Evaluation of Spectrum Rights for Radio Broadcasting Operators

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Abstract. The paper explores the valuation of radio spectrum granted by the State to radio operators for radio program broadcasting. Radio spectrum may be one of the most tightly regulated resources of all time, since every wireless device, from mobile phones to traditional radio devices, depends on access to the radio frequency wireless spectrum. Due to the scarcity of radio spectrum, the available number of radio broadcasting licenses is limited, therefore the State usually offers the licenses through open tender procedures following several tendering options such as auctions and beauty contests. One of the most crucial factor in the licensing procedures, is the valuation of the offered spectrum. The valuation of the spectrum determines the amount of money that radio operators should pay to the State, in order to hold the spectrum license for a fixed period of time. In this paper a cost model for radio spectrum evaluation is applied in order to identify the most crucial parameters that affect the determination of the spectrum price. The dynamic structure of the model allows a sensitivity analysis study in relation to the assessment of the variation effect of several parameters to the determined spectrum price. The appropriate determination of the examined parameters allow the State to maximize the government revenues but most important to grant the spectrum with the most efficient way.

Keywords: Spectrum Policy, Evaluation of Spectrum Rights, Radio Broadcasting, Spectrum value.

1 Introduction

Traditional radio stations broadcast theirs programs through frequencies allocated for radio broadcasting service. Each radio station holds a license in order to be able to broadcast its program through the allocated radio frequencies. Due to scarce characteristics of radio spectrum the available number of radio licenses is limited. Therefore radio stations should apply to State in order to grant a radio license. The radio stations operate under a license for a fixed period. Once this license expires, the State either initiates an open allocation procedure such us an auction or a beauty contest, or extent the existing licenses, if the latter is foreseen in the relevant legal framework. In both cases, the State should set the appropriate financial terms in order to promote spectrum efficiency, while in parallel to maximize the public revenues for the State.

The new EU framework for electronic communication sets the principles for radio frequency licensing and usage, including the principles should be adopted in the case of frequencies used for radio broadcasting. In particular in article 5 of the Authorization Directive (2002/20 Directive as amended in 2009) is foreseen that Members States shall ensure that the rights of use for radio frequencies shall be granted through open, objective, transparent, non-discriminatory and proportionate procedures. In addition in the same article is mentioned that the Member States shall ensure, that radio frequencies are efficiently and effectively used in accordance with the provisions of Framework Directive (2002/21 Directive as amended in 2009) in relation to competition promotion and harmonization of use of radio frequency. Although the current financial crisis forces the States to find ways to maximize the revenues in each licensing procedure the relevant EU Framework, clearly promote the efficiency usage of radio frequency, the competition and the provision of innovative services. Indeed as stated in the point 32 of the preamble of the Authorization Directive the imposed fees should not hinder the development of innovative services and the competition in the relevant market.

The efficient assignment of the spectrum and in general the efficient spectrum management has been several times subject for discussion both from academic and industry point of view. In particular in [4] a techno-economic analysis was conducted in order to examine the impact of the different spectrum management approaches to the social welfare. The authors concluded that regimes allowing secondary use, whether by sharing or by trading, have greater preferences, in most cases, than other approaches. In addition in [5] the degree of substitutability of frequencies with or without regulatory constraints was examined. The authors concluded that the regulatory constrains are a major source of limitations on substitutability. In addition alternative forms of intervention were considered, including caps on spectrum holdings or on the acquisition of spectrum at any award. In [6] the authors examined the policy trends towards more flexible forms of spectrum management. In [7] the authors argued that when the spectrum is allocated to operators and high investments are required, the government should consider real options methodology for setting the price of the license, or the base price of the licenses in case the government decides to follow an auction methodology to allocate the licenses to determine a more accurate price of the license which takes into account the managerial flexibility.

In [8] the authors argued that the Discounted Cash Flow (DCF) valuation is the most common method to value real assets whose future cash flows can be forecasted with certain degree of predictability. They believed that if a project's risk differs considerably from the firm's average risk then the WACC is adjusted upwards or downwards to arrive at the new discount rate for the project depending on whether the project is more risky or less risky respectively. They criticized DCF method for one of its inherent and structural weakness which is that the project's value will remain same and unaffected despite any future decisions by the management of the firm or the project.

In [9] a methodology is proposed for the calculation of licenses fees for radio broadcasting, based on an objective assessment of the value of the spectrum for an averagely efficient entrant. It is argued that as incumbents have made specific investments to operate a license 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 license in case a (second bid) auction were held.

Compared to existing research efforts, this paper is more closed to [9] but its innovation could be summarized in the following three reasons: (a) it proposes a fully dynamic model for spectrum evaluation used for radio broadcasting (b) it uses data from a real market but could be easily applied to any other market ,(c) it identifies the most crucial parameters that affect the determination of the spectrum price and (d) its conclusions could be used by policy makers for efficient spectrum allocation, promoting the competition and the provision of innovative services.

The rest of the paper is organized as follows. Section 2 expands on the spectrum evaluation available options. Section 3 presents in details the model used for the spectrum evaluation, while in Section 4 the results of the model are discussed, attempting the determination of the most crucial licensing factors. The conclusions of our study are presented on Section 5.

2 Spectrum valuation

For the evaluation of radio spectrum by the State authorities, two methodologies are mainly used, the benchmarking approach and the modelling approach. Indeed in [10] the authors concluded that in Europe radio broadcasting licenses are usually awarded by means of a beauty contest or, less frequently, an auction.

In the benchmarking approach, prices/costs from other countries are used with appropriate adjustments. The disadvantage of this method is that the prices in each market depend on national circumstances such as the size of the offered spectrum, the used technologies, the legal framework, the local economy the level of competition, as well as the projections for the future revenues growth and costs. The adjustment of all these factors into the implied values requires full knowledge of the national circumstances in each case and of the related factors under examination.

The most used methodology in the modeling approach is the Discounted Cash Flow (DCF), since the radio spectrum is an asset that is not trade on a commercial market, therefore an operator interested to buy a radio spectrum right is willing to pay based on what he could earn using the radio spectrum. In the DCF the future costs and revenues of a spectrum operator are estimated, in order to determine the relevant Net Present Value (NPV). It could be said that the NPV represents the maximum price that an operator would be prepared to pay for a given amount of spectrum, since any higher payment would not lead to a reasonable return on its investments for a given duration of the license. It should be also noted that, in some cases the DCF methodology may result in uncertain estimates, since the future cash flows are based on projections of the spectrum operator's revenues and costs. In addition, the longer the license duration, the higher the uncertainty of the projections, resulting in uncertain estimates for the NPV. Nevertheless the DCF methodology is accepted as an appropriate methodology for spectrum valuation.

3 DCF modelling approach

The model has been implemented in Microsoft Office Excel using Microsoft Visual Basic. The DCF model, by determining the future cost and revenues of a radio broadcasting operator, provides the required inputs in order to set appropriate radio spectrum fees. The accuracy of the model outputs depends, among others, on the extent to which the DCF model reflects all the relevant current and future revenues and costs of a modelled radio operator. To do so several assumptions, reflecting actual market condition, should been adopted.

The user of the model is able, via the Graphical User Interface (GUI) of the model, to examine several scenarios by changing a variety of model input parameters. As results, the model provides an estimation of the NPV (Net Present Value) of the discounted cash flows for a potential license owner, during the lifetime of the radio license, as well as the relevant Terminal Value (TV). The TV indicates mainly the value of the radio operator's infrastructure at the end of the license period. The NPV can be used as an indicator, for the determination of the spectrum fee that should be charged in the relevant licensing procedure.

Figure 1 shows the structure of the DCF model. For reasons of simplicity, only the high level architecture of the model is presented.

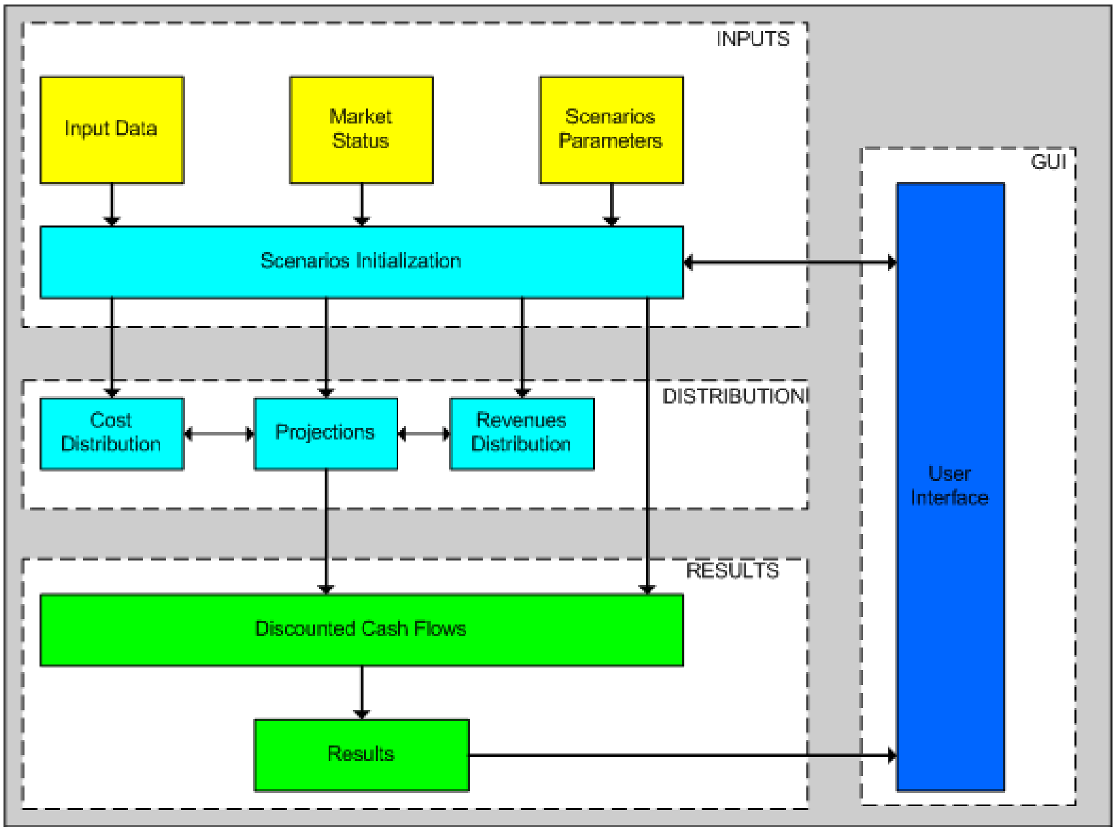

Fig. 1. Structure of the DCF model

As depicted in the above Figure the model consists of four main segments: the Inputs, the Distribution, the Results and the Graphical User Interface. In the following paragraphs is described in detail each of the model segments.

The Inputs Segment contains the inputs required for the determination of the parameters of each scenario. It consists of four sub-segments: Input Data, Market Status, Scenarios Parameters and Scenarios Initialization. The input data are grouped in the following three data categories: Revenues, OPEX and Investments. Revenues data are related to revenues coming from advertising as well as to all other revenues from operations related to radio broadcasting. Operating expenditures (OPEX) are related to the operating costs for the provision of a radio broadcasting service. Investments are related, to the investments made in the past, as well as, to the future investments in relation to radio broadcasting operation. Market Status sub-segment contains the parameters which are related to national conditions in the radio broadcasting market. In particular it contains data related to required network infrastructure for each type of geographical license (for example local, regional and national), such as the number of required sites and the number of required transmission links. It should be noted, that as regards the local licenses, the model provides two categories, one for urban areas and one for rural areas. The user of the model - through the GUI - is able to determine the number of areas that should be considered as rural and urban, taking into account the local market conditions such as the population, the number of radio listeners and the revenues of local radio operators. Scenario Parameters sub-segment contains all the rest parameters required for the initialization of each examined scenario. The fourth sub-segment, Scenarios Initialization, initializes all the required parameters for the running of each scenario. To do so, it receives inputs from the other three sub-segments of Inputs Segment and interacts through the GUI with the user of the model.

The Distribution Segment consists of three sub-segments: Projections, Cost Distribution and Revenues Distribution. The Cost Distribution allocates the existing and future costs related to radio broadcasting operation over the duration of license. In particular the costs are allocated as depreciation expenses to each period in which the asset is used, beginning when the asset is placed for the provision of radio broadcasting service. The level of existing infrastructure and future investments are mainly driven by the geographical type of license (national, regional, local), as well as whether in the examined scenario the radio operator is an existing one or a new entrant. For the allocation of each type of cost, an estimation of the useful lifetime of each asset has been taken into account, while the straight line (linear) depreciation approach has been chosen. In straight-line depreciation, a yearly portion of original cost in equal increments is allocated over the lifetime time of each asset. It should be noted that the salvage value of the assets has been ignored. The lifetime of each group of assets is determined by the user of the model through the GUI of the model. The Revenues Distribution determines the revenues of a radio broadcaster on a yearly basis, during the period of the license. The future revenues and costs (OPEX and CAPEX) are driven by the Projection sub–segment parameters, where the user of the model is able to examine several scenarios. In particular for both revenues and opex costs, several options for linear increase or decrease are available. For future investments two options are available: in the first option, it is assumed that the future investments of the radio operators, during the period of the license, are based on the operator's relevant projections for the years 2012, 2013 and 2014, while in the second option the future investment are determined as a portion of the future revenues of radio broadcasting operators. The level of portion of the future revenues allocated to investments is determined by the user of the model. The revenues of each radio operator are driven by the relevant market share. In our scenarios, equal market shares have been considered between radio operators for each geographical type of license. Given that the DCF analysis will be truncated after the duration of the license, it is considered appropriate to take into account a terminal value (remaining value) that reflects the continuity of the business and the on-going value of the business's assets. Thus the non-amortised values of the assets at the end of the license period has been calculated as the remaining value (or terminal value) of a radio operator at the end of the license period. It should be noted that only the assets related to infrastructure have been taken in to account for the estimation of the terminal value.

The Results Segment contains the outputs of the DCF model and consists of two sub-segments: Discounted Cash Flows and Results.The Discounted Cash Flows interacts with the relevant sub-segments of Distribution and Inputs segments. The discounted cash flows are estimated taking into account the future cash flows, the discount rate (WACC) and the terminal value at the end of the license period. The formula of the discounted cash flows is:

$$DCF_y = \frac{(R_y - C_y - T_y) - I_y - CWC_y}{(1+i)^y} \qquad (1)$$

with

$$T_y = t(R_y - C_y - D_y) \qquad (2)$$

where,

DCF: Discounted cash flow,

R: Revenues,

C: Operational costs (distribution and non-distribution),

T: Taxes,

I: Investment expenditures (distribution and non-distribution),

D: Depreciation (distribution and non-distribution),

i: discount rate (cost of capital - WACC),

y: Year,

t: taxes,

CWC: Change in Working Capital (represents the operating liquidity of an operator),

The NPV is derived from the following formula:

$$NPV = IV_0 + \sum_{1}^{n} DCF_y + TV_{n+1} \qquad (3)$$

where,

IV: Initial value (distribution and non-distribution),

TV: Terminal value (distribution and non-distribution),

n: License period.

The Results sub-segment contains the outcome of the model which is the NPV, and the TV of each scenario. As discussed previously, the Terminal Value represents the value of a radio broadcasting operator at the end of the licensed period. Since the

TV mainly reflects the non-amortized values of the assets, and in particular, the assets related to network infrastructure, it is considered appropriate to represent, in each scenario, the relation between TV and NPV. Depending on the extent to which the non-amortized assets at the end of the licensed period could be re-used in other operations, not necessarily in a radio broadcasting operation, the total or a portion of the TV should be taken into account for the determination of the relevant spectrum fee. It is also assumed that the Initial Value of the existing operators is zero, since the existing infrastructures have been taken into account for the estimation of the required future infrastructure per type of operator and license.

The Graphical User Interface (GUI) Segment provides the appropriate interface to the user of the model, in order to set the inputs parameters of each scenario, as well as, to initialize the variation of the input parameters. In addition, as results, the GUI segment provides the NPV and the TV of each scenario.

4 Model Results

The input values used in the model were taken from the Greek national market. Several sources have been used such as the Greek National Council for Radio and Television (NCRTV) [1] and other national public sources such as [2], [3]. When national data were not available public benchmarking input data have been used such as [4]. Although the majority of the input data, was taken from the Greek market, we argue that the results of our analysis can be easily adopted in any other national radio broadcasting market mainly for the following reasons: i) our conclusions are based on the absolute variance of the parameters focusing on the influence of each parameter to the outputs of the DCF model, ii) the business model of a radio broadcasting operator used in the DCF model, could be applied in any radio broadcasting operator outside of Greece and iii) the network architecture and network components of a radio broadcasting operator used in the DCF model, could be also applied in any radio broadcasting operator outside of Greece.

In each of the following graphs the vertical axis shows the NPV and TV in nominal basis while horizontal axis shows the variation of examined parameter. In each graph the NPV and TV actual values have been normalized to the NPV's actual value of the first value of the examined parameter. It should be mentioned here that our aim is to reveal the sensitivity of each examined parameter to the NPV and TV and not to determine the actual values of the NPVs and TVs. In addition in each examined scenarios only one parameter varies (the examined parameter) while all the other parameters remain constant, in order to reveal the sensitivity of the NPV and TV to the examined parameter.

In the first set of scenarios the following policy parameters are examined: Number of licenses for each geographical type of license, Number of areas for each type of geographical area, License duration, and Type of operator (existing or new entrant).

In Figure 3 the impact of the variation of the number of available licenses for each geographical type of licenses to the NPV and TV is presented. As expected, the NPV and the TV are decreased, as the number of available license increases. The impact of number of license variation is higher, in the case of national license, since as shown in the following Figure, an increase of the available number of licenses from 4 to 6, leads from positive values of NPV to negative values. As regards the local urban licensing it seems that even for 90 licenses the business case is profitable. We should mention here that based on the Greek national market conditions, very high percentage of the national radio broadcasting revenues (mainly advertising revenues) has been allocated to the radio broadcasters operating in local urban areas. On the other hand it seems that there is no business case for local rural radio operators, when the number of licenses exceeds a specific threshold. In our case this threshold is determined on five but we should mention that this threshold is highly sensitive, among others, to the distribution of advertising revenues.

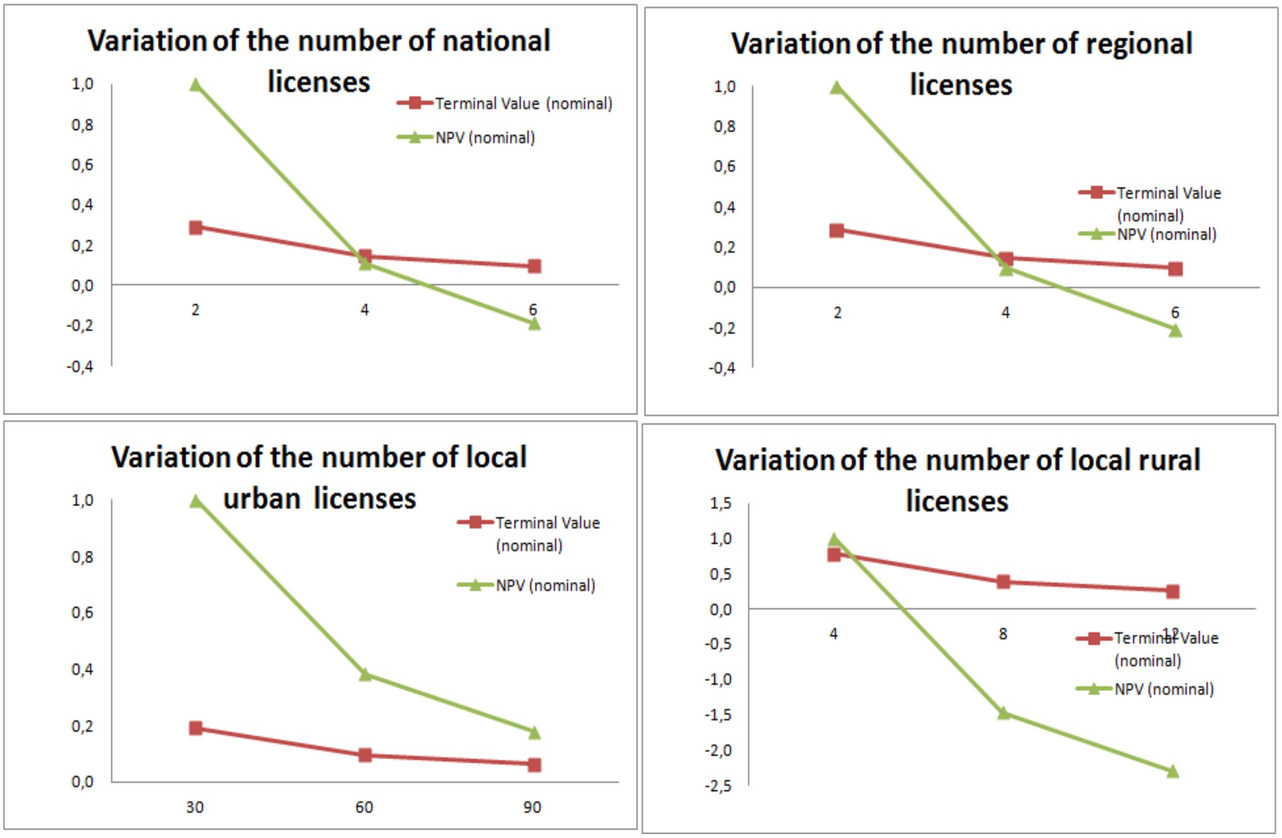

Fig. 2. Variation of the number of geographical license type .

In the next set of scenarios the impact of the number of geographical areas per type of areas (regional, local urban and local rural) is examined. As presented in Figure 4, the NPV is more elasticity to number of areas variation than the TV. This is due to the fact that the TV mainly depends on the level of network infrastructure required for population and geographical coverage, while the NPV highly depends, among others, on the operators' revenues. As depicted in the following graphs, the variation of the number of areas has the higher impact on the NPV values in the case of local areas.

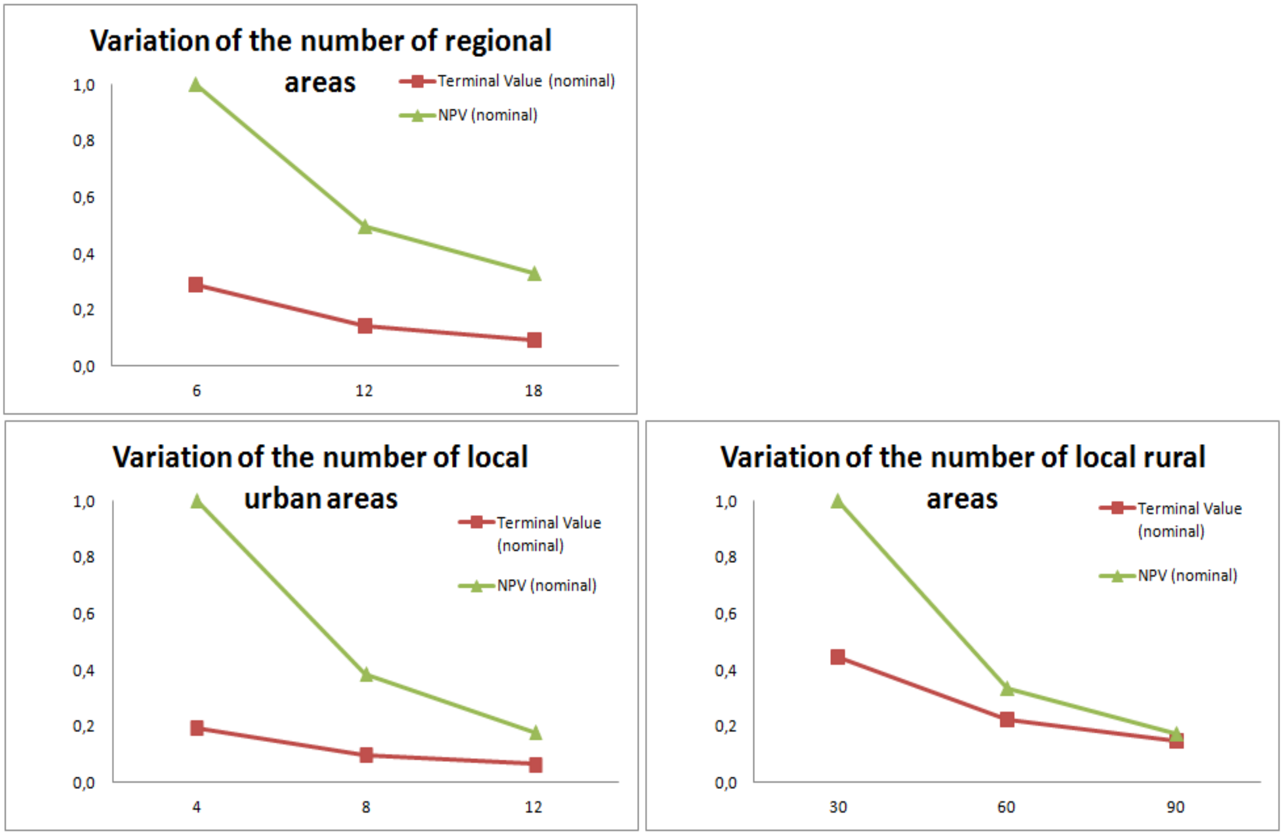

Fig. 3. Variation of the number of areas

In the left diagram of Figure 5 the impact of license duration in the NPV and TV for local urban license is presented. The national legal frameworks foresee license life time with specific duration (for example 6 years), while in the most cases there is the option to only once license extensions, therefore policy makers should be aware of the impact of the license duration in the NPV. As shown in the diagram below, an increase of the license duration leads to slight increase of the relevant NPV, while the TV is decreased. In the right diagram of Figure 5, the NPV and TV of an existing operator and new entrant are compared, both for national license radio operator. The NPV in the case of new entrant is almost 26% lower than the relevant NPV of an existing operator, due to the higher level of the required investments mainly on the network infrastructure.

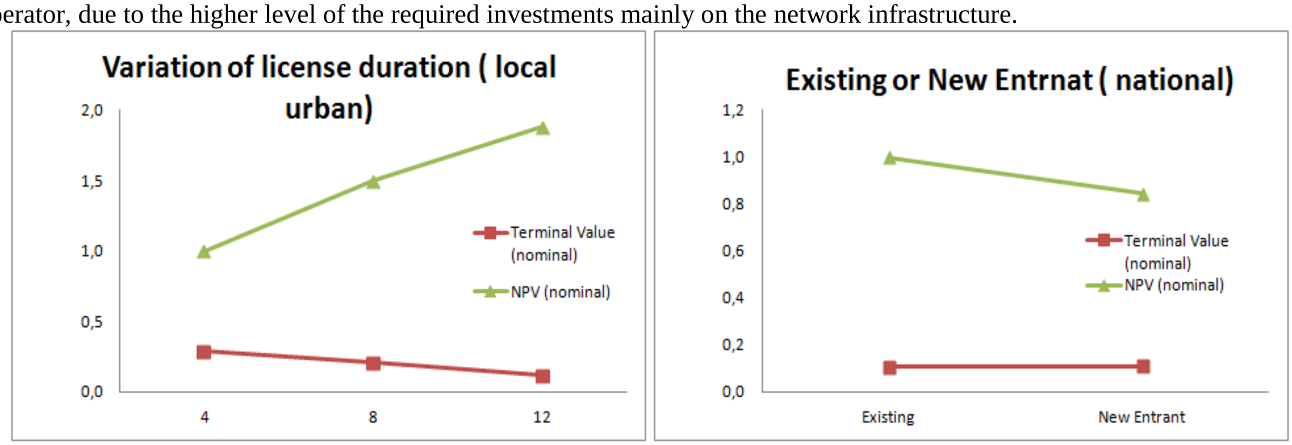

Fig. 4. Variation of License duration and Existing or New Entrant

The next set of scenarios deals with the future market conditions in relation to revenues projections. Due to the high uncertainty of future conditions, mainly due to financial crisis, the examination of the impact of revenues variation to the NPV should be also under consideration. In Figure 6 is examined, the impact of revenues projections to the values of NPV and TV for a local urban operator. In the left diagram, a linear increase of revenues has been assumed, during the lifetime of license with yearly growth of 1%, 3% and 5%. As expected the impact of the level of yearly growth has significant impact on the value of NPV. An annual growth of 4% leads to NPV almost 125 % higher than in the case of 2% annual growth. In the right diagram the impact of annual decrease in revenues is shown. Similarly with the left diagram, a revenues degradation leads to significant decrease of the NPV depending on the rate of revenues decrease. An annual decrease of 4% leads to almost 20% lower NPV compared with the NPV of 2% annual decrease.

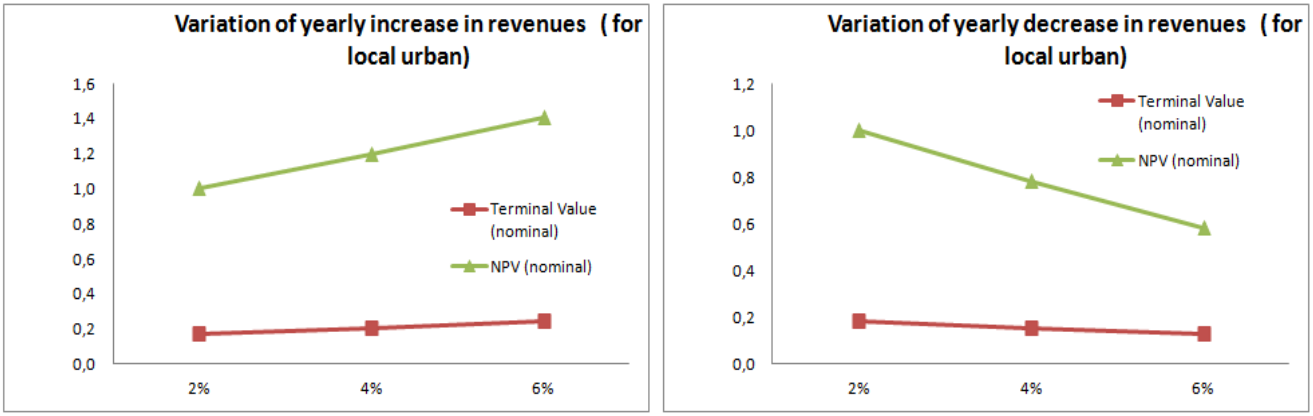

Fig. 5. Variation of revenues projections

In Figure 7 the impact of site' s opex variation to the NPV and TV of a national and local urban ratio operator is presented. Since the number of required sites in a case of national operator is a multiple of the relevant number in a case of local urban operator, the impact of the relevant site's opex is higher in the case of national licenses. Indeed an increase of 40% of the site's opex, decreases the NPV of a national operator by almost 11%, while the relevant NPV of a local urban operator remains almost constant (less than 4% decrease).

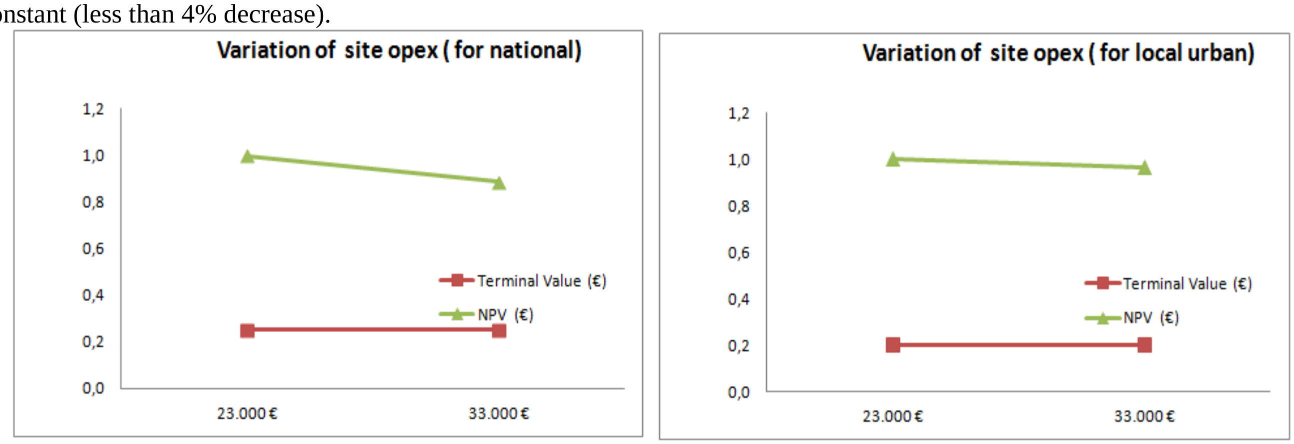

Fig. 6. Variation of site's opex

5 Conclusions

In the previous sections the valuation of radio spectrum granted by the State to radio broadcasting operators has been analysed. In particular a DCF model has been implemented for the affect examination of several parameters in the spectrum valuation. Since the spectrum valuation determines the amount of money that radio operators should pay to the State, in order to hold the spectrum license for a fixed period, an appropriate determination of the examined parameters will lead to efficient spectrum assignment.

The results of our analysis indicate the future revenues projections, the number of available licenses per geographical type of license, the number of areas and the duration of license as the most crucial parameters that affect the determination of the spectrum price.

As regards the number of licenses it is quite clear that depending on the geographical type of license an increase of the number of license may lead to a non profitable business case. The threshold which determines the profitability of a business model varies between the geographical type of license and depend mainly on the allocation of advertising revenues between the geographical types of licenses. In addition the allocation of advertising revenues between the types of licenses depends on national market conditions and may also varies between different national markets. In the issue of revenues projections the results of the model indicate that the spectrum valuation is highly sensitivity to revenues projections. Under current conditions, the projection of revenues, mainly advertising revenues, involves high uncertainty due to financial crisis, therefore policy makers should examine several scenarios in order to analyse future market conditions under different revenues assumptions. Last but not least the duration of a license plays an important role in the determination of the spectrum fees. In particular as the duration of licenses increases such the operators have more time to depreciate its investments and to increase its revenues therefore the determination of spectrum fees is directed connected with the license duration.

In addition the results of our model indicates that due to high sensitivity of spectrum valuation to a set of parameters, policy makers prior the determination of license procedures should examined in detailed each of these parameter taking utmost into account actual data from the national markets. The appropriate determination of the examined parameters analysed in this paper, will allow policy makers not only to maximize the government revenues but also to grant the spectrum efficiently and effectively.

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