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Abstract Within the EU regulatory framework, licensees for commercial radio broadcasting may be charged a fee to ensure optimal allocation of scarce resources but not to maximize public revenues. While radio licence renewal occurs in many EU countries, an objective, model-based approach for setting licence fees has not been used so far. In this paper, it is described how such a fee can be determined for the purpose of licence renewal or extension. National and regional Dutch FM licences were valued, taking into account that simulcast broadcasting of digital and analogue radio is obligatory upon extension. Licences are valued using discounted cash flow methodology, whereby the cash flows of an averagely efficient entrant are taken as the benchmark for valuation of each individual licence. Cash flows during the licence period 2011–2017 are forecast based on generalized least squares regressions, using financial variables of Dutch radio stations for the years 2004–2008. Separately, bottom-up cost and investment models are used to calculate analogue and digital distribution costs. This results in a value per licence, based on objective licence characteristics, which can be used to set licence fees if administrative renewal or extension is opted for instead of a new auction or beauty contest.

Keywords Radio · Licence value · Renewal · Extension · Net present value (NPV) · Digital audio broadcast (DAB)

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1 Introduction

Commercial radio stations in developed countries commonly operate under a licence for a fixed period. Once this licence expires, policymakers can either opt for an open allocation procedure using an auction or a beauty contest, or for an extension or renewal of the current licences. If the latter is chosen, setting the financial terms is an important issue. These terms should promote efficient use of scarce radio spectrum and avoid state aid to incumbents, while maximization of public revenues by rent extraction beyond allocation purposes should be avoided.

In the Netherlands, licences for national and regional commercial FM radio broadcasting (hereafter: 'licences') were assigned by means of a beauty contest in 2003, with the licence period ending in September 2011. In June 2009, the Dutch government announced plans for extension of the licences. Cornerstone of the extension is the ambition to stimulate the development and uptake of digital radio broadcasting. Based on the assumption that this is best accomplished by the incumbents, analogue licences are extended conditional on investments in, and simulcast broadcasting of, digital radio (Tweede Kamer 2008–2009). Incumbents that want to extend their licence have to pay a one-off licence fee, covering both a six-year extension of the current licence as well as access to the digital radio spectrum.

In this paper, it is described how such a one-off licence fee can be calculated, based on an objective assessment of the value of the spectrum for an averagely efficient entrant.[1] As incumbents have made specific investments to operate a licence and have an installed base of listeners, they can be expected to have a higher valuation of the spectrum than an entrant. The value of the spectrum for an averagely efficient entrant would be the second highest bid and therefore the expected price that the incumbents would have to pay for renewing their licence in case a (second bid) auction were held.[2]

This paper is organized as follows. In Sect. 2, the legal framework is discussed that is relevant for setting the financial terms for licence renewal or licence extension. In relation to this framework, several methods are discussed for determining the value of commercial radio spectrum, and it is concluded that value is best calculated by means of a discounted cash flow exercise. This means that all cash flows that can be generated with a licence during the licence period must be forecast. It is argued that an averagely efficient entrant should be the starting point for this calculation. Section 3 covers the methodology and data used to assess

[1] This paper is based on research the authors conducted together with TNO Informatie- en communicatietechnologie and Prof. Paul Rutten, commissioned by the Dutch Ministry of Economic Affairs (Poort et al. 2010, 2011).

[2] Using an alternative auction design, for instance a first price sealed bid auction, the price for incumbents is expected to be higher as a result of winner's curse and uncertainty about the entrant's exact bid.

values. Cash flow forecasts are based on generalized least squares (GLS) regressions and bottom-up investment and cost models for distribution-related variables. In Sect. 4, each of the cash flow items is discussed in more detail and the resulting models for forecasting are described. The cash flows relating to digital radio are described separately in Sect. 5, in view of their specific role in the Dutch reassignment procedure. In Sect. 6, the final steps towards calculation of the licence values are described, after which Sect. 7 is concluded with policy implications.

2 Legal and economic framework

2.1 Legal framework

Renewal of licences for commercial radio broadcasting is not a new phenomenon but has already taken place elsewhere in Europe in several ways. Where appropriate, the renewal was regulated via an amended legislative framework, for instance, by adjusting the existing licences, testing against previous eligibility criteria or by interlinking with investment in digital radio.

Renewal of frequency licences also occurs outside the commercial radio market. A recent example is the renewal of GSM 900 licences in the Netherlands. The licences of the two mobile providers KPN and Vodafone have been renewed for a limited period of time, so that the licence duration coincides with the duration of other mobile licences (the so-called DCS 1800 licences). Both parties have to pay a renewal fee (Poort et al. 2006).

The regulatory context of the renewal of licences for frequency use has been defined in both a European and a national framework. The Framework Directive (2002/21/EC) and the Authorization Directive (2002/20/EC) provide the primary regulatory context at a European level. From a national perspective, licence renewal has been laid down in the Telecommunications Act and the Frequency Decree.

2.1.1 Framework Directive and Authorization Directive

The general principles with respect to frequency distribution have been laid down in the European Framework Directive and are further addressed in the Authorization Directive. This directive does not include any specific provisions with regard to licence renewal. Yet, there are some general criteria that may be considered applicable to licence renewal as well, especially when it comes to both imposing fees and procedural guarantees.

In principle, two types of fees are allowed: fees for administrative costs and fees for the purpose of encouraging the optimum use of frequencies. The first category is beyond the scope of discussion here. As to the second category, it should be underlined that a fee in the form of a special duty—in particular in the context of a renewal—will only be permitted if it is intended to encourage the optimum use of frequencies. Revenue maximization is contrary to this. The issue is further underlined by other considerations in the preamble of the directive (especially

consideration 32 of the preamble of the Authorization Directive[3]). Fees are not to hamper the development of innovative services and competition in the market. As a matter of fact, this condition implies for instance that there should be sufficient room to invest in digital radio (particularly if this is a condition that is linked with renewal, such as roll-out obligations). If a requested fee is a one-off fee and could be regarded as a comparison-based fee or a competition-based selection procedure, possible appropriate payment schemes are to ensure that in practice this will not lead to selection based on criteria that have nothing to do with the objective of achieving an optimum use of radio frequencies. As will be discussed below, the approach presented in this paper guarantees optimum use of frequencies by taking the value for an entrant as a benchmark.

In the preamble of the Authorization Directive, it is further stated that the European Commission can publish on a regular basis benchmark studies about best practices with respect to the assignment of radio frequencies. Such a benchmark is not available with respect to the distribution of broadcasting frequencies.

The Authorization Directive (consideration 33 of the preamble) also provides a framework with respect to the question if amendments can be made to 'rights, conditions, procedures, charges and fees' relating to licences. Such amendments should be justified objectively. All interested parties that should have the possibility of stating their views, must be informed about these amendments timely and in the proper way.

2.1.2 State aid

At a European level, there are no specific rules or guidelines for renewing frequency licences. Consequently, general criteria should be used to find out if (improper) state aid is provided for a renewal. These criteria can be largely derived from Article 107 of the EC Treaty and case law of the Court of Justice.

Before answering the question as to whether or not state aid is permissible, it should first be determined if renewal fees may in fact be qualified as state aid. In the context of this paper, a valuation methodology for licence renewal is proposed which is aimed at preventing any form of state aid. The fee requested for renewal has been calculated in a way that is in conformity with the market, with due observance of the criteria as set forth in the framework directive/Authorization Directive. It is therefore stated that, given the method chosen, state aid is not involved in the valuation of the intended renewals.

2.1.3 Telecommunications Act

Renewal of frequency licences on the basis of further regulations is provided for in Chapter 3 of the Dutch Telecommunications Act. This further regulation can be found in the so-called Frequency Decree. Renewal is possible if a general social, cultural or economic interest is involved.

[3] 'Where, in the case of competitive or comparative selection procedures, fees for rights of use for radio frequencies consist entirely or partly of a one-off amount, payment arrangements should ensure that such fees do not in practice lead to selection on the basis of criteria unrelated to the objective of ensuring optimal use of radio frequencies'.

2.1.4 Accuracy

The framework directive/Authorization Directive, the Dutch Communications Act and previous experience in granting or renewal of licences indicate that it is important that the valuation of frequency licences is performed with the utmost care.

The valuation should be suitable to the intended government objectives that allow renewal as an instrument (Article 9 Frequency Decree), for instance. In the presented valuation model, this has been achieved by including the costs of the innovation (especially the costs for distribution of digital radio). In addition the valuation should stimulate the optimum use of frequencies. This is reflected in the valuation model, where the optimum use of the available frequency space rather than revenue maximization is the starting point.

In addition, a careful procedure was used for choosing the valuation model and for calculating licence values. An extensive study was conducted, taking the technically and legally relevant aspects into account. The market parties involved have been consulted extensively before a model was prepared based on generally acknowledged economic parameters. Next, the market parties were consulted about this model again. The researchers evaluated the comments on their merits and processed them in a well-founded way. Additional feedback was provided through the formal public consultation process based on the Telecommunications Act, which generated additional input for the optimization of the model.

Finally, a valuation methodology is used, which to a large extent corresponds with the methodology used earlier for the renewal of the GSM 900 licences in the mobile telecommunication sector. It was the subject of a legal dispute and was brought before the court. The court concluded that the question of what could be a fee in conformity with the market, had been studied carefully and in a comprehensively documented way.

2.2 Economic framework

Despite the fact that a model-based valuation of licence renewal fees is concluded to be in line with the European Regulatory Framework in Sect. 2.1, there are no previous examples of such an approach. In a study covering several European countries Analysys Mason/Hogan & Hartson (2009) conclude that in Europe radio broadcasting licences are usually awarded by means of a beauty contest or, less frequently, an auction. For renewal, a competitive procedure such as an auction or a beauty contest is often organized if there is sufficient market interest. If too few parties are interested, the licence is offered to the incumbent for renewal or extension. The incumbent is sometimes charged a fee that is fixed or based on its turnover, but objective economic value is no driver for fee determination.

Ofcom's methodology used in 2006 and 2010 to determine the financial terms for the UK's three national licences, is most congruent with such a value-based approach. The terms set by Ofcom were aimed at reflecting the value to a (fictional) bidder, which was assumed to equal 'the net value of the rights and obligations associated with the licence' (Ofcom 2006, 2010a, b).

This suggests the use of an objective valuation model. However, possibly due to the small number of licences to be valued, Ofcom does not translate this economic starting point into an objective model-based approach. The value of each licence is based directly on the costs and revenues for the incumbent, adjusting for the costs of entry. By doing so, the idiosyncratic efficiency or inefficiency of each incumbent determines the licence value: licensees with high advertising revenues are penalized for their success and end up paying more.

Apart from the UK, other European countries have either not experienced renewal or have preferred to rely on the market to determine prices; they have thus not valued licences based on economic principles.

Economic theory offers—in broad terms—three possible ways to assess the economic value of an asset: based on cost, market or cash flow. The cost approach is most suitable for assets which can be reproduced, with value being determined on the basis of costs involved in producing the asset. As broadcasting licences are unique assets, which cannot be reproduced, this is not a viable approach. The market approach is suitable for assets being traded on an 'active market', i.e. markets with homogeneous assets, readily available sellers and buyers, and publicly available prices. In this case, the market price is a good proxy for economic value. As broadcasting licences are not traded on an 'active market', this approach does not seem suitable either. Historic financial bids for licences could provide an alternative starting point. These historic market prices should be corrected for changes in market conditions, advertising behaviour and cost structures over time, which might prove difficult. But even then, historic prices are not a solid proxy for objective valuation of spectrum. Bids in an auction or beauty contest do not necessarily reflect the value of the licence at that time but first and foremost the value attributed to the licence by the bidding party. This value will be affected by elements such as the design of the beauty contest or auction and the number of bidding parties. Another issue is the 'winner's curse', which refers to the risk that—depending on the chosen bid method—the party overestimating the value of the asset will win, resulting in an upward price bias. The outcomes for the unrestricted lots in the 2003 beauty contest in the Netherlands illustrate this: despite relatively small differences in demographical coverage, the financial bids for these lots ranged from €32.8 to €80.4 million. Hence, historic prices are rejected here as an alternative starting point.

The cash flow approach values an asset based on the discounted future cash flows that can be obtained with the asset. Free cash flows are discounted on the basis of a discount factor reflecting the required return on invested capital. It is best suited for unique assets that are not traded on a(n active) market, such as commercial radio licences: an economic agent interested in buying a commercial radio licence would logically value the licence based on what he could earn with it. The cash flow approach—also called discounted cash flow (DCF) in valuation literature—is therefore best used for valuing radio frequency licences.

2.2.1 Discounted cash flow methodology

As part of the DCF methodology, all cash flows resulting from the licence during the licence period must be determined—that is: all financial flows resulting in actual

Table 1 Cash flow schedule (station x, year t)

1	Net advertising income		
2	Non-advertising income		
3	Total income	=	(1)+(2)
4	Distribution costs—analogue		
5	Costs telecom agency		
6	Wages		
7	Other non-distribution operational costs		
8	Other non-distribution costs		
9	Depreciation distribution assets—analogue		
10	Depreciation distribution assets—digital		
11	Depreciation non-distribution assets		
12	Total costs	=	(4)+(5)+…+(11)
13	Net result	=	(3)−/−(12)
14	Taxes (−/−)		
15	Net result after taxes	=	(13)−/−(14)
16	Depreciation (+)		
17	Gross cash flow	=	(15)+(16)
18	Investments/divestments distribution assets—analogue		
19	Investments/divestments distribution assets—digital		
20	Investments/divestments non-distribution assets		
21	Gross investments	=	(18)+(19)+(20)[a]
22	Net cash flow	=	(17)−/−(21)

[a] Divestments are treated as negative investments

cash-in or cash-out. In simple and generic terms this means that the net result after taxes should be corrected for depreciation (which is a cost, impacting net result and thus taxes, but not a real cash-out), after which investments (cash-out) are subtracted and divestments (cash-in) are added. The cash flow schedule used in our analysis is presented in Table 1, where all cash flows for a radio station in a given year during the licence period are illustrated. Note that the costs of digital broadcasting are treated differently.

2.2.2 Valuation benchmark: an averagely efficient entrant

It was postulated earlier that the value of the spectrum for an *averagely efficient entrant* would be the expected price that the incumbents would have to pay for renewing their licence in case an auction were held. Here, 'entrant' refers to a new licensee; the entrant can be both a start-up, a newcomer in the radio business or a company already owning another radio licence.[4] The cash flows—and hence the value—for an entrant are modelled based on historic cash flows of the incumbents,

[4] In the Netherlands, a company can acquire a maximum of two national radio licenses, provided one has format restrictions and the other is unrestricted. Combining regional licences is also allowed, within restrictions concerning the total demographic coverage.

accounting for objective differences between licensees and for the evolution of an entrant's costs and revenues in time. By taking the historic cash flows of incumbents having at least survived up and until 2010, and including a variable for 'number of years active', the model forecasts the cash flows for an averagely efficient entrant, given objective licence characteristics.

Taking an entrant as a starting point for the valuation guarantees concordance with the legal framework, as was argued in Sect. 2.1. Charging a fee to incumbents equal to the value for an averagely efficient entrant implies that the incumbents, if they agree to pay this price, value the licence at least at the level of the maximum cash flows an entrant could generate with it. Therefore, the licence could not be put to a more efficient use if it were to be operated by an entrant instead of an incumbent. Put differently, the opportunity costs for an incumbent of operating the licence itself instead of selling it to an entrant are equal to the cash flows an averagely efficient entrant could earn with it—implying this is the price the incumbent could earn by selling its licence in an efficient market.

Moreover, the value for an averagely efficient entrant would also be the outcome of a hypothetical auction, without a winner's curse, as the resulting price would be determined by the runner-up, and this would most likely be an averagely efficient entrant. The incumbent can be expected to value the licence more and to be willing to pay a higher price, as he has already sunk costs in an installed base of listeners and in broadcasting equipment. An entrant still has to make these investments. Finally, taking an entrant as a starting point prevents penalizing successful incumbents by charging them what an efficient entrant *could earn* rather than what incumbents *actually earn* based on their success.

3 Research methodology and data handling

As argued in Sect. 2.2, the value of a licence for an averagely efficient entrant is equal to the present value of all cash flows that can be generated during the licence period. In our analysis, it is assumed that the averagely efficient entrant is as efficient as the market average, after accounting for the fact that net cash flows will be relatively low during the first years in view of the build-up of market share. To predict cash flows during the licence period, historic data of all the radio stations in the Netherlands have been analysed: econometric models for expected revenues and costs have been developed, based on exogenous licence characteristics. By including the 'years active' as an explanatory variable, the build-up of market share in a mature market is explicitly accounted for. Subsequently, a forward looking cash flow model was built for a hypothetical entrant.

All commercial FM radio stations active in the Netherlands by November 2009 were asked for details on specific cost, income and investment variables. For regional stations, data were gathered for the financial years 2006, 2007 and 2008. For national stations, data for two additional years were used (2004 and 2005), since the years from 2006 onwards were expected to be insufficiently representative for the first years of an entrant operating a national unrestricted licence.

This resulted in a robust data set on cash flows for five financial years (2004-2008), which was corrected for inconsistencies and exceptional cash flows that were out of scope of 'normal radio activities'. In order to guarantee correct understanding and interpretation of the data, interviews were held with various radio companies, sector representatives and business experts. Finally, the licensees were consulted during the research process on the methodology and the underlying assumptions.

The variables in the resulting dataset are all expressed in 2008 prices and analysed as panel datasets in econometric regression models. A model is prepared for each of the cash flow variables in Table 1. More specifically, the method of generalized least squares (GLS) with random effects is used to estimate the relevant variables in a log-linear regression model. Panel robust (sandwich) standard errors are used, correcting for serial correlation and heteroscedasticity.

All explanatory variables that were used to predict cash flows are objective, licence-specific variables, which facilitates determining an objective value for each individual licence that is independent of the specific performance and business model of the current holder of a licence. The explanatory variables, some of which are further explained below, are described in Table 2. The final model for each cash flow variable includes those explanatory variables that result in the highest predictive power.

Separate from the above methodology, distribution costs have been forecast based on bottom-up cost and investment models. This was done for all variables related to distribution, i.e. those cash flows that relate to the technicalities of broadcasting like (operation of) broadcasting antennas.[5]

In the general modelling approach, several complicating elements have to be taken into account:

- Licences apply to ether only: the data used refer to the entire operational activities of a radio station, including non-ether broadcasting through cable networks and the Internet. The value calculated based on these data must be corrected in order to obtain the value for ether-only.
- Cooperation between non-national radio stations: based on the dataset and interviews, it turns out to be common practice for non-national licensees to exchange frequencies to optimize their coverage or to seek other kinds of cooperation. At the far end of the possibilities is the option for the licensee to pay a third party for the full operation of its radio frequency. A less rigorous example is a third party (holding a different licence) that is responsible for programming of a frequency while the licensee remains responsible for selling advertising time. Related financial flows are included in the datasets per radio station rather than per licence. The actual challenge is how to recalculate these financial flows to a specific licence, because this is vital in relating financial streams to objective licence characteristics. As various types of cooperation and of financial settling of services are used, the solution chosen is to consolidate non-national radio stations that are interlinked by these forms of cooperation

[5] These calculations were carried out by TNO Informatie- en communicatietechnologie (Poort et al. 2010, chapter 5).

Table 2 Explanatory variables

Variable	Abbreviation	Explanation
Demographic reach FM—national[a]	RCH-N	Demographic reach in the Netherlands of a national licence as a percentage of the Dutch population
Demographic reach FM—local[a]	RCH-L	Demographic reach in the Netherlands of a non-national licence as a percentage of the Dutch population
Dummy National licence	DNAT	Dummy value is '1' if the licence refers to a national licence and '0' if not
Number of sites	SIT	Number of broadcasting sites used to operate the licence, based on specifications by Telecom Agency.[b] This will affect distribution costs but may also be a proxy for the demographic comprehensiveness of the region served
Dummy format restriction—Non-recent (golden oldies)	DFR-OLD	Dummy value is '1' if radio content should apply to a minimum percentage of 'non-recent music' and '0' if not
		Dummy refers to licence A2
Dummy format restriction—News	DFR-NWS	Dummy value is '1' if radio format should apply to a minimum percentage of 'news' and '0' if not
		Dummy refers to licence A4
Dummy format restriction—Recent	DFR-NEW	Dummy value is '1' if radio format should apply to a minimum percentage of 'recent music' and '0' if not
		Dummy refers to licence A5
Dummy format restriction—Dutch/European	DFR-NL	Dummy value is '1' if radio format should apply to a minimum percentage of 'Dutch music' and '0' if not
		Dummy refers to licence A9
Competition level within demographic reach	CMP	Variable reflecting the average number of commercial radio stations within the demographic reach of a licence
Number of years active	YRS	The number of years the radio station is active in the Dutch radio market
Number of stations in cluster	CLUS	The number of radio stations that is active within a cluster
Total revenues[c]	REVTOT	Total revenues, consisting of net advertising income and other revenues, net of rebates

[a] These two variables are separated in order to determine whether the relation between advertising income and demographic reach, for example, is identical for national and non-national licences. This might be expected, because business experts claim that these licence types service different markets

[b] Telecom Agency ('Agentschap Telecom') is part of the Dutch Ministry of Economic Affairs and deals with technical aspects of ether frequencies

[c] This variable is not licence-specific but was only used to predict working capital, which can be expected to have a logical relation with total revenues

into clusters. In this way all financial streams between the stations are related to one fictive multi-station conglomerate with objective licence characteristics.

- Format restrictions: an important element in the Dutch commercial radio licence structure is the regulation of the format of some licences, in order to guarantee a broad supply of radio content. The underlying argument is that supplying some

particular formats might not be considered commercially viable by radio companies but might be in the public interest. Therefore, four licences are restricted in relation to their programming, in line with a specific format, such as 'News' or 'Dutch music'. This is reflected in the models by the inclusion of dummies for content constraints as potential explanatory variables.

- Defining an entrant: the explanatory variable 'number of years active' (YRS) is essential to determine the specific value for an entrant. When cash flows for an entrant are predicted, this variable starts at 1 in the first licence year and increases from there. This facilitates forecasting the development of cash flows during the licence period for a player that acquired the licence at the start of the licence period.

In conclusion, each cash flow item is modelled based on objective licence characteristics, whereas the variable YRS is used to model the specific development of an entrant's revenues and costs in time. This results in generic models per cash flow variable. With the help of the characteristics of a specific licence, cash flows per licence per year are predicted. The licence value follows from discounting all yearly values to the start date of the licence. In the next sections, the models for each of the cash flow variables are discussed.

4 Modelling cash flow variables

In this section, the models derived for revenue and cost variables, as well as investment, divestment and depreciation are described.

4.1 Revenues

Gross advertising income includes the discounts on advertising fees given to advertisers, as well as commission paid to sales agencies. These are excluded to arrive at the Net Advertising Income (NAI), representing actual cash-in. It can be expected that the number of years a radio station is active will be a relevant variable in predicting NAI, which is to be tested within the GLS regression. However, including 'number of years active' (YRS) as an explanatory variable presents a potential pitfall if combined with the use of panel data. Data on NAI would not only be impacted by growing experience over time but also by the growth of the total advertising market. The coefficient of YRS would thus not only reflect growing experience of the individual radio company but also of general market growth—both resulting in increased NAI. Therefore, if the NAI of each station is taken as a dependent variable, the maturity effect would be overestimated. To prevent this, total revenues (NAI plus other revenues) have been normalized using data on the total radio advertising market. Thus, total revenues relative to the total radio advertising market (including both commercial and public stations) are modelled. Subsequently, the total revenues per licence per year are predicted by multiplying this variable by the market totals. In this way the exogenous impact of the development of the total market is taken out of the equation.

Table 3 Total revenues relative to the total radio advertising market

Variable	Coeff.[a]	SE	z	*P* value
YRS	0.47	0.09	5.20	0.00
RCH-N	1.16	0.11	10.33	0.00
RCH-L	0.42	0.33	1.27	0.20
DFR-NWS	<0			0.00
DFR-NEW	<0			0.00
DFR-NL	<0			0.00
Constant	−7.92	0.47	−17.01	0.00
R^2 (overall)	91 %			
Observations	57			

[a] Values for the licences with a unique content constraint are not shown for confidentiality reasons

The results of the regression of total revenues relative to the total radio advertising market are shown in Table.[6] Demographic reach has a statistically significant and positive impact. For national licences this effect is close to linear. For non-national licences the coefficient (<1) implies decreasing additional income per additional unit of demographic reach. This corresponds with the fact that non-national licences focus on smaller broadcast areas and that increasing demographic reach does not add as much value as for national licences. The variable for the 'number of years active' turns out to be highly significant: a company's total revenues increase with experience gained over the years, but the increase in market share diminishes in time. Finally, the content constraints 'News', 'Recent specific music' and 'Dutch' are statistically significant and negative. Format restrictions limit a station's market share, and thereby its income. Only the fourth content constraint, 'Non-recent music' (Golden Oldies), turned out not to have a statistically significant effect on total revenues.[7]

Based on the model in Table 3 total revenues for a hypothetical averagely efficient entrant are predicted for each year of the licence renewal period. To do this, expected market development needs to be assessed up and until the end of the licence period.

Economic development (measured by gross domestic product, GDP) is assumed to be a key variable for the development of market NAI. Companies want to profit from economic growth and aim to achieve this, amongst others, by increasing advertising budgets, while these budgets are an easy target for cost cutting during an economic downturn. This is backed by NAI figures on the Dutch commercial radio market, which develop in line with Dutch GDP. In addition, relating market NAI to GDP figures shows that a sharp decrease in the former is corrected within 2 to 3 years once GDP development turns positive again—implying strong growth of

[6] One-sided minimum significance level for all variables is set at 90 %. The relatively low limit is the result of the aforementioned clustering of non-national radio stations, which led to a reduction of the number of data points. Most variables are significant at 95 or 99 %.

[7] To test the effect of competition within a geographical area on the revenues, the effect of a variable 'competition level within demographic reach' (CMP) has been tested. As could be expected, the coefficient was negative—more competition results in lower income—but the coefficient did not pass the (rather generous) threshold for significance that was used.

Table 4 Forecasts for NAI, inflation and GDP

	2010	2011	2012	2013	2014	2015	2016	2017
NAI growth (nominal)	5 %	4.50 %	4.00 %	3.75 %	3.75 %	3.75 %	3.75 %	3.75 %
Inflation	1.3 %	1.5 %	2.0 %	2.0 %	2.0 %	2.0 %	2.0 %	2.0 %
Real GDP growth	1.7 %	1.5 %	2.0 %	2.0 %	2.0 %	2.0 %	2.0 %	2.0 %
NAI (Nominal)	231	241	251	260	270	280	290	301

NAI during GDP recovery. Thereafter, NAI development returns towards its long term trend, i.e. to its 'fixed' relation compared to GDP.

In line with this, the sharp decrease of market NAI in 2009 as a result of the financial crisis (−15.7 % in nominal terms), was followed by a solid growth of 5.0 % in 2010, 2 % above the nominal growth in GDP. The forecasts for nominal NAI development, real DGP growth and inflation that are used in our valuation are shown in Table 4. For 2011 a growth level of 1.5 % above GDP is forecast, while NAI growth is expected to be equal to GDP growth in 2012. After 2012, NAI is expected to return to its long-term trend compared to GDP.[8] For this long-term trend, the compound annual growth (CAGR) rate of both variables was analysed. CAGR of market NAI is 0.1 percentage point lower than that of GDP during the 1996–2009 period. This figure is corrected downwards to 0.25 percentage point for the trend after 2012 in view of the expectation that NAI development will structurally fall behind GDP growth due to the crowding-out effect of other advertising media like the Internet.

Tables 3 and 4 combined can be used to project the total revenues for each licence per year. As an illustration, the total revenues projected for a single entrant that acquires a typical national licence with no format restrictions are presented in Fig. 1.

4.2 Cost variables

Four cost categories are defined: distribution costs, wages, other non-distribution operational costs and other non-distribution costs. Distribution costs include costs for analogue and digital distribution. The latter is addressed separately in Sect. 5.

4.2.1 Analogue distribution costs

Analogue distribution costs have not been based on econometric analysis of financial data of current licensees. They have been calculated using a bottom-up approach, based on the required network configuration per licence. Each licence

[8] GDP growth in 2010 and 2011 is based on figures by Centraal Planbureau (www.cpb.nl). For subsequent years, structural GDP growth of 4 % is assumed (2 % real growth and 2 % inflation).

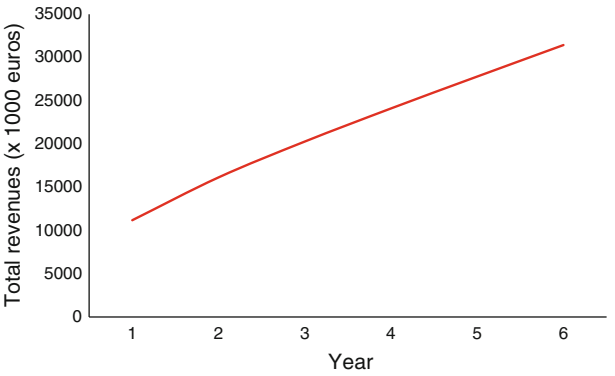

Fig. 1 Average total revenues per year for a single entrant that acquires a typical national licence with no format restrictions

Table 5 Definition of site classes and related OPEX

Site class	Station power (kW)	Transmitted power (kW)	OPEX (€)
Low power			
L1	0.25	0.5	25,763
L2	0.5	1	28,845
L3	1	2	33,010
Medium power			
M1	2	5	46,840
M2	3	10	49,170
M3	5	20	53,831
High power			
H1	10	50	103,502
H2	12	100	108,162
Monitoring[a]			125,752

[a] Referring to a simple monitoring facility occupied by maximum 2 persons

requires a different number and type of broadcast sites. Distribution costs differ between these 'site classes', with cost categories including amongst others transmitters/amplifiers, installation costs, network monitoring facility and electricity usage. The costs for each site class have been estimated to acquire estimates of the entire distribution costs. The definition, and resulting operational costs, of each class are shown in Table 5. Based on the technical parameters the Telecom Agency has assigned to each licence, the number and type of sites per licence determines its analogue distribution costs.[9]

[9] Results have been calibrated based on the data on distribution costs received by the radio stations and discussions with those radio stations for which difference between received data on costs and calculated costs were substantial.

Table 6 Wages

Variable	Coeff.[a]	SE	Z	*P* value
YRS	0.24	0.11	2.21	0.03
RCH-N	1.35	0.19	7.28	0.00
RCH-L	0.94	0.31	3.06	0.00
DFR-NEW	<0			0.00
DFR-NL	<0			0.00
DFR-OLD	>0			0.00
Constant	2.38	0.78	3.07	0.00
R^2 (overall)	83%			
Observations	50			

[a] Values for the licences with a unique content constraint are not shown for confidentiality reasons

4.2.2 *Wages*

Wages refer to salary of personnel including taxes. The GLS results are shown in Table 6. Wages depend on demographic reach and on the number of years a licensee is active in the market. The former might refer to a larger income potential justifying personnel investments, the latter to the build-up of personnel in time.

4.2.3 *Other non-distribution operational costs*

Other non-distribution operational costs include marketing costs, programming costs, housing, etc. Most radio companies rent their office space, and it is assumed that an averagely efficient entrant does the same. Although they are not the owner, it is common to make (small) investments in the rented office space—for instance to redesign space to the specific needs of radio activities. Related depreciation is treated as housing cost and not separately under investments.[10] *Other non-distribution operational costs* are modelled as the sum of the underlying variables.[11] The results are shown in Table 7.

In this model, stations that have been in de market longer have higher costs, possibly to support a larger operation with higher income levels and cost levels. Conversely, format restrictions have negative coefficients: these stations have lower incomes as well as lower costs.[12] As might be expected for these cost categories, national licences face substantially higher costs than non-national licences. Another variable of importance is the number of radio stations in a cluster. More radio stations result in higher costs. The low coefficient points to economies of scale, most probably one of the *raisons d'être* for clustering.

[10] For technical reasons, the same is assumed for those few radio companies in the sample that bought instead of rented office space.

[11] As part of the sensitivity analysis all underlying variables have also been modelled separately. Predictive power of the resulting models, except for Royalties, was lower than that of the summarized variable.

[12] In Table 3, we saw that the format restriction 'golden oldies' has no significant effect on potential income as compared to an unrestricted licence. In this model, this dummy has a value that is over six times closer to zero than the other dummies, indicating that the negative effect on these cost levels is also much smaller.

Table 7 Other non-distribution operational costs

Variable	Coeff.[a]	SE	Z	*P* value
YRS	0.18	0.09	2.06	0.04
DNAT	4.10	0.38	10.72	0.00
CLUS	0.31	0.04	6.89	0.00
DFR-NWS	<0			0.00
DFR-NEW	<0			0.00
DFR-NL	<0			0.00
DFR-OLD	<0			0.09
Constant	3.90	0.35	11.22	0.00
R^2 (overall)	94 %			
Observations	47			

[a] Values for the licences with a unique content constraint are not shown for confidentiality reasons

Table 8 Other non-distribution costs

Variable	Coeff.[a]	SE	Z	*P* value
RCH-L	0.78	0.10	7.48	0.00
CLUS	0.21	0.05	3.90	0.00
DFR-NWS	>0			0.00
DFR-NL	<0			0.02
DFR-OLD	<0			0.00
Constant	3.23	0.49	6.64	0.00
R^2 (overall)	89 %			
Observations	39			

[a] Values for the licences with a unique content constraint are not shown for confidentiality reasons

4.2.4 Other non-distribution costs

The results for *other non-distribution costs* are shown in Table 8. From the coefficients it becomes apparent that there is a positive and significant relation with demographic reach for national licences. For regional licences there is a significant effect of the number of stations in a cluster.

4.3 Investment, divestment and depreciation

Investments are divided in analogue distribution and non-distribution assets. Investments in assets for digital distribution are discussed separately.

4.3.1 Analogue distribution assets

For analogue distribution investments, the same model as for analogue distribution costs is used. Relevant investments differ between the broadcast site classes as defined in Table 5, with important investment categories including for instance transmitters/amplifiers and belongings, spares and network monitoring facility. The resulting investments and depreciations per site class are shown in Table 9. Based

Table 9 Analogue distribution investments and depreciations per site class

Site class[a]	CAPEX (€)	Depreciation (€)
Low power		
L1	11,515	768
L2	12,290	819
L3	13,375	892
Medium power		
M1	26,415	1,761
M2	32,615	2,174
M3	46,565	3,104
High power		
H1	106,240	7,083
H2	125,615	8,374
Monitoring[b]	12,000	4,000

[a] For a definition, see Table 5

[b] Referring to a simple monitoring facility occupied by maximum 2 persons

Table 10 Tangible fixed assets (non-distribution)

Variable	Coeff.	SE	Z	*P* value
RCH-N	0.63	0.18	3.51	0.00
CLUS	0.27	0.10	2.79	0.01
Constant	1.89	0.74	2.54	0.01
R^2 (overall)	58 %			
Observations	42			

on the technical parameters the Telecom Agency has assigned to each licence, the number and type of sites per licence determines its analogue distribution investments and depreciations.

4.3.2 Non-distribution investments

Non-distribution investments refer to tangible fixed assets,[13] like housing, computers and furnishing, and to working capital. As explained, housing investments and related depreciation are treated as costs. The GLS results for tangible fixed assets are shown in Table 10.

The number of radio stations per cluster is statistically significant: the more radio stations, the higher the required investments. But, in line with expected economies of scope, the increase in investments diminishes significantly with the number of radio stations. In addition, national broadcasters face substantially higher investments than local broadcasters, and a higher demographic reach correlates with higher investments. The most striking aspect, however, is the lack of (statistically significant) predictive power of the number of years a station is active. This implies

[13] The only intangible assets of importance as part of 'normal exploitation of radio activities' is the payable licence fee, which may be booked as an intangible asset. As this exercise is aimed at calculating the value of the licence as a proxy for the licence fee, it is not included in the Net Present Value calculation.

Table 11 Working capital

Variable	Coeff.	SE	Z	*P* value
Total income	0.43	0.16	2.61	0.01
Constant	3.78	1.54	2.45	0.01
R^2 (overall)	29 %			
Observations	25			

Table 12 Costs for digital audio broadcast (DAB) per channel

DAB network	Capex (x € 1000)	Capex (x € 1000)
National	106	45
Regional	25	9

that licensees start off with investing in all assets that are needed during the licence period and thereafter invest only as much as is necessary to balance depreciation. This seems in line with the character of the related assets, i.e. computers and the like. The balance sheet value of the investments, in real terms, therefore remains constant during the licence period and will only increase with inflation. Assuming an average depreciation period of six years, equal to the licence period, the corresponding depreciation and investments in each year can be calculated. The balance sheet value at the end of the licence period is treated as a divestment.

4.3.3 Working capital

The results for working capital are shown in Table 11. In this model, total revenues (advertising plus non-advertising income) are introduced as an explanatory variable, as a direct impact of the total turnover on the required working capital can be expected. Since total revenues increase during the licence period, so does working capital. Working capital at the end of the licence period is treated as a divestment.

5 Digital radio

The Dutch government wishes to stimulate the development and uptake of digital radio. It has made simulcast (analogue and digital) broadcast a prerequisite for an incumbent for licence renewal. This means radio stations will have to invest in digital radio distribution and promote it to their listeners. Expected digital distribution costs and investments have been calculated using a model that is comparable to the model used for FM (analogue) distribution. This resulted in yearly costs and investments per licence for the use of one channel, as summarized in Table 12. Spare capacity that will result from setting up digital networks is expected to be used for launching new stations. Hence, the costs of this spare capacity are not allocated to the current licences.

Digital radio has several advantages compared to analogue broadcasting. Higher spectrum efficiency facilitates a larger number of radio stations. In addition, it

provides a potentially better sound quality and offers opportunities for data services. For radio stations this might result in higher income due to, for example, improved attractiveness in view of enhanced quality and fees for data services. It is hard to draw any conclusions on the exact impact based on Dutch experience, as the uptake of digital radio has been modest so far. In Europe, the UK is the frontrunner in terms of digital radio uptake; almost 30 % of all households have at least one receiver for digital radio (Ofcom 2009).[14] There is no proof as yet that the increased listening time in the UK resulted in higher advertising income. With some years to go before uptake towards UK levels will be achieved in the first place, we assume there will be no net financial benefit to be gained in the Dutch market during the licence period. More specifically, it is assumed that any costs to promote DAB are equal to any additional income resulting in a zero net income effect. This leaves the investments and cost of digital distribution necessary for simultaneous broadcast, as discussed above.

6 Licence value

Based on the bottom-up models for the distribution cost variables and the GLS models for the other variables, the value of all elements in the cash flow schedule in Table 1 can be calculated. Inputting the licence-specific characteristics in the models and the model outcome in the cash flow schedule, results in an overview of net cash flows per licence in each of the years of the licence period.

The final step is the calculation of the net present value per the beginning of the licence period based on the (nominal) annual net cash flows. Future cash flows are discounted to the start date of the licence period based on the discount rate: the weighted average cost of capital (WACC). The WACC is a measure of the return that investors—providers of equity and debt—demand. One euro invested today should at least have grown with the WACC in a year time and, the other way around, one euro next year is worth only 1/(1+WACC) today. Discounting the cash flows using the WACC therefore results in a value of the radio licences that takes the return demanded by investors into account. Based on international data, a nominal post-tax WACC of 6.4 % was used for national radio licences and a WACC of 7.3 % for non-national licences. The WACC is defined by the following formula:

$$\text{WACC} = l \times (R_f + D) \times (1 - Tc) + (1 - l) \times (R_f + \beta_E \times MRP)$$

The underlying parameters and the values used are specified in Table 13. Discounting the (nominal) cash flows to the beginning of the licence period based on the (nominal) WACC, provides the net present value (NPV). Remember, however, that the models are based on the financial data of entire radio stations. This means that income, costs and investments of *all platforms* used to broadcast radio programmes are included—that is: value generated via analogue air broadcasting, cable

[14] With more radio stations to listen to, listening time appears to increase after the purchase of a DAB receiver (Green 2009). For the largest part, however, this effect accrues to digital-only stations. Stations with simultaneous (analogue and DAB) broadcast experience only a very modest increase in number of listeners. Moreover, income generated by data services has been highly moderate.

Table 13 Results for the WACC and underlying input variables

Symbol	Variable	National	Non-national	Calculation method/source
WACC	Nominal WACC	6.4 %	7.3 %	See above
R_f	Risk-free rate	4.0 %	4.0 %	Average interest on 10-year Dutch government bond
β_A	Asset Beta	0.57	0.57	Average of international radio peer group
β_E	Equity Beta	0.99	0.99	Average of international radio peer group
l	Leverage defined as debt over total assets	50 %	60 %	Expert opinions from Dutch banking sector and information from international radio peer group
MRP	Market risk premium	4.0 %	4.0 %	Based on literature, e.g. Dimson et al. (2002, 2003, 2009a, b, 2010)
Tc	Corporate Tax	25.5 %	25.5 %	Dutch corporate tax rate
D	Interest premium	2.5 %	4.5 %	Average of international radio peer group, calibrated with expert opinions from Dutch banking sector

Internet and other platforms such as satellite. To estimate the value generated via air broadcasting, the resulting NPV should be corrected in order to reflect the value generated via this specific platform. This is done by assuming that the value of each platform is determined by the share of audience.[15] Availability of reliable data on this matter is, however, lacking—not even the radio stations themselves were able to determine the exact division of listeners over platforms. Based on (Intomart/GFK 2009), which provides insight in the listening share per medium instead of platform, assumptions are made for the division over platforms. Where (Intomart/GFK 2009) provides insight in the share of radio listening via car radios (medium), for instance, this is interpreted as 100 % air broadcasting (platform), while listening to a radio or audio set at home is interpreted as 50 % air broadcasting and the remainder via other platforms such as cable. This results in an estimated listening share for air broadcasting of 60 %.[16]

The same share of the calculated NPV is assumed to be generated via ether broadcasting. Thus, the value of the current licences after renewal is arrived at. However, the costs of investing in digital broadcasting still have to be accounted for. As discussed in Sect. 5, the investment costs involved have been calculated, while there are no additional revenues expected during the renewal. Hence, all costs associated with digital distribution have to be subtracted from the value of the licence.[17] This is done by calculating the (negative) NPV of the digital broadcast business case, which is subtracted from the value of the ether licence.

[15] A similar approach is adopted in (Ofcom 2006) and (Ofcom 2010a, b).

[16] This is in line with the general perception about these market shares in the industry, even though this general perception turned out to be ill-founded.

[17] This is in line with the approach adopted in (Ofcom 2006) and (Ofcom 2010a, b). There, all shared costs are attributed according to audience share per platform, while distribution costs are attributed directly to each platform.

Table 14 Value of Dutch Radio FM Licences (ether & digital) in € per 1-9-2011

Licence	Format restriction	Value
A1	–[a]	€ 25,592,000
A2	Non-recent ('Golden Oldies')	€ 20,692,000
A3	–	€ 26,804,000
A4	News	–
A5	Recent specific music	–
A6	–	€ 26,473,000
A7	–	€ 21,726,000
A8	Classical music & Jazz[b]	–
A9	Dutch/European music	–

[a] '–': an entrant would not assign any commercial value to the licence

[b] No data were available for the format restriction 'Classical music/jazz'. Therefore cash flows for this licence have been estimated by averaging cash flows for licences A5 and A9 (both estimated to have no commercial value for an entrant)

In order to calculate appropriate licence fees, one final calculation had to be performed on the NPV as calculated in the way described so far. If this was the licence fee the Dutch government demanded for reassignment, the licensees would actually make an additional profit on top of the discount rate. The reason for this is that the licence fee is either a cost or an investment that is depreciated over the licence period. Either way, the licensee can deduct the fee from its income, thereby lowering profit and tax payable. The value corrected for tax deductibility, based on the Dutch tax rate of 25.5 %, is provided in Table 14.[18]

The calculated licence values for the national radio licences for ether and digital broadcasting are given in Table 14. All non-national licences turn out to have no value for an entrant, given the current market structure. Differences in value are determined by licence-specific elements, mainly demographic reach. In addition, the number and type of broadcast sites necessary for operation can have the same effect. For national licences content constraints appear to be an important determinant for the value of a national licence. In Table 14 is shown that, apart from licence A2, all licences with a content constraint reflect no commercial value to an entrant. As explained, the reason for this is that the constraint limits the ability to attract market share and thereby income. This does not imply that these licences do not reflect any value to the incumbents. Licensees have invested, for instance in broadcasting sites, and have attracted a dedicated share of listeners over the years. The '–' value in the table does imply that opportunity costs for an entrant are zero and that reassignment without a licence fee is considered a market-efficient outcome. Licence A2 is the only licence with a constraint ('Golden Oldies') providing value to an entrant. This is in line with the outcome of the auction of radio licences in 2003.

[18] The government could allow for deferred payments, e.g. annual, instead of a one-off payment. If this option is chosen, a market based interest rate should be charged to prevent state aid.

7 Policy implications

The valuation of commercial radio licences for the purpose of licence extension or renewal is discussed in this paper. This is done by estimating what an averagely efficient entrant would be willing to pay for each of the Dutch radio broadcasting licences.

Cash flows, the key input parameters for NPV, have been forecast based on GLS regression models and on separate, bottom-up cost and investment models for distribution variables. The values in Table 14 reflect the net cash flow potential for an entrant that can be attributed to each licence discounted to the start of the licence period, including a return for investors. The government agency responsible for assigning the licences (Agentschap Telecom) has adopted these values as the fees payable by incumbents for licences to be reassigned.

Never before have policymakers in other countries taken licence valuation based on an objective, model-based approach as a starting point for reassignment fees, at least not in Europe. Although the model that is at the centre of the value assessment is based on data specific for the Dutch radio sector, its mechanisms can be used for policymakers in other countries to determine the (reassignment) value of commercial radio broadcasting licences.

In addition to this general observation on the valuation methodology, several insights were provided into the cost and income structure of national and non-national commercial radio. Demographic reach and time-in-market turn out to be key variables to explain both costs and incomes. The result that advertising income increases in a more or less linear fashion with demographic reach for national radio, while it is strikingly concave for non-national radio, stresses the observation that these are two separate markets. The importance of the time-in-market variable underlines that despite relatively small sunk capital investments, incumbents have an important advantage to entrants in terms of advertising income. Most strikingly, several national and all non-national licences were estimated to have no commercial value for entrants, despite the fact that most incumbents are making modest profits with them. Therefore, policymakers that want to encourage entry in an auction should increase the number of licences or take other measures to ensure that entrants have a chance relative to incumbents. Finally, the exchange of frequencies and various types of co-operation encountered in the Dutch non-national radio market, can be perceived as a substitute to a proper market for radio spectrum. Restricting such co-operation would bridle market forces and would most probably lead to a welfare loss.

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