and monetary exchange has developed at London Heathrow (National Economic Research Associates, NERA, 2004, p. 53).

If regulation 95/93, amended by regulation 894/2002, were amended to allow airlines to trade slots for money throughout the EU, the gray market would cease to exist and a new proper market would emerge. Indeed, although secondary trading has not been formalised yet, in April 2008 the European Commission issued a 'clarification' of the Slot Regulation (Commission of the European Communities, 2008), which endorsed the UK model of slot trading. Furthermore, in November 2012 a draft European Parliament Legislative Resolution was approved to allow market-based mechanisms in slot trading and a strengthened slot allocation process (European Parliament, 2012; Library of the European Parliament, 2012).

Slot trading, as proposed, would be a natural transition from slot coordination, and would increase economic efficiency in the sense that the slots would go to those airlines that value them the most. A step further yet, would be to auction slots in the first place. The slots at schedule facilitated and slot coordinated airports, currently allocated on the basis of historic use, commonly known as 'grandfather rights', could be initially auctioned. Needless to say, airlines will typically oppose the idea of auctioning (Sentance, 2003). Clearly, auctioning would improve allocation efficiency and would ensure that slots were used more effectively (Button, 2008, p. 292).

Auctioning has a number of advantages over grandfathering: it reduces barriers to entry, increases regulation stringency, prevents the possibility of wind-fall profits, and generates revenues that can be recycled for environmental purposes and/or airport expansion/improvements, amongst other uses.

In this paper we propose the Vickrey–Clarke–Groves auction mechanism for slot allocation at European airports. It is important that any mechanism for primary auctions is efficient from an economic point of view and from the airlines' point of view. Using the Vickrey–Clarke–Groves mechanism for primary auction would ensure so.

2. Description of the auction mechanism

The aim here is to develop an auction mechanism to allocate slots that will satisfy certain constraints.

First, we want the auction mechanism to be allocatively efficient, i.e. to maximise the value of the allocation, and to be incentive-compatible. A mechanism is incentive-compatible if it is structured such that each bidder finds in its interest to report his valuation honestly. We also want the auction mechanism to be flexible enough, so that airline carriers (especially hub carriers) can develop a strategy to schedule departures and arrivals. Finally, we want the auction mechanism to be understandable, quite easily implementable and transparent.

To allow airlines (especially the hub ones) to have a scheduling strategy, an interesting idea is to sell slots by set. That is why we chose a "generalised Vickrey–Clarke–Groves mechanism" for multiple non-identical objects, which yields efficiency. It is based on the auction mechanism developed by Vickrey (1961) for one good, and then extended by Clarke (1971) and Groves (1973) for multiple goods. The mechanism that we use is a light and adapted version of the generalisation of the Vickrey–Clarke–Groves (VCG) mechanism developed by Dasgupta and Maskin (2000) and by Ausubel and Milgrom (2002, 2005). Basically, the result of such an auction will be a partition of the set of the auctioned goods across bidders, which maximises the income of the seller.

One idea developed by NERA (2004) would be to auction only 10% of slots per year, all slots being allocated in a rolling programme of ten-yearly auctions. To this 10% of slots all the slots in the pool[3] would be added, which should not be significant if secondary trading was allowed too. But even if only 10% of slots were auctioned every year, given the quantity of slots involved, which at some airports can be 1500 per day, for practical reasons we propose to split the day in different periods and to have as many auctions as periods. The periods must be neither too short (so that carriers can cluster departures and arrivals if they wish to), nor too long (so that the number of combinations is small enough to allow airline carriers to evaluate almost all the combinations of slots and to solve the maximisation program of the auction within a reasonable time). Therefore, we propose to split the day in periods of 1 hour at peak times and of 2 hour at off-peak times. This would of course need to be thought out and defined more accurately by and for each airport.

In the following paragraphs, we present the model we will use to describe the bidders (the airline carriers) and the set of goods (the slots). Then we present the program that the seller (the airport) will solve, the prices that the bidders will pay to get their set of goods, and finally, the efficiency properties of that auction mechanism.

[2] The exception to that is detailed in article 10(3), which specifies that the airline will not be entitled to keep those slots unless it can demonstrate that they have been operated for at least 80% of the time during the period for which they were allocated.

[3] The pool contains the slots that were not requested by (allocated to) any carrier, plus all the slots that were returned by carriers, plus all new slots, plus the slots that were not used and were therefore lost by carriers.