Valuing spectrum in Mexico

Overview and summary

A report for the IFT

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Overview of study objectives

The objective of this study is to provide advice on a spectrum valuation framework to assist the IFT in carrying out its regulatory functions which include the setting of reserve prices for auctions, the setting of the annual fees for different frequency bands and the assessment of opportunity cost of spectrum. The work also involves the development of an avoided cost model which would enable the IFT to generate estimates of spectrum value for future valuations. The main focus of this study is on spectrum for cellular mobile services, in particular mobile broadband.

The overall study comprises of four papers as follows.

- Paper 1 sets out the market context, examining market shares of each operator, the current spectrum holdings and how these have been awarded, the existing policy framework and statements on future spectrum awards.
- Paper 2 examines the demand for mobile data, first by considering existing studies and the IFT's current methodologies, and then recommending an estimation framework.
- Paper 3 discusses the different methodologies of valuing spectrum, how they are applied, and which ones would be appropriate for a robust, transparent valuation framework.
- Paper 4 contains worked examples of the recommended methodologies for four bands chosen by the IFT (AWS, PCS, 2.5 GHz, 800 MHz bands), and the valuation results based on the methodologies used. Alongside Paper 4, the avoided cost model is accompanied by its own documentation.

In addition, the IFT has been provided with a number of presentations, updates and notes which have fed into this work. The main findings of each major paper are discussed below.

Market and regulatory context in Mexico

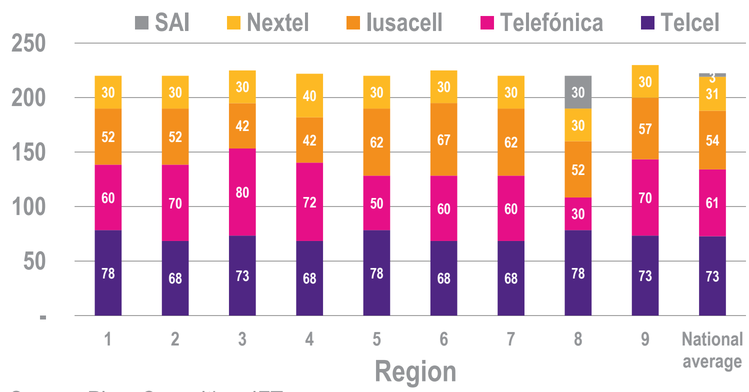
The mobile telecoms market in Mexico is dominated by Telcel (a brand name of AMX) which has approximately 70% market share by subscribers and revenue. Telefonica is the second operator by subscribers and revenues with 20% and 11% of the market, respectively. Iusacell and Nextel are the third and fourth operators, but have recently been acquired by AT&T and the combined entity will have a similar market share to Telefonica. The Mexico market structure in which one operator (Telcel) has more than three times the subscribers of its competitors is unlike most markets where differences in market share among operators tend to be smaller.

In terms of network coverage, Telcel's voice network covers approximately 95% of the Mexican population compared to Telefonica's 85%; AT&T will have about 70% coverage by population. Currently about 220 MHz of spectrum in three frequency bands (850 MHz, PCS and AWS) have been assigned to mobile operators and the holdings differ across the nine spectrum regions as shown in Figure 1.

Figure 1

Spectrum holdings by region

850 MHz, PCS and AWS bands (MHz)



Source: Plum Consulting, IFT

Over the next couple of years, the IFT is planning a number of spectrum awards as shown in Table 1. With the release of this additional spectrum, the total bandwidth available for cellular mobile could increase more than 2.5-fold to 580 MHz by 2017.

Table 1: Planned spectrum awards for cellular mobile

Band	Timetabled release	Quantity of new spectrum for mobile
AWS-1, AWS-3	September 2015	2×40 MHz
2.5 GHz	2016	130 MHz (1)
PCS extensions	Early 2016	2×10 MHz
800 MHz	Early 2016	2×15 MHz

Note: (1) Only 130 MHz will be available for mobile as MVS will have 2×30 MHz for its MMDS system.

Mobile data traffic forecasting

The value of spectrum depends on demand and this is driven by mobile data traffic. There are two approaches generally used for forecasting mobile data traffic, namely bottom-up and top-down.

A bottom-up approach estimates different types of mobile traffic based on historical volumes and expectations of future trends. This is done either in aggregate, or at the per-user level and grossed up by the number of users. This approach has been favoured by many equipment vendors and research organisations, since it gives a view of how the total traffic is broken down into different application types. Examples of bottom-up mobile data traffic forecasts include Cisco's Visual Network Index[1] and Ericsson's Mobility Report[2].

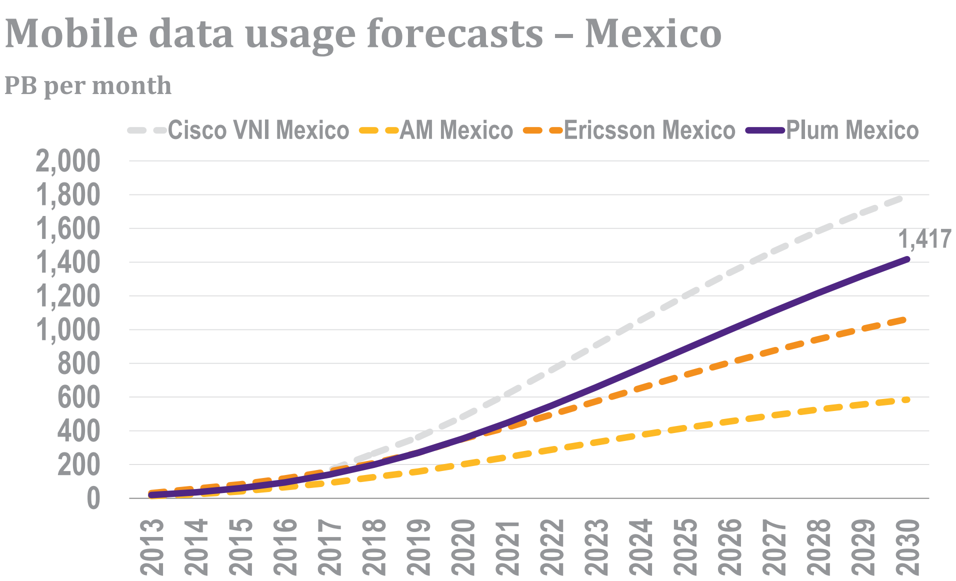
[1] http://ciscovni.com/forecast-widget/index.html

[2] http://www.ericsson.com/mobility-report

The top-down approach refers to the use of existing forecasts to come to a conclusion on the possible range of mobile data traffic. A top-down approach uses other forecasts as guides for potential growth paths of mobile data traffic demand. In general the forecasts from external sources are extrapolated and then averaged to derive the final demand curve. An example of top-down forecasting is the ITU's report ITU-R M2290.[3] While a top-down forecast is simpler and requires relatively less information to produce than a bottom-up forecast, it does not provide insights for network planning.

In this study, a top-down approach is used to derive a mobile data traffic forecast for Mexico as there is insufficient level of detail from existing forecasts to produce a bottom-up forecast. Plum's mobile data traffic forecast for Mexico is shown in Figure 2. In terms of usage per subscription per month, the level is 1.5 GB in 2014 and rises to 10 GB in 2030. The usage level beyond 2025 appears to be consistent with the volume expected in the UK, where Ofcom expects usage to be between 7 and 14 GB per user per month in 2025.

Figure 2:



Source: Cisco, Ericsson, Analysys Mason, Plum Consulting

Valuation methodologies

There are a number of methodological tools available to regulators for the valuation of spectrum for cellular mobile services. In general regulators typically use the following methods:

- Benchmarking analysis based on past auction results or trades, including:
  - Direct benchmarking based on direct comparisons with international benchmarks for similar frequency bands,
  - Adjusted benchmarking using own country results as reference values and adjusting based on relative ratios (value or distance ratios) from international benchmarks,

[3] www.itu.int/dms_pub/itu-r/opb/rep/R-REP-M.2290-2014-PDF-E.pdf

- Econometric analysis, which tests effects of different explanatory variables such as socio-economic, topological or auction-specific differences.

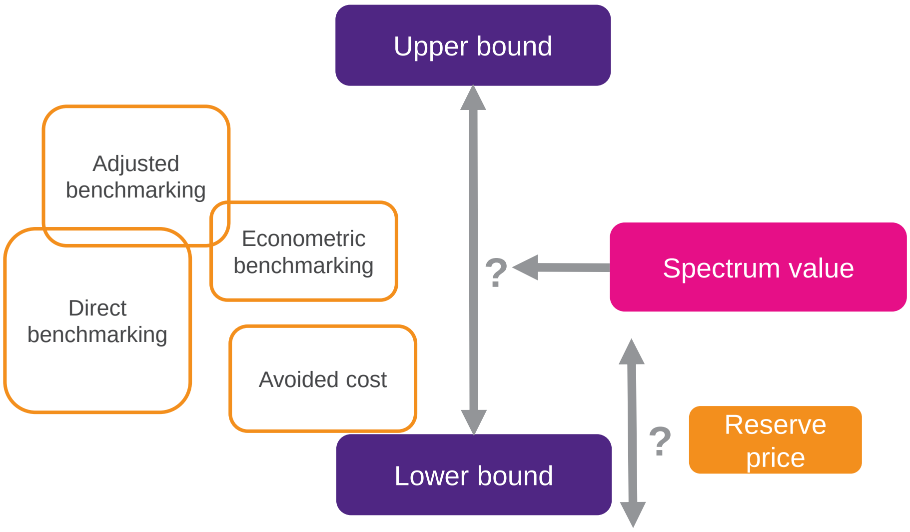
- Avoided cost modelling, which calculates the cost that operators would need to invest in their networks to meet demand absent the award of additional spectrum. A variant of avoided cost modelling involves iterative models, such as Plum's "bootstrap" model, which are based on assumptions of willingness to pay rather than taking demand as exogenous.
- Business modelling, such as full enterprise valuation or discounted cash flow modelling, which looks at the profit that operators can expect from rolling out additional spectrum and reflects the business planning process that will have been followed.
- Opportunity cost estimation using least cost alternative or earnings approaches to calculate the value of spectrum to potential spectrum applications other than cellular mobile. This method is used in cases where there are potential alternative uses of the band besides cellular mobile.

There is no one ideal or correct method and deciding which ones are appropriate depends on the policy context and objectives, and the amount of information available. As there is a necessary degree of uncertainty when valuing spectrum, regulators typically use more than one method to give a sense check on the value estimates. It is therefore important to understand each methodology and recognise their limitations when applying them and when interpreting the results obtained.

Table 2: Pros and cons of spectrum valuation methodologies

Methodology	Pros and cons
Direct benchmarking	✓ Transparent, data available publicly ✓ Reflect actual prices paid by operators × 'Like for like' comparisons may not be possible due to country-specific factors
Adjusted benchmarking	✓ Transparent, data available publicly ✓ Reflect market factors as well as spectrum characteristics × International ratios may not be appropriate comparators as business operations and strategies differ across countries and operators
Econometrics	✓ Robust statistical method; a variety of effects can be tested through different models × Explanatory power of models may be limited due to dataset limitations × Difficulty in accounting for certain drivers of value, such as operators' future expectations, spectrum caps, coverage obligations
Avoided cost modelling	✓ Reflects network planning decisions of mobile operator when acquiring spectrum ✓ Gives a lower bound of spectrum value × Complex modelling requiring access to commercially-sensitive data which may not be available × Results sensitive to input and network cost
Full enterprise valuation:	✓ Gives a theoretical upper bound on spectrum value × Complex modelling requiring accurate forecasts on future costs and revenues for mobile operators × Likely to overstate spectrum value as all profit assumed to derive from spectrum (other intangible factors such as brand, reputation not considered)

Figure 3: Range of values



The application of different valuation methodologies will give a range of values as shown in Figure 3. The value range is useful as a guide but deciding on the appropriate value to use depends on a number of policy and regulatory considerations and the trade-offs between them, for example:

- Award mechanism – if the spectrum is to be auctioned, then a lower value is appropriate as the objective is to set a reserve price for the auction and not a final price; for non-auctions, a higher value may be appropriate to reflect the premium for the risks and costs of an auction which operators avoid.
- Investment and industry growth – high spectrum fees increase costs to mobile operators and may affect investment through reduced cash flow so lower fees may mitigate such risks,
- Competition and market entry – to attract bidders and potential entrants, reserve prices should be set conservatively,
- Optimal use of spectrum – reserve prices should not be set so high as to deter potential bidders or to lead to unsold spectrum; for non-auctions fees should reflect opportunity cost to provide incentives for efficient use,
- Government revenue – auction and annual fees for spectrum represent a return on a public asset but this needs to be weighed up against the potential impacts of high fees on industry, consumers and other public policy objectives.

Valuation results and recommendations

The valuation results for the four bands are summarised in the following tables. The dataset used for direct benchmarking is OECD plus Argentina, Brazil and Colombia. Adjusted benchmarking based on relative value ratios is used to estimate values for the 800 MHz and 2.5 GHz bands with the 2010 Mexico PCS and AWS auction results as the reference values.

The econometric analysis is based on a Generalised Least Squares (GLS) model with seven explanatory variables – population, GDP, cell size, bandwidth sold, number of operators in the market, fixed line penetration and a criticality dummy for spectrum intrinsic to a mobile network. The R^2

statistic for the model is 33% indicating that there are significant country-specific factors that are not being captured in the econometric analysis.

The avoided cost modelling valuation is based on the mobile data traffic forecast described above and the spectrum supply given in Table 1. The avoided cost values for the four bands are modelled for a big operator and a small operator, representative of Telcel and Telefonica or AT&T respectively, taking into account their current and preferred long-run spectrum portfolios across all regions. The marginal bandwidth for avoided cost is 2×5 MHz for an FDD band and 10 MHz for a TDD band.

Table 3: Valuation results for AWS band (MXN/MHz/pop)

Valuation method	Value estimate	Comment
Direct benchmarking	1.5 – 5.3	OECD+3, post 2010 dataset, excluding USA
Econometrics	2.7	
Avoided cost modelling (big operator)	3.8	Preferred acquisition 2×20 MHz
Avoided cost modelling (small operator)	1.1	Preferred acquisition 2×20 MHz

Table 4: Value estimates for 2.5 GHz FDD band in Mexico (MXN/MHz/pop)

Valuation method	Value estimate	Comment
Direct benchmarking	0.4 – 1.4	OECD+3, post 2010 dataset
Adjusted benchmarking	0.9 – 1.2	Mexico 2010 AWS, PCS results used as reference values
Econometrics	1.6	No differentiation between FDD and TDD
Avoided cost modelling (big operator)	3.8	Preferred acquisition 2×20 MHz
Avoided cost modelling (small operator)	1.1	Preferred acquisition 2×20 MHz

Table 5: Value estimates for 2.5 GHz TDD band in Mexico (MXN/MHz/pop)

Valuation method	Value estimate	Comment
Direct benchmarking	0.2 – 0.8	OECD+3, post 2010 dataset
Adjusted benchmarking	0.4 – 0.6	Mexico 2010 AWS, PCS results used as reference values
Econometrics	1.6	No differentiation between FDD and TDD
Avoided cost modelling (big operator)	N/A	Not preferred
Avoided cost modelling (small operator)	1.1	Preferred acquisition 50 MHz

Table 6: Value estimates for PCS band in Mexico (MXN/MHz/pop)

Valuation method	Value estimate	Comment
Direct benchmarking	1.6 – 5.2	OECD+3, post 2010 dataset
Econometrics	6.7	
Avoided cost modelling (big operator)	3.8	Preferred acquisition 2×10 MHz
Avoided cost modelling (small operator)	1.1	Preferred acquisition 2×5 MHz

Table 7: Value estimates for 800 MHz band in Mexico (MXN/MHz/pop)

Valuation method	Value estimate	Comment
Direct benchmarking	2.9 – 9.6	OECD+3, post 2010 dataset
Adjusted benchmarking	10.9 – 24.5	Mexico 2010 AWS, PCS results used as reference values
Econometrics	5.5	
Avoided cost modelling (big operator)	N/A	Not preferred
Avoided cost modelling (small operator)	1.1	Preferred acquisition 2×5 MHz

Auctions are the most common award mechanism for mobile spectrum particularly where demand exceeds supply. A well-designed auction increases transparency and maximises efficiency (and therefore maximises social welfare) while removing the need for governments and regulators to decide on whom to assign spectrum to. Therefore it is recommended that auctions should be the main award mechanism which should be considered by the IFT for spectrum which has been harmonised for cellular mobile use.

In deciding on the value for each band, the policy and regulatory considerations discussed above need to be taken into account. In addition, other relevant issues such as spectrum caps, spectrum set-asides and coverage obligations attached to spectrum licences, could potentially affect demand and thereby spectrum value.

There are certain drivers of spectrum value related to strategic objectives of operators which are not possible to quantify due to the lack of information on operators' plans and motivations. These may include competitive advantages gained by preventing rival operators from acquiring the spectrum they need, blocking prospective market entrants or improving brand image. The ability to trade or lease spectrum in secondary markets could also have an impact on value as this represents another avenue of spectrum access for operators, besides primary assignments. Assessing how these factors affect spectrum value involves an element of judgement and understanding of the local market context.

When deriving reserve prices, the annual fee levels in Mexico need to be taken into account and an appropriate reduction factor applied to the estimated value. In general where there is a significant degree of uncertainty over bidding behaviour, level of demand or potential market entry, then it would be prudent to set a lower reserve price to forestall the possibility of unsold spectrum.