REVIEWING THE FINANCIAL TERMS OF CHANNEL 3 LICENCES: ESTIMATING INCUMBENTS' BIDS

A paper written on behalf of ITV plc by

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He is the author of more than 77 published papers and 11 books. His research areas are evolutionary game theory, auction theory, bargaining theory, experimental economics, political philosophy, mathematics and statistics. He is a Fellow of the Econometric Society and British Academy and was awarded the CBE in the New Years Honours List 2001 largely for his role in designing the UK 3G Spectrum Auction.

Professor Binmore has worked with Market Analysis on a number of consulting projects, including the Competition Commission's inquiry into the proposed takeover of Manchester United by BSkyB, the Airtours merger case before the European Commission and the Office of Fair Trading's Competition Act investigation into BSkyB.

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His academic research focuses on electricity auctions, the markets for sports rights and the analysis of contracts in the pay-TV market. He has recently published articles in the *Economic Journal*, the *International Review of Law and Economics*, the *European Competition Law Review* and the *Electricity Journal*.

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1. Introduction

The current Channel 3 licenses were originally awarded under a procedure specified in the 1990 Broadcasting Act. Sections 15 to 17 of 1990 Act required applicants to submit written cash bids for each licence and, subject to certain conditions being met, the licence was awarded to the applicant submitting the highest bid.[1] The Act therefore effectively specifies that the licences be sold in a first-price, sealed-bid auction.

Section 20 of the 1990 Act specified that in considering an application for renewal of a licence, the amount payable would be the amount which, in the opinion of the ITC, would be payable to them "if they were granting a fresh licence" under the procedure specified above. The ITC interpreted this requirement as an obligation to determine a 'cash bid equivalent', being 'the sum which it considered would be bid if the licence were put out to public tender'.

The ITC approach to determining the level of the 'cash bid equivalent' was to estimate the discounted revenues and costs associated with exploiting a licence over its contractual lifetime to derive a net present value (NPV) for each licence. The NPV was taken as equivalent to the 'surplus value' of the licence after providing a return on capital as reflected in the discount rate used in the valuation. The ITC equated the 'surplus value' of a licence to the incumbent licence holder with the cash bid that would be required to win the licence in a first–price, sealed-bid auction as specified in the 1990 Act.[2]

The ITC recognised that certain incumbent Channel 3 license holders would face lower per licence costs due to the economies of scale and scope achieved from holding a number of licences in "common ownership." However, the ITC accepted that "Channel 3 licence renewal is a process which applies to each licence taken separately, irrespective of whether two or more licences are in common ownership."[3] Its methodology, therefore, effectively ignored these economies of scale and scope by allowing the benefits of common ownership to be "added back" into the costs of each licence, thus reducing the estimated NPV values and accordingly the level of the licence payments.

Under the Communications Act 2003, in reviewing the financial terms for Channel 3 licences, Ofcom is now required to determine the amount which, in its opinion, would have been the cash bid of the licence holder in a competitive tender were the licence being granted afresh. Ofcom originally proposed to adopt the ITC's approach, i.e. to use a discounted cash flow model to establish a "surplus value" for each licence, and to equate this value with the incumbent's winning cash bid.[4] In order to reflect the amounts that existing licence holders would be willing to bid for their licences, Ofcom departed from the ITC's approach by proposing that the benefits of common ownership should be included in the incumbent licence holder's valuation, and hence in its estimated cash bid.

In a first-price, sealed-bid auction, however, no bidder ever submits a cash bid equal to its own valuation (NPV), since to do so would guarantee a payoff of zero. All bidders will rationally 'shade' their bids below their own valuations according to their predictions of the

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1 Where two or more applicants submitted identical bids, a subsequent round could potentially be initiated in which each remaining applicant submitted a single cash bid, and so on.

2 This NPV or surplus value was then recovered from the licensee via licence payments, with 75% recovered from PQR payments and 25% from annual fixed payments.

3 "Channel 3 Licence Renewal: Methodology and Procedure," ITC, July 1998

4 Ofcom, January 2004 "Consultation on Reviews of Financial Terms for Channel 3 Licences."

behaviour of rival bidders. Determining the expected valuation of the bidders in an auction is only a first step in estimating the likely value of the winning, or the incumbent's, bid.

Ofcom now appears to have recognised that it is illegitimate to assume that the incumbent's cash bid in a 1991-type licence auction can be represented by the NPV of the licence, and has accepted that the incumbent's bid in such an auction will be less than his valuation.[5] This means that Ofcom has now set itself the task of estimating the expected bid of the incumbent in a hypothetical licence auction, and not merely the incumbent's 'surplus value', or willingness to pay.

Under the Communications Act, Ofcom's obligation is to determine the amount of *the cash bid of the licence holder*. This evidently differs from the obligation of the ITC under the 1990 Act which was to determine the level of the *winning cash bid*. Clearly, in any hypothetical auction or competitive tendering process there must be some chance that the incumbent license holder will not win the auction, and hence that his bid would not be the winning bid.[6] In this case, Ofcom is required to determine the bid of the incumbent licence holder, rather than that of the winning bidder.

However, Ofcom's January 2004 "Consultation on Reviews of Financial Terms for Channel 3 Licences" states that,

> "Ofcom is required to set financial terms according to the amount it believes the licence holder would bid in order *to win* its licence in a competitive tender."

Similarly, in its 29 June Consultation document, Ofcom states:

> "Ofcom believes that it must assume in its valuation that the incumbent licence holder would win the auction, and therefore would be the highest bidder."

Thus Ofcom is interpreting its mandate to be to calculate the winning cash bid in the hypothetical licence auction, as opposed to the incumbent's cash bid, by assuming that the incumbent will always submit the winning bid.

Ofcom's current proposal is that the incumbent's winning bid can be assumed to be not less than the valuation of the second-highest bidder in the hypothetical auction, where this valuation differs from the incumbent's valuation by an amount equal to the assumed fixed costs of market entry.[7] Moreover, Ofcom further departs from the ITC and now considers that *all* bidders' valuations (and not just the incumbent's), should include the benefits from holding a number of licenses in common ownership.

Ofcom has reached these conclusions by making a number of questionable assumptions:

(i) If it were to hold a licence auction today, Ofcom would offer as many licences as possible simultaneously and would allow "contingent" bids for multiple licences, i.e. Ofcom would hold a particular type of "combinatorial auction" for multiple licences rather than independent auctions for each individual licence.

(ii) That there would be competing bidders for all of the licences, that competing television companies would have the highest valuations, and that

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5 Ofcom, 29 June 2004 Consultation Document, para 10.

6 If the incumbent licence holder was guaranteed to win, it is difficult to explain why any competitors would enter the auction in the first place. See further below.

7 Marketing costs and other fixed costs related to entering the market.

these competitors would bid for multiple licences so their valuations would reflect the value of the licences held in combination, and hence include the economies of scope achieved via common ownership.

(iii) That the incumbent bidder would exhibit *an extreme form of risk aversion* because its existing business model is dependent on holding broadcasting licences, and therefore would bid an amount which would *guarantee* that it won the licences in each auction.

(iv) That lack of information by the incumbent concerning the identities and valuations of competing bidders would add to the incumbent's uncertainty and reinforce the incumbent's need to bid an amount which exceeded the expected valuation of any competing bidder.

Because of these assumptions, Ofcom believes that the incumbent bidder would bid its own valuation less the assumed value of the costs of market entry, and this "would be a conservative estimate of the incumbent's winning bid given that it would not reflect any assumption that the incumbent would increase its bid above this value in order to reduce further the risk of losing the licence."

Ofcom's new proposal for determining the value of the incumbent's cash bid, however, is as untenable as its original proposal to equate the incumbent's bid with his own valuation, and falls far short of qualifying as a reasonable prediction of the value of either the incumbent's or the winning cash bid in a hypothetical licence auction. There are a number of reasons for this:

(i) The 1990 Broadcasting Act specified that each licence be sold in a first-price, sealed-bid auction in which the licence is awarded to the highest bidder. Ofcom's proposal to hold a combinatorial auction, in which bids for one or more licences can be made contingent upon winning a number of other licences, cannot be guaranteed to satisfy this constraint. That is, in order to award the licences to the bidder who is willing to pay the most for them in combination, it may be necessary to award individual licences to a bidder who did not submit the highest bid for that licence. This evidently conflicts with the requirements of the 1990 Act.[8]

(ii) If, as a consequence of (i), Ofcom *cannot* hold a combinatorial auction of the type it proposes, then licences will have to be sold independently, and the difference between the entrants' and the incumbent's valuations will reflect not only the market entry costs, but also the benefits of common ownership which are only available to the incumbent. In these circumstances, where the asymmetry between the incumbent's and entrants' valuations is large, assuming the incumbent would bid the highest valuation of any entrant is an overestimate of the incumbent's winning bid in almost all realistic cases.[9] Nevertheless, it is a more reasonable supposition in the presence of large cost asymmetries than in the combinatorial auction setting, since the profit for the incumbent from winning at this price remains large.

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8 In fact, as we shall show below, with contingent bids it may be impossible to award licences to the highest bidder in each individual auction.

9 In particular because entry by competing bidders is less likely the more certain it is that the incumbent will win the auction.

(iii) If Ofcom *could* hold contingent-bidding auctions of the type it proposes, there is no foundation at all for the assumption that the incumbent would submit a cash bid equal to its estimate of the highest entrants' valuation. In these circumstances, the asymmetry between the incumbent's and the entrants' valuations is small, making it much more costly for the incumbent to bid an amount which guarantees it will win the auction. Auction theory predicts that the incumbent will bid much less than this, possibly considerably less than half his own valuation. Consequently, Ofcom's assumption that the incumbent will always win the auction by submitting a very high bid is untenable.

(iv) Ofcom's assumption of extreme risk aversion on the part of the incumbent is also both unrealistic and untenable. Standard theories of risk aversion would indicate that, if anything, the incumbent should be assumed to be *less* risk averse than any potential entrant, and that risk aversion would have less effect on the incumbent's valuation (and hence bids) than entrants'. Any risks associated with the licences' cost and revenue streams should first be reflected in the risk-adjusted cost of capital used in estimating licence valuations. Since entrant's face greater uncertainty about these streams than incumbents, entrants' valuations will be correspondingly lower, thus belying Ofcom's assumption that entrants' valuations differ only by the amount of the market entry costs. Making arbitrary assumptions concerning extreme and unrealistic forms of bidding behaviour by the incumbent is an inadequate approach to modelling the effects of risk aversion in this context.

(v) Ofcom's assumption that the incumbent will bid so as to win the auction with certainty in any event undermines its own assumption that there will be competing bidders in the auction. If the costs of preparing a bid and entering the auction are nonnegligible, as they surely must be,[10] and potential competitors assume (as Ofcom does) that the incumbent will win the auction, they will not be willing to incur the costs of competing. Given this, the incumbent will be able to secure the licences for a nominal amount.

(vi) Ofcom's proposal more generally ignores the difficulties associated with attracting entry to an auction with an incumbent bidder, particularly one with significant cost and informational advantages. Entrants will frequently not expect to profit from entering such an auction.[11] Thus an evaluation of the competitive conditions to be expected in the hypothetical auction being considered is a key component in arriving at a realistic prediction of the winning cash bid, and Ofcom has simply assumed this problem away without justification.

Ofcom's proposed solution to the problem of estimating the incumbent's (or the winning) cash bid in a licence auction is therefore arbitrary and unrealistic, and ignores the extensive auction theory literature which has accumulated over the past two decades, which should be used to inform its judgement. Indeed, Ofcom's current proposal is less realistic than the approach taken by the ITC in previous licence renewals, even though the ITC

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10 The costs of preparing a business plan, estimating valuations, securing funding and paying a non-refundable fee for each licence application.

11 In 8 out of the 16 licence auctions held in 1991, the incumbent bidders faced no competition at all (or no bidders satisfying the quality threshold), and in one auction Central acquired a licence for a nominal £2000 which was later valued at over £10 million by the ITC. See Section 3 below.

eschewed consideration of auction-theoretic issues altogether. By assuming that licences would be auctioned independently, and hence leaving out any consideration of common ownership benefits in its estimate of the winning cash bid, the ITC's simplistic approach corresponded more closely to the predictions of recent auction theory than does Ofcom's current proposal.[12]

The purpose of this paper is to suggest how a reasonable prediction of the incumbent's cash bid in a hypothetical licence auction can be arrived at based on advances in auction theory which make such predictions possible. Section 2 reviews some of the considerations that need to be taken into account in estimating the cash bids that would be made in the hypothetical tendering process envisaged in the 1990 Act. Section 3 describes what is known about combinatorial auctions, and explains why Ofcom's proposal to hold a 'contingent-bidding' auction appears to fall foul of the rules laid down in the 1990 Act. Section 4 assumes that such contingent-bidding auctions cannot be held (or assumed), and considers the likely outcomes of auctions for individual licences (auctions with large cost asymmetries). Section 5 considers the likely outcome of holding a simplified version of the combinatorial auction proposed by Ofcom (auctions with small asymmetries), assuming that such an auction could be held. Section 6 discusses the consequences of allowing for risk aversion on bidders valuations and strategies, and Section 7 concludes.

2. Determining Incumbents' Bids in Licence Auctions

Equilibrium bids in any auction are determined by the bidders' valuations, informational conditions, the degree of competition and the auction format. In the case of a hypothetical auction for the Channel 3 licences we may take it that the auction format is a first-price, sealed-bid auction as specified in the 1990 Act. We review here some of the considerations which need to be taken into account in making an estimate of either the incumbent's or the winning cash bid in the counterfactual event that such a tendering process were actually to be run in 2004. Auctions differ in a number of important dimensions, and the analysis of bidding strategies in any particular auction depends upon a number of crucial distinctions:[13]

Single object versus multi-unit or combinatorial auctions: In a single unit auction, as the name implies, only one item is up for sale. In a multi-unit combinatorial auction, bidders may acquire more than one item or unit, and submit multiple conditional bids, specifying the amount bid for each asset *conditional* on a particular set of assets being acquired.

Private versus common value auctions: In a *private value auction* each bidder knows his own valuation and this is independent of the valuations of other bidders. In a *common value auction*, the object being sold is worth the same amount to every bidder, but bidders may have only imperfect information concerning this value. *Affiliated or interdependent value auctions* are auctions which are neither independent private values nor pure common value auctions, in which bidders' valuations are positively correlated.

Auctions with perfect versus imperfect information: In an auction with *perfect information* each potential bidders' valuation is known by all other bidders, and known to be known, etc. (i.e. common knowledge). In an auction with *imperfect information* bidders

12 As we show in Section 4.

13 See Krishna (2002) or Klemperer (1999) for expositions.

only have information concerning the probability distribution of the valuations of other bidders.

Symmetric or asymmetric auctions: In a *symmetric auction* each bidder's valuation is drawn from the same joint probability distribution, i.e. bidders are *ex ante* identical, and two bidders with the same valuation have the same beliefs concerning the remaining bidders' valuations. In an *asymmetric auction* bidders have idiosyncratic characteristics, e.g. differing opportunity costs of exploiting the resource being sold. In this case, some bidders may be more likely to have a high or a low valuation than other bidders.

The number of potential rival bidders: In practically any auction, equilibrium bidding behaviour will be effected by the number of rival bidders faced by the incumbent bidder. If there are positive costs associated with preparing and submitting a tender ('auction entry costs'), persuading potential competitors to participate in the auction process may be a key difficulty.

Bidder risk aversion: When bidders have private information they will be uncertain of winning the auction at any particular price. This uncertainty plays an important role in determination of the equilibrium bids if bidders are risk averse.

Determining the equilibrium outcome in any putative 2004 licence auction requires a clear understanding of the type of auction being held with respect to each of the above factors. In particular this is required to calculate the valuations of every potential or 'virtual' bidder, and to determine, via an extensive simulation exercise or some other suitable form of analysis, the equilibrium bids. Needless to say, this is major undertaking, subject to a great deal of room for error. In undertaking such an exercise, a number of important modelling issues would need to be addressed.

It might be argued, for example, that incumbent advantages built up by licence-holders since 1990 should be left out of any such calculation on the grounds that they would not be available to bidders were the licences genuinely being granted 'afresh'. Ofcom does not take this view, since it plans to calculate the valuations of current licence-holders on the basis of the incumbent advantages current in 2004 (i.e. the benefits from common ownership). Moreover, Ofcom appears to accept that the fixed costs of entry into the market ensure that a licence is more valuable to its current holder than to any potential rival. Therefore, in either the auction for individual licences envisaged by the ITC or the 'contingent-bidding' auction being contemplated by Ofcom, incumbent bidders may be assumed to have a higher valuation (but not necessarily to submit a higher bid), than any rival bidder.

This asymmetry in valuations creates a difficulty in assessing the likely competitiveness of a licence auction that mirrors similar difficulties that arose in auctioning 3G telecom licences in the UK,[14] and which has already arisen in previous Channel 3 licence auctions. No one but an incumbent is likely to be willing to expend the resources necessary to prepare a tender if any new entrant to the market is extremely unlikely to win the auction. If an incumbent bidder can be sure of facing no competition for a licence, he will be able win the auction for a nominal amount. While this entry problem is alleviated by using a first-price, sealed-bid auction, this is only because it creates the possibility that the incumbent *may not win the auction*, and hence the incumbent's bid and the winning bid will not be identical, as Ofcom assumes.

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14 See Binmore and Klemperer (2000) for a discussion.

Even in first-price, sealed-bid auctions, however, the entry problem can remain severe. This was starkly illustrated in the 1991 Channel 3 licence auctions. Table 4 below summarises the outcome of the auctions for each of the 16 regional and national Channel 3 licence-holders.

Bidding by incumbent licence holders in the 1991 licence auction	
Incumbent	*Comments*
Border	No rival bids
Scottish	No rival bids
Central	No rival bids
Channel	No rival bidder meeting quality threshold
LWT	No rival bidder meeting quality threshold
Grampian	No rival bidder meeting quality threshold
Granada	No rival bidder meeting quality threshold
Ulster	No rival bidder meeting quality threshold / not overbidding
Thames	Incumbent outbid by new bidder satisfying quality threshold
TV-AM	Incumbent outbid by new bidder satisfying quality threshold
TVS	Incumbent ruled out for overbidding
TSW	Incumbent ruled out for overbidding
HTV	Incumbent outbid new bidder satisfying quality threshold
Anglia	Incumbent outbid new bidder satisfying quality threshold
Yorkshire	Incumbent outbid new bidder satisfying quality threshold
Tyne Tees	Incumbent outbid new bidder satisfying quality threshold

In 8 out of 16 licences, the incumbent either faced no rival bidders at all or no bidders meeting both the quality threshold and demonstrating an ability to maintain the licence throughout the licence period. In each case, the absence of effective competition meant that the incumbent would have retained the licence however low their cash bid. In several of these cases, the incumbent posted a nominal bid or a bid well below the level of rival bidders. Central, for example, bid £2,000 compared to a cash bid of over £10 million (together with a higher PQR rate) set seven years later by the ITC for the same licence.

A second set of issues concerns the information bidders in the hypothetical auction will have about their own and rival bidders' valuations. Informational conditions (i.e. 'who knows what about whom') matter enormously in auctions. In an auction with perfect information the outcome of the bidding process can usually be fairly easily predicted (although this is not necessarily the case for combinatorial auctions: see Section 3), but this in turn means that the problem of entry can be particularly acute, since bidders will know in advance whether they will win or lose the auction. The analysis of auctions with imperfect information, and possibly bidder asymmetries, is much more complex as we shall see below, making predictions less robust. Nevertheless, if Ofcom is to fulfil its remit of estimating the incumbent licence-holder's bid in a hypothetical licence auction, the only choices available are to design and undertake an extensive simulation exercise, or to employ the best predictions that recent auction theory makes available.

In the sections which follow we consider what auction theory would predict if either the licences were to be sold individually, as under the ITC approach (Section 4), or in a

contingent-bidding, combinatorial auction of type envisaged by Ofcom (Section 5). In Section 3 we first consider some of the difficulties inherent in Ofcom's proposal to hold a combinatorial auction. As we shall see, even if we assume that Ofcom is able to run a pure combinatorial auction, and thus avoid the difficulties identified in Section 3, its own predictions of the likely outcomes in such an auction differ significantly from those derived from the available auction theory.

3. Combinatorial Auctions

In a fully fledged combinatorial auction for the sale of complementary assets, bidders are allowed to submit multiple conditional bids. Such bids will specify the amount bid for each asset *conditional* on a particular set of assets being acquired by the bidder. For example, a bidder might offer £2 for object 1 alone and £3 for object 2 alone, but £3 for object 1 and £4 for object 2 conditional on both objects 1 and 2 being acquired.

In a first-price, sealed-bid version of a combinatorial auction - which is the auction being contemplated by Ofcom - each bidder seals a set of conditional bids into an envelope, which is then submitted to the auctioneer independently of the sealed bids of any rival bidders. The auctioneer then assigns the licences by assembling whatever feasible collection of conditional bids maximizes the total selling price for the whole collection of objects. Each bidder pays the total amount he bid for any of his conditional bids that form part of the auctioneer's revenue-maximizing collection of bids.

The theory of optimal bidding in such combinatorial auctions is still in its infancy, and has only been worked out for the case of perfect information. As leading auction theorist and designer Paul Milgrom points out, 'just determining the identity of the winning bidder – *the winner determination problem* – is a hard computational problem,' which, 'makes it hard for bidders in a [combinatorial] auction to forecast the consequences of their bids.'[15] Another problem is the multiplicity of Nash equilibria that such auctions engender, many of which may be inefficient (i.e. fail to allocate the objects to the bidders who value them most).[16] A further barrier to progress is that, in real-life situations, bidders are likely to have different views on how to evaluate different combinations of the objects being sold, and their beliefs about the valuations of the other bidders are unlikely to be very sharp.[17]

Thus predicting equilibrium outcomes and bids in a fully-fledged combinatorial licence auction is probably beyond the limits of current auction theory. Even if we assume perfect information (which we must to apply the developed theory), the equilibrium outcomes may be inefficient (i.e. the incumbent bidder loses, despite having the highest valuation) or may allow the incumbent to obtain the licences for a price well below his valuation. The problems with the contingent-bidding auctions being proposed by Ofcom, however, may be worse still.

In the hypothetical procedure envisaged by Ofcom for auctioning ITV plc's licences, 11 simultaneous, first-price, sealed-bid auctions would be held in which the bids in any auction could be made contingent upon winning one or more licences in other auctions.[18]

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15 Milgrom (2004), Chapter 8.

16 See Bernheim and Whinston (1986). Bernheim and Winston also point out a coordination problem that may arise in a first-price combinatorial auction, which allows an advantaged, or incumbent, bidder to win the auction for a mere fraction of his valuation.

17 To say nothing of their beliefs about these beliefs, and so on.

18 Ofcom does not specify if bidders would be permitted to submit an entire 'menu' of bids for different combinations of licences, including 'stand-alone' bids for single licences, in its hypothetical auctions,

However, choosing the revenue-maximising outcome in a combinatorial auction does not necessarily entail each individual object (i.e. licence) being sold to the highest bidder, as would appear to be required by the procedure specified in the 1990 Act. Given this, it is not clear that Ofcom is in a position to hold (or assume) a hypothetical combinatorial auction.

To see this, suppose there are just two licences for sale, Licence A and Licence B. Bidder 1's preferences are such that he is willing to bid £4 for Licence A, £0 for Licence B and £4 for both licences (i.e. Bidder 1does not value holding the licences in combination). Bidder 2, on the other hand, is willing to bid £1 for each licence individually and £6 for both licences in combination. Given these preferences, efficiency requires allocating both licences to Bidder 2. Doing so will not necessarily result in the first licence being sold to the highest bidder, however, if Bidder 1 simply bids his valuations and Bidder 2 bids £3 for each licence conditional upon winning the other, say. If Ofcom were forced to sell each licence to the highest bidder, it would then award Licence A to Bidder 1 for £4 and Licence B to Bidder 2 for £1, i.e. on the basis of the unconditional bids alone. This allocation fails to maximise the auctioneer's revenues, and involves accepting bids which do not include any common ownership benefits. Hence Ofcom's assumption of a contingent-bidding or combinatorial auction would not appear to provide a blanket justification for including these benefits in its estimate of the incumbent's (or winning) bids. [19]

Many similar examples can be constructed in which the structure of bidders' preferences (and bids) forces the auctioneer to allocate the licences on the basis of the unconditional bids alone. The problems with Ofcom's proposed combinatorial auction are more severe than this, however, and do not depend upon assuming a particular pattern of asymmetries in the bidders' valuations.

Even in the case of common values, it can still be in a bidder's interest to arrange his contingent bids in a manner which allows him to win one or more licences with positive probability, despite the fact that it is common knowledge that another bidder has a higher overall willingness to pay for the licences in combination. To see this refer to Tables 1 and 2 below.

Table 1

Bids/Bidder	**Licence A**	**Licence B**	**Licences A&B**
Incumbent	2	2	
Incumbent*	4	4	8
Entrant	1	1	
Entrant*	3	3	6

* Conditional bids for two licences

In Table 1, the Incumbent bidder is willing to bid £2 for each licence individually and £8 for both licences. The Entrant bidder is assumed to suffer a cost disadvantage (i.e. must pay a market entry cost), so is willing to bid only £1 for each licence individually and £6 for

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or only a single bid as may be required under the 1990 Broadcasting Act. Consequently, we consider both possibilities below.

[19] One could object to the above example by supposing that Bidder 2 would allocate his conditional bids so as win both licences, i.e. by making his conditional bids £5 and £1 for example. But this is to assume that Bidder 2 knows Bidder 1's preferences, which is illegitimate. For all Bidder 2 knows, Bidder 1 may have the opposite preferences, which implies his conditional bids should be £1 and £5 to ensure winning both licences.

both licences. Thus both bidders achieve an economy of scope worth £4 for common ownership of both licences, but the Entrant incurs a £1 entry cost for acquiring each licence.

If, as in Table 1, the Incumbent and Entrant submit conditional bids of £4 and £3 respectively for each licence conditional upon winning both licences, then the incumbent will win both licences for a price of £8. This allocation is efficient and also maximises the auctioneer's revenues, given the bids.

The Entrant, however, could predict that he will lose the auction with these bids, and thus have no incentive to enter the auction in the first place, if there is any small cost associated with preparing a tender. But the Entrant can do better than this. Given the auction rules, the Entrant can strategically reallocate his contingent bids to win a licence he would not have otherwise obtained. In Table 2 the Entrant's conditional bids are £5 for Licence A and £1 for Licence B, with his unconditional bids unchanged. If the rules of the auction are that each licence must be awarded to the highest bidder, then Licence A must be awarded to the Entrant and Licence B to the Incumbent. But since each is only awarded a single licence, each will only pay their unconditional bid for the licences awarded, i.e. the Entrant will pay £1 for Licence A and the Incumbent £2 for Licence B. This allocation is both inefficient and fails to maximise the auctioneer's revenues. Further, the bids paid do not reflect any benefits from common ownership.[20]

Table 2

Bids/Bidder	**Licence A**	**Licence B**	**Licences A&B**
Incumbent	2	2	
Incumbent*	4	4	8
Entrant 2	1	1	
Entrant*	5	1	6

* Conditional bids for two licences

In fact it is not at all clear how the auction rules would or should allocate the licences between the bidders in this example, under the procedure proposed by Ofcom. No consistent set of rules would appear to allow Ofcom to choose the bids which maximise total revenue without violating the condition that each licence must be awarded to the highest individual bid. That is, a combinatorial, or contingent bidding, auction as envisaged by Ofcom would appear to be inconsistent with the rules as specified in the 1990 Act. As we have seen, this inconsistency does not solely arise when bidders' preferences are assumed to be asymmetric. Rather, disadvantaged (i.e. entrant) bidders have an incentive to manipulate their bids in order to exploit the inconsistency in the rules to win a licence when they otherwise would not have.

Finally, it is worth noting that the problems with the contingent-bidding auction become even worse if bidders can only submit a single bid for each licence: either a contingent or a noncontingent bid, but not both. In these circumstances, as illustrated in

[20] Again, it is not a valid objection to this example to posit that the Incumbent would rearrange his conditional bids so as to win both licences. For any such rearrangement by the Incumbent, the Entrant can rearrange his bids to ensure that he is allocated one licence. In fact there would not appear to be a pure strategy equilibrium in this example. In any mixed strategy equilibrium, the resulting allocation will be inefficient with positive probability, i.e. in which one licence is awarded to the Entrant and both bidders will pay their stand-alone bids.

Table 3, it may be impossible to decide how to allocate the licences on the basis of the bids for each individual licence. Accepting the highest bid for one licence may always entail accepting the lowest bid for the second licence.

Table 3

Bids/Bidder	Licence A	Licence B	Licences A&B
Incumbent*	2	6	8
Entrant*	5	1	6

* Conditional bids for two licences

These considerations cast considerable doubt both on the assumed efficiency of Ofcom's hypothetical contingent-bidding auction, and on Ofcom's ability to hold such a hypothetical auction in the first place, given the constraints placed on it by the 1990 Act. Consequently, in the sections which follow we consider what auction theory would predict if the licences were auctioned independently, as they were in 1991, or if they were sold in a simplified version of a combinatorial auction which assumes that the constraints imposed on Ofcom by the 1990 Act do not apply.

4. Determining Bids in Auctions for Single Licences

If we assume that the Channel 3 licences were to be auctioned individually, because of the difficulties in implementing a contingent-bidding auction identified in Section 3, then the incumbent's and entrants' valuations would differ by the amount of the benefits of common ownership plus any fixed costs of market entry. Each licence auction would therefore be an auction with *large cost asymmetries* between the incumbent and any rival bidders.

Auction theory has now advanced to a sufficient extent that one could attempt to employ a model of Vickrey [1961] as developed by Maskin and Riley [2000] to predict the likely outcome of such hypothetical licence auctions. Quantifying the answers that such a model would yield, however, involves making many assumptions about market conditions, informational conditions and the like. We therefore restrict attention here to three very simple cases which serve to illustrate the range of likely outcomes.

In each example we suppose that several bidders participate in a first-price, sealed-bid auction, i.e. an incumbent and a number of entrants. The incumbent's valuation for a licence is assumed to exceed those of the entrants' due to incumbency advantages, such as having lower costs of exploiting a licence because of its common ownership of a number of licences. We consider first the extreme case in which the valuations of all the bidders are common knowledge, i.e. an auction with perfect information.

Case 1: In an individual licence auction with perfect information, the incumbent will always win the auction by bidding (and therefore paying) negligibly more than the second-highest valuation of any rival bidder. This bidding strategy guarantees winning the auction at the lowest equilibrium price. It cannot be rational for the incumbent to submit a higher bid, since it is never rational for rival bidders to bid more than their valuations. If it were rational for the incumbent to bid less than the second-highest valuation of any bidder, its nearest rival would predict this behaviour and make a profit by winning with a bid of one

penny more. A lower bid would thus induce the bidder with the second-highest valuation to bid his valuation, and hence win the auction.[21] In this example, the valuation of the licence-holder is irrelevant once it is known that it exceeds the valuations of all the entrants. The winning bid of the incumbent is determined entirely by the (lower) valuations of its rivals.

Although the outcome in this example appears to correspond to the outcome hypothesised by Ofcom for the licence auction, note that the second-highest valuation here will not include any common ownership benefits, and more importantly that it is predicated on bidders having perfect information concerning their rivals' valuations.[22] The assumption of perfect information means that that if the potential rival bidders have to pay any small positive cost to participate in the auction, they will choose not to enter, because no entrant stands any chance winning the auction in this scenario.

It follows that the incumbent must face some uncertainty about the valuations of potential entrants before entry becomes rational. Only then is it possible that the incumbent might underestimate the strength of an entrant, and so bid low enough to allow a new entrant a chance of winning. The probability of this event may be small, but only a small probability of an entrant winning is necessary to justify entry if the costs of participating are also small.

Case 2: Accordingly we now consider an auction with imperfect information, however we initially assume that each potential bidder is equally likely to have the highest valuation, i.e. there are no *ex ante* cost asymmetries. Each bidder's valuation assumed to be independently and identically distributed on the unit interval, and we assume that bidders are risk neutral. In this standard textbook example, equilibrium bidding strategies are given by the formula:[23]

$$B(v) = \left(\frac{N-1}{N}\right)v$$

where v is the bidder's valuation, $B(v)$ his bid and there are N bidders. Hence it is optimal for each bidder to shade his bid downwards by a factor that depends on the total number of bidders. In particular, if there are only two bidders, the optimal bid will be half the bidder's full valuation; if there are three bidders, it will be two thirds of the bidder's valuation, and so on. It is never true that a rational bidder will bid his full valuation.

The actual selling price of a licence depends on what the bidders' valuations turn out to be, but we can calculate in advance the expected or average selling price. This is exactly the same as the price the auctioneer would get on average if the licence were always sold at whatever the valuation of the second-highest bidder turns out to be (see Krishna, 2000).

In this example, the expected value of the second-highest valuation is 1/3 when there are two bidders, ½ when there are three bidders, and so on. The expected value of the incumbent's bid, on the other hand, is ¼ with two bidders, 1/3 with 3 bidders, etc. Thus the incumbent's expected bid will be less than the expected value of the winning bid for any value of N.

When valuations are no longer independent or uniformly distributed, it will no longer be true that a bid will be half a bidder's valuation when there are two bidders. Hence even

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21 This argument simply outlines the familiar principle behind Bertrand competition. See von der Fehr and Harbord (1993), Proposition 1, for an exposition in a very similar context.

22 Something explicitly ruled out by Ofcom.

23 See, for instance, Krishna (2000), p.19.

in a situation in which the incumbent enjoys no cost advantages, it is necessary to assess the state of the market to determine by how much a bidder will shade his bid down from his full valuation.

Case 3: Finally, we consider a case in which bidders are both asymmetric and have imperfect information concerning each others' valuations. In particular, following Maskin and Riley (2000), Example 1, we assume that the entrant's valuation is uniformly distributed on the unit interval [0,1] while the incumbent's valuation is distributed on the interval [2,3]. That is the incumbent's distribution is shifted to the right reflecting a significant cost advantage over any new entrant. The (essentially) unique equilibrium in this case in a first-price, sealed-bid auction, is for the entrant to bid his valuation and for the incumbent to bid 1, i.e. the highest possible valuation of the entrant. This is because the item being sold is worth so much more to the incumbent than to the entrant that it pays the incumbent to be sure that he will win. [24]

This example is perhaps most representative of an auction for a single Channel 3 licence in that there is both some degree of imperfect information and the incumbent's cost advantage is large, so he is strongly motivated to bid in a manner that ensures that he will win in equilibrium.[25] As in Case 1 above, however, the incumbent's bid does not depend upon his own valuation but upon the distribution of the entrant's valuation, and the incumbent never pays more than the highest possible entrant's valuation. Another similarity with Case 1 is that the existence of positive entry costs would mean that no rival bidders would choose to enter the auction, so the incumbent could expect to pay only a nominal sum for the licence. [26]

In each of the above examples, the licence is sold to the highest bidder at a price equal to the expected value of the second-highest valuation of any bidder, assuming that entry occurs. In practically all relevant circumstances this is the most the auctioneer could expect to achieve in an auction for single Channel 3 licence, and there are reasons for believing that even this is an overestimate of the winning bid in a hypothetical licence auction.

We have already mentioned auction entry costs,[27] but another significant factor is informational. Each of the cases discussed assumed that bidder's valuations were either common knowledge or known with certainty to each bidder (i.e. private values). The value of a licence to any bidder, however, is more likely to be subject to some degree of uncertainty (e.g. concerning future cost and revenue flows), and to contain a significant common component. In this case bidders will face the 'winner's curse' and have a further incentive to shade their bids downwards to avoid winning the auction at a price exceeding the licence value. For well-known reasons, the winner's curse problem is particularly acute in first-price, sealed-bid auctions as compared with second-price or ascending (i.e. English) auctions.[28]

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24 A similar case is analysed by Frutos and Jarque (2002).

25 However, the example assumes private values whereas it is more likely to be the case that an auction for licences would be characterised by common or affiliated values. See further below.

26 Another interesting feature of the example is that the equilibrium does not depend on how many entrants there are with valuations in the interval [0,1]. For any number of rival bidders it remains the incumbent's best strategy to bid 1.

27 Note the distinction between the costs of entering, or participating in, the auction and the fixed costs of entering the market. The former effect entry decisions but not valuations or bids.

28 C.f. Krishna (2002), Chapter 6. Also of potential relevance here is the work of Klemperer et. al. on auctions with 'almost common values', in which a small cost or other type of asymmetry between an incumbent bidder and new entrants can have dramatic effects on bidders' entry decisions, bids, and

It can therefore be argued with some justification that the second-highest valuation of any bidder *in an individual licence auction* (i.e. auctions in which entrant's valuations do not include any common ownership benefits) places an upper bound on the amount that we would expect the auctioneer to achieve in such an auction (i.e. the winning bid). Our estimate of the incumbent's equilibrium bid can obviously not exceed this, and in a number of cases it would be smaller still.

5. Determining Bids in Combinatorial Auctions for Multiple Licences

Assuming that Ofcom *could* hold a combinatorial auction for Channel 3 licences (i.e. that it could overcome the difficulties associated with such auctions identified in Section 3), we can then assume, following Ofcom, that the incumbent's and entrants' valuations will differ only by the amount of the fixed costs of market entry. Each licence auction would therefore be an auction with *small cost asymmetries* between the incumbent and rival bidders.

As noted in Section 3, full-fledged combinatorial auctions are very complex and extremely difficult to analyse, so for the purposes of discussing the *hypothetical* auction being contemplated we will simplify some of the issues. If we assume that each extra licence acquired increases the valuation for any licence yet to be auctioned, we would expect the winning assemblage of bids in a combinatorial auction to consist of a single conditional bid, in which the winner offers a cash sum for all of the licences on offer. In other words, we can treat the auction *as if* it were a first-price, sealed-bid auction of a single object: i.e. the package of all eleven licences treated as a unit. The remainder of this section assumes that this is the case, even though such an approach may be in conflict with the relevant legislation.[29]

Following Ofcom, we also assume that an entrant who wins the licences would face fixed costs of market entry which the incumbent has already sunk. The existence of such fixed costs ensures that incumbent's valuation of the licence package would necessarily exceed the valuation of the hypothetical entrant by a small amount, and this fact would be common knowledge between the bidders.

5.1. Information and Equilibrium Bids

As discussed above, informational conditions - 'who knows what about whom' – are crucial determinants in predicting the outcome of any particular auction. At one extreme, in an auction with *perfect information,* the valuations of both the hypothetical entrant and the incumbent are common knowledge. Under these informational conditions the incumbent's winning bid would be equal to the entrant's valuation, if we assume that entry occurs. However, if the hypothetical entrant incurs a non-negligible cost in entering the auction (e.g. by preparing a business case to justify bidding for the package of licences), then he will not enter the auction at all, since it is known in advance that the incumbent will win the

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hence the auction outcome. Fortunately, in this case the problems are alleviated by holding a first-price, sealed-bid auction. See Klemperer (1999) and Binmore and Harbord (2000) for discussions.

[29] That is we are assuming that Ofcom could hold a pure combinatorial or package auction, with no requirement to sell each individual licence to the highest bid in each of a number of auctions. Predicting outcomes in Ofcom's proposed 'contingent-bidding' auctions is much more difficult, as discussed in Section 3.

auction with probability one. The package of licences will then go to the incumbent for a nominal amount.[30]

This entry problem can be overcome with a first-price, sealed-bid auction provided there is sufficient uncertainty in the mind of the incumbent concerning the entrant's valuation. If the entrant believes that his valuation is higher than the incumbent expects, then a relatively small entry cost can be outweighed by the probability that the incumbent will bid too low in order to win the package of licences at a low price.

Even in this case, however, the entry problem can be severe. Suppose, for example, that the entrant's valuation is drawn from the interval [0,1] and that the entrant plays a pure strategy such that if his valuation is v he bids $b(v)$.[31] If the entrant enters the auction whenever his valuation v exceeds some number x, then given entry the incumbent will always choose a bid greater than $b(x)$, as otherwise he will lose the auction with certainty. Given this, for any level of the auction entry cost, an 'x – value' entrant will not enter. But this means – by backwards induction – that no entrant with $b(x) < V$ (where V is the incumbent's valuation) will enter the auction. Hence there will be no entry and, as in the perfect information case, the incumbent will win the auction for a nominal sum.

Vickrey's [1961] analysis, as extended by Maskin and Riley [2000], can again be used to further illustrate these points. To allow for entry to occur, we will now assume that the entrant first pays the auction entry cost and *then* learns where in some previously known interval his valuation lies (i.e. receives an informative signal). The incumbent knows only that the entrant's valuation is equally likely to take any value in this interval.

Case 4: In Vickrey's model, the incumbent's valuation is commonly known to exceed the maximum possible valuation for the entrant. The incumbent can therefore be sure of winning by bidding slightly more than the entrant's maximum valuation, but he will make much more on average by bidding *less* than this maximum. The small chance of losing is outweighed by the fact that the incumbent will pay less when he wins.

In equilibrium the incumbent cannot simply to choose a particular bid from the interval from which the entrant's valuation is drawn, however. If he did so, the entrant would adapt his strategy to his prediction of this choice. Entrants with a higher valuation than the incumbent's predicted bid would bid one penny more than their prediction, while entrants with lower valuations would not bother to compete. The incumbent must therefore use a mixed strategy in which he *randomizes* his bid using probabilities that are positive in the range of possible values of the entrant's valuation interval.

In this case, one would therefore have to estimate the incumbent's bid as an average taken over the set of the possible valuations of the hypothetical entrant, using the mixed strategy probability distribution if this could be explicitly calculated. Eliciting entry makes it *necessary* that a probability distribution with a sufficiently large variance be used if there is to be an auction at all, since otherwise the rival bidder will not enter. Predicting a cash bid for the incumbent (or a winning bid) entails a precise estimate of the range of this distribution.

Case 5: We now consider a case in which the incumbent's valuation is drawn from an interval of the form [0, 1/(1-z)] and the entrant's valuation is drawn from an interval [0,

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30 It is not clear that the 1990 Act allowed for the setting of a reserve price. However, Ofcom's ability to commit itself to a reserve price in the hypothetical auction is in any event, extremely limited. It would require that Ofcom commit itself to *not selling* the Channel 3 licences if no bid exceeded the reserve price, something which would no doubt be viewed as intolerable. It therefore seems reasonable to assume that any reserve price set would be extremely low.

31 $b(v)$ will be an increasing function of v.

1/(1+z)], with z≥0. That is, the incumbent has the same distribution as the entrant only "stretched out" to the right over a wider interval (see Maskin and Riley, 2000, Example 2).[32] It can then be shown that the incumbent's and entrant's equilibrium inverse bid functions are given by,

$$B^{-1}{}_I(B) = \frac{2B_I}{[1 - z(2B_I)^2]}$$

$$B^{-1}{}_E(B) = \frac{2B_E}{[1 + z(2B_E)^2]}$$

where B_I and V_I are the incumbent's bid and valuation respectively, and B_E and V_E those of the entrant. The incumbent's bid is less, and the entrant's bid is greater, than they would be in the corresponding symmetric auction with valuations drawn uniformly from [0,1], for any z > 0 (see Section 3, Case 2). That is, the incumbent bids *less* than half his valuation and the entrant *more* than half his valuation. Although in this case both the incumbent's and entrant's valuations include the common ownership benefits, $V_I/2$ is the highest bid ever made by the incumbent (which occurs when z=0, so there are no cost asymmetries). Hence $V_I/2$ provides an upper bound for our estimate of the incumbent's cash bid in this case.

5.2. The Winner's Curse

Maskin and Riley's analysis assumes that the incumbent's and entrant's valuations are independently distributed (i.e. a private values auction), and as noted in Section 4, this assumption is not very realistic in the context of a hypothetical auction for Channel 3 licences. Although it is true that an entrant would be unlikely to know the incumbent's valuation with any certainty, there is likely to be a large 'common value' component in the incumbent's and entrant's valuations. In particular, the entrant would be likely to change his own valuation if he were to learn the incumbent's valuation, while the incumbent would be unlikely to change his own valuation in response to learning the entrant's valuation. Hence, the independence assumption is not realistic in this context.

This observation takes our problem beyond the reach of most current auction theory. However, one general principle that applies in these cases is the 'winner's curse' problem. As noted above, this implies that the entrant should condition the probabilities he assigns to each possible valuation of the licences on the event that he wins the auction at the price he intends to bid. This will result in the entrant *lowering* his bid. Although the winner's curse may not apply directly to the incumbent (since he is better informed than the entrant about the value of the licences), it will have the indirect effect of reducing his bid also, since the predicted competition will be less fierce.

By how much the incumbent lowers his bid depends on what is assumed about the relationship between the incumbent's and the entrant's valuations. If we suppose that the valuation of the entrant is equal to the valuation of the incumbent less the entrant's fixed costs of market entry, it is then natural to assume that only the entrant knows his fixed cost, and only the incumbent knows the future profit stream from operating the licences.[33] The

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32 Note the contrast with Case 3 above, where the incumbent's valuation was assumed to exceed the entrant's possible valuation to such an extent that the incumbent would always bid so as to win the auction. However, that example was predicated on the idea the incumbent alone would include the benefits of common ownership in his valuation, and is no longer appropriate in the combinatorial auction with small cost asymmetries now being considered.

33 That is, entrant's will only have estimates of this value.

entrant would then assign some probability distribution to the profit stream obtained from owning the licences, and the incumbent would assign some probability distribution to the entrant's fixed cost. To use standard techniques we need to assume that these distributions are common knowledge. The equilibrium outcome will depend on what is hypothesized about these distributions, but any reasonable assumptions would result in the incumbent shading his bid down from his valuation by a very substantial margin, as the following cases demonstrate.

Case 6: The case in which the fixed costs of the entrant are zero, so the entrant suffers from no cost disadvantage, has been studied by Engelbrecht-Wiggans et al [1983] (see Krishna, 2002, 119-121 for an exposition). In this case it is the entrant who must now play a mixed strategy, since if he played a pure strategy, b_E, the incumbent would bid just slightly above it whenever it was profitable to do so, and below it otherwise. The entrant's mixed strategy has the property that the incumbent faces the same distribution of bids that he would if he were confronting a bidder with independently distributed private values (as in Case 2 above). The equilibrium bidding strategy of the incumbent is then the same as in the symmetric two-bidder first-price auction with independently distributed private values (i.e. the incumbent would bid $V_I/2$ in the uniform case). As a consequence, the expected price in the auction is equal to the expected price in an independent private value auction with two bidders (for instance, in the uniform case it is equal to 1/3).

It is important to note that, contrary to what occurs in the independent private values model, introducing more entrants does not change the incumbent's equilibrium bid nor effect to the auctioneer's expected revenue in this auction. That is, the expected outcome is independent of the number of rival bidders the incumbent faces. A second property of the equilibrium is that the entrant makes an expected profit of zero if he enters the auction. He will therefore not enter the auction if there are auction entry costs.

Case 7: We now consider a variation of the model in Case 6 in which the entrant (or entrants) suffer from a cost disadvantage in the form of a fixed market entry cost, which we denote by *C*. In this case, the incumbent's equilibrium bid is the same as in Case 6, but reduced by an amount equal to the market entry costs. For example, in the uniform case the incumbent's equilibrium bid is equal to $V_I/2 - C$. As above, the entrant plays a mixed strategy in equilibrium. One property of the equilibrium bids is that the higher is the market entry cost *C*, the lower is the entrant's expected equilibrium bid. In the uniform example, the effect of the market entry cost on the entrants' equilibrium bids is such that, together with the change in the incumbent's bid, *the expected price decreases by more than the market entry cost.* Hence $V_I/2 - C$ provides an upper bound for our estimate of the incumbent's cash bid in this case.[34]

5.3. Increasing the Incumbent's Uncertainty about the Entrant

In the case of large cost asymmetries between the incumbent and the entrant, an increase in the incumbent's uncertainty about the entrant's private information can lead to higher bids by the incumbent. As we have seen (in Case 3 above), with large cost asymmetries the incumbent may find it profitable to submit a bid that guarantees he will the win auction against any type of potential entrant. Hence, if the incumbent's uncertainty about the entrants' private information (e.g. market entry cost) increases, the incumbent must submit a higher bid to ensure that it always exceeds any possible bid by the entrant.

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[34] Note that V_I and C are both quantities which Ofcom is proposing to estimate the values of. Hence Ofcom would be in a position to implement this solution to the hypothetical auction, unlike the previous case in which we would first need to calculate the incumbent's mixed strategy distribution.

This is not true, however, when the level of the cost asymmetry is already small. In this case, as we have noted above, the incumbent no longer finds it optimal to submit a bid sufficiently large to ensure that he outbids the entrant. With small cost asymmetries an increase in the incumbent's uncertainty may lead to a decrease in his bid, and consequently the expected auction price. This is demonstrated in our final example, Case 8.

Case 8. Campbell and Levin (2000) have studied a model similar to Case 6, in which there are no asymmetries between the insider and an entrant, but in which the incumbent knows the common value of the license, but not the entrant. They use this framework to compare two situations. In both the entrant has some imperfect information about the common value, but they differ in whether the incumbent knows what the entrant knows or not. The comparison between these two scenarios may be used to understand the effect of an increase in the incumbent's uncertainty about what the entrant knows. Campbell and Levin (2000) (Figure 1) show that the expected price in a first-price auction is lower when the incumbent does not know what the entrant knows. To understand this result, note that when the incumbent is uncertain about what the entrant knows, he is tempted to "gamble" that the entrant is" pessimistic" and hence submit a lower bid. If the entrant anticipates this, he will find it profitable to submit a lower bid also.

6. Risk Aversion

Ofcom assumes that the incumbent's behaviour in a hypothetical contingent-bidding licence auction will exhibit *an extreme form of risk aversion,* leading him to bid an amount which will *guarantee* that he wins the auction, even though this strategy may reduce the expected profits from holding the licences by a large amount. Ofcom further assumes that lack of information by the incumbent concerning the identities and valuations of competing bidders will add to the incumbent's uncertainty, and thus reinforce the incumbent's need to bid an amount which exceeded the expected valuation of any competing bidder.[35]

Because of these assumptions Ofcom believes that the incumbent can be assumed to bid its own valuation less the entrant's market entry costs, and that this "would be a conservative estimate of the incumbent's winning bid given that it would not reflect any assumption that the incumbent would increase its bid above this value in order to reduce further the risk of losing the licence."

Ofcom's assumption of extreme risk aversion on the part of the incumbent is nothing more than that, however (an assumption), and is both unrealistic and untenable. The standard assumption made in the auction literature of risk neutrality would appear to be far more appropriate in an auction in which the participants are large, well-funded businesses.[36] Further, any risks associated with the cost and revenue streams of the licences should be reflected first in the cost of capital used in estimating licence valuations, and not employed as a pretext for making arbitrary assumptions concerning extreme forms of bidding behaviour by the incumbent.

Ofcom, however, conflates two quite separate issues in its brief discussion of incumbent risk aversion, as is apparent in the following statement:

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35 See Section 5.3 immediately above for a refutation of this hypothesis.

36 In particular, because it is the risk aversion of the shareholders of the business which is of relevance, who can be assumed to hold diversified portfolios of assets.

"It seems sensible to assume that the incumbents would be relatively risk averse because their existing business models are dependent on holding the broadcasting licences."

The degree of *risk aversion* exhibited by a bidder in an auction is a property of the bidder's expected utility function, whereas what Ofcom is discussing here is the consequences for a particular bidder of winning or losing the auction. That is, Ofcom is conflating *the degree of risk aversion* exhibited by bidders with the *level of risk* they face.

Ofcom's assumption appears to be that the consequences of not winning the auction are more severe, or costly, for incumbents who already hold the licences than they are for the competing bidders who do not. This hypothesis – even if it were realistic – tells us nothing about the relative degrees of risk aversion we would expect incumbents versus competing bidders to exhibit. Rather it posits an *externality* whereby the incumbent suffers an additional cost from losing the licences not suffered by any other bidder, and which is not already captured in the incumbent's valuation of the licence.[37] In this case, the cost of losing the licences should be included in the valuation of the incumbent, since it is a cost which is saved by winning the auction. The difference between the incumbent's and entrant's valuations will then not simply be the costs of market entry, as assumed by Ofcom, but would also include this externality effect.[38]

Risk aversion would effect valuations in the opposite direction. If, as it is natural to assume, both incumbents and entrants are equally risk averse, then this should reduce the entrant's valuations for the licences more than the incumbents, since the entrants face greater uncertainty about the cost and revenue streams associated with the licences. More uncertainty means greater risk, so entrants will require a higher risk –adjusted cost of capital than incumbents, and hence have lower valuations. [39]

To summarise, Ofcom appears to assume – without providing any evidence for this - that an incumbent's cost of losing the auction will be greater than an entrant's. If this were true, then it should already be captured in the incumbents' estimated valuation for the licences, rather than effecting the incumbent's assumed degree of risk aversion. Ofcom also appears to assume that new bidders for the licences may be risk averse. This should be reflected first in the bidders' valuations, and in particular by using a higher risk-adjusted cost of capital for entrant's than for the incumbent. Both of these factors will tend to increase the gap between the incumbent's and the entrant's valuations, making it even more certain that the incumbent will win the auction. This in turn will reduce the likelihood of entry if there is any cost associated with preparing a bid, and thus make it more likely that the incumbent will win the auction at negligible cost.

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37 It is difficult to see any economic justification for such an assumption, unless Ofcom is conceding that its NPV calculation fails to capture adequately the valuation of the licence. such a concession would clearly have wider ramifications for the methodology and indeed somewhat undermine Ofcom's proposed approach.

38 If there are additional costs associated with the incumbent losing the licences, there might also be additional benefits (e.g. the ability to broadcast a schedule without channel 3's public service broadcasting constraints). Ofcom simply assumes that the additional costs of losing the licences would outweigh any such additional benefits.

39 Risk aversion also tends to increase bids in a first-price, sealed-bid auction. The effects of bidder risk aversion in common value auctions of the type we are considering here has received little attention in the literature, however. In the model studied by Holt and Sherman (2000) these two effects, i.e. lower valuations and increased bids, exactly cancel, leading to no change in the expected price.

7. Conclusion

It is in the nature of a competitive tender that the market conditions need to be assessed in order to determine who the other bidders might be, their valuations, and the probabilities with which they might make various bids. This is true no matter what the auction design (e.g. a combinatorial auction or an auction for an individual items), and regardless of whether all bidders have the same valuation (i.e. a "common value auction"); valuations differ for each bidder (a "private values auction"); or bidders' valuations are *ex ante* "asymmetric".

The participation of hypothetical rival bidders in a putative competitive tender creates a particular difficulty. There is a contradiction involved in Ofcom taking for granted that the current incumbent would necessarily submit the winning bid and the assumption that he would bid more than a nominal amount (or the auction reserve price, if there were one). If the incumbent is bound to win, rivals will not bother to compete, and an incumbent licence-holder will bid more than the minimum price required to participate in the auction.

Perhaps the most robust conclusion reached from a consideration of the relevant auction theory is that if a Channel 3 licence auction were held today, there would likely be few or no rival bidders given the incumbent's cost and informational advantages. As we have emphasised, this is particularly the case if we assume (as Ofcom does), that the incumbent will always bid so as to win such an auction. Whatever reasoning has led Ofcom to this conclusion can be replicated by any potential rival bidder, and in the face of such a prediction rival bidders will not enter.

If enough uncertainty concerning valuations and market entry costs is allowed for, then it may be possible to elicit entry into the auction. This means, however, that it cannot be assumed that the incumbent will always win the auction. Further, in neither an individual nor a combinatorial licence auction would the incumbent be expected to bid (or pay), an amount approaching his own valuation.

In an auction for a single licence, the second-highest valuation, i.e. the highest valuation of any rival bidder, places an upper bound on the amount the incumbent could be expected to bid, and this valuation excludes any incumbent cost advantages obtained from holding licences in common ownership. The greater degree of cost asymmetry in a single licence auction may mean that the incumbent is prepared to bid the second-highest valuation, but there are grounds for believing that even this is an overestimate of the incumbent's bid, as discussed in Section 4.

In the 'combinatorial' licence auction, on the other hand, the incumbent would never bid the highest valuation of any rival bidder.[40] Rather, a bid of half the incumbent's valuation provides a reasonable upper bound for, and hence overestimate of, the incumbent's equilibrium bid in this case.

As described in Section 3, Ofcom's suggested approach of assuming a number of simultaneous auctions with contingent bidding creates possibly insurmountable difficulties in determining the winning bids and predicting the auction outcome. Nevertheless, the Communications Act requires Ofcom to accurately estimate the 'conditional' bids which an incumbent and a number of hypothetical challengers would make if Ofcom really believes that it could overcome the practical problems inherent in holding such an auction. This is

[40] Unless the market entry costs were extremely large, making it an auction with large cost asymmetries.

an extremely complex task, but the complexities cannot be resolved by making unrealistic assumptions about the incumbent's bidding behaviour or relative levels of risk aversion.

In the highly simplified examples of a combinatorial auction we have considered here, either entry will not occur at all, so the incumbent would win the auction for a nominal amount, or the incumbent's bid will be shaded downwards by more than 50% from his true valuation. If Ofcom is unhappy with an approach which relies on the predictions of auction theory alone, one option would be to simulate the results of the auction using a computer model (itself a nontrivial exercise), or to run experiments in a laboratory setting. The 1991 Channel 3 licence auctions have already provided one such 'experiment' however, and the results seem to strongly confirm even the most pessimistic conclusions of auction theory.

8. References

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