Spectrum

Effective Spectrum Pricing: Supporting better quality and more affordable mobile services

Executive summary and overview
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1. Executive Summary

To deliver affordable, widespread, quality mobile broadband services, operators require fair access to sufficient radio spectrum. Careful spectrum management is central to the digital economy. This report highlights the damage done to consumers by governments and regulators that artificially inflate spectrum prices. Put simply, higher prices are associated with more expensive, lower quality mobile broadband and irrecoverable losses in consumer welfare worth billions of dollars worldwide.

The report investigates spectrum pricing trends worldwide and their impact on consumers, and highlights best practice for policymakers. We observe that average final prices paid in spectrum auctions have increased 3.5 fold[1] in the 4G era (i.e. 2008-2016). While price outcomes for many awards remain moderate, the upward trend in prices appears to be driven by a growth in the number of exceptionally high price auction outcomes.

There is a view that very high spectrum prices have no downside for consumers. Spectrum costs are categorised as 'sunk costs' and this has been interpreted as meaning they have no impact on operators' investment and pricing decisions. Thus auctions are sometimes viewed as a risk-free means of maximising state revenue. This report is part of the growing body of academic and industry research which refutes this thesis.

We present statistical evidence linking high spectrum spend with:

- **lower quality and reduced take-up of mobile broadband services;**
- **higher consumer prices for mobile broadband data; and**
- **lost consumer welfare with a purchasing power of US$250bn across a group of countries where spectrum was priced above the global median – equivalent to $118 per person.**

High prices in auctions can often be traced to decisions by policymakers. The study draws attention to three types of policy mistake that distort outcomes by artificially inflating prices:

1. **Setting reserve prices that are above the true market value**
2. **Limiting spectrum supply or creating uncertainty over future availability**
3. **Inappropriate award rules which expose bidders to undue risk or are anti-competitive**

The report highlights many examples of auction outcomes blighted by such bad practices. In some cases, mistakes may have been inadvertent but in others they are a direct result of misguided efforts to raise revenues. Such cases are contrasted with countries who have adopted policies which prioritise improving mobile broadband access – rather than revenue maximisation – when awarding spectrum.

The report makes four key recommendations:

1. **Set modest reserve prices and annual fees, and rely on the market to set prices**
2. **License spectrum as soon as it is needed, so as to avoid artificial spectrum scarcity**
3. **Avoid measures which increase risks for operators**
4. **Publish long-term spectrum award plans that prioritise welfare benefits over state revenues**

With 5G and advanced 4G technologies requiring ever-increasing amounts of spectrum, those countries that inflate prices are not only damaging their broadband future, they are holding back their entire digital economies. The mobile industry, directly and as an enabler of adjacent sectors and services, contributed US$3.1tn to global GDP (i.e. 4.2%) in 2015. Governments and regulators must fully appreciate their ability to maximise – or thwart – their digital futures when making policies that determine spectrum prices.

1 We use a three-year moving average of spectrum prices from 2008 to 2016 to identify the underlying trend

2. The spectrum pricing fallacy: why high prices are not risk-free

Radio spectrum is used to carry information wirelessly for a vast number of vital services. Demand for this precious national resource is so great that governments and regulators take great care to ensure it is used as efficiently as possible. Efficient use helps to ensure that the socioeconomic benefits that spectrum enables can be maximised.

The main rationale for charging a price for spectrum, whether through upfront fees or annual charges (or both), is to promote its efficient use. The price is an objective means of distinguishing between different applications for spectrum licences. In this way a well-designed auction will allocate spectrum to those who value it most thus incentivising them to use it efficiently. Charging for spectrum also provides money for the state and where demand is great, this can be significant.

Following the huge amounts raised by some 3G spectrum auctions in the new millennium, a critical question has arisen as to whether there is a trade-off between maximising revenues and maximising efficient spectrum use. Over time, does very expensive spectrum discourage efficient use and thus reduce the flow of welfare benefits?

On one point there is broad agreement. If spectrum is priced so high that it fails to sell, this does serious harm. Spectrum is a renewable resource, so when it is left unassigned for any prolonged period, welfare benefits that would have accrued to consumers, and society more widely, are lost forever. The mobile economy – which relies on spectrum – is hugely valuable. In 2015 alone, mobile services (directly and indirectly) contributed US$3.1tn to the global economy[2] – and provided vital social benefits such as mobile health and education.

But what if the spectrum does all sell at high prices, is this risk-free? Historically, many mobile industry observers argued that because spectrum costs were 'sunk', no matter how high a price is paid, there should be no impact on network investment or higher mobile tariffs. The classic comparison is with investing in a piece of factory machinery which cannot be sold again. The upfront cost of the machine is sunk. Therefore, as it cannot be recovered, it should not influence future decisions regarding the price of the products created using the machine.

In the report, we highlight recent academic work that contradicts this notion that firms ignore sunk costs when making decisions on investment and pricing. These are summarised in the box below. Far from being a distortion-free tax, the literature suggests that high upfront input costs can depress investment and reduce price competition, especially in settings when there are only a modest number of operators. This reinforces the point that regulators should take great care to avoid actions that could distort auction outcomes and lead to prices that exceed a fair market level. The financial upside, if any, for governments from higher revenues is offset by the risk of award failure and downstream inefficiencies leading to lower quality, more expensive services.

WHY DO HIGH SPECTRUM COSTS IMPACT INVESTMENT AND CONSUMER PRICING?

1. Hold-up problem	■ Spectrum awards are not one-off ■ If firms believe their expected returns will be extracted in successive auctions, they will change their investment strategy
2. Internal financing constraints	■ High prices may exhaust scarce, lower-cost internal funds ■ Access to investment capital from multinational parents or external sources may be rationed in response to low profitability
3. Observed pricing decisions	■ In sectors with naturally constrained competition, firms with high sunk costs may engage less in price competition ■ Expensive licences may act as a signal for firms to set higher prices

3. How do rising spectrum prices impact consumers?

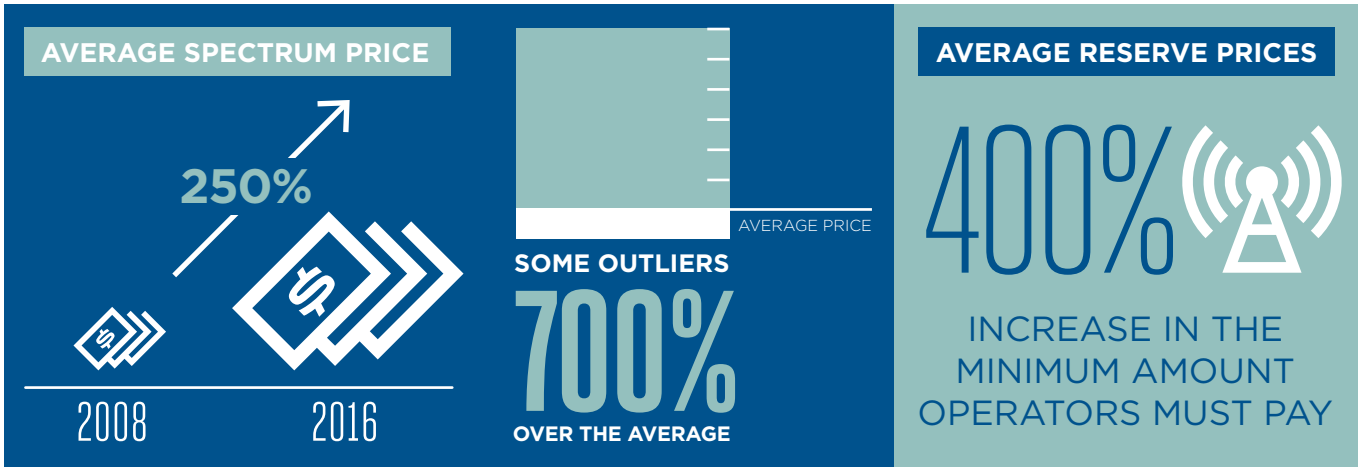
The study presents our investigation of spectrum pricing trends worldwide and the impact they are having on consumers. We found that on average spectrum prices are rising, and that there is a statistically significant link between high spectrum prices and more expensive, lower quality mobile broadband services. We link these trends directly to lost welfare benefits.

Rising spectrum prices

To explore the link between spectrum prices and consumer outcomes, the study examined 325 awards of spectrum bands across 60 countries from 2000-2016. This highlighted that, over the 4G era (2008-2016), the average final price paid for spectrum sold at auction increased 3.5 fold, while average reserve prices increased over 5-fold.

Although the prices paid for many awards remain moderate, the upward trend appears to be driven by a growth in the number of very high price auctions[3], including many where regulators or governments set reserve prices well above the global mean. This situation would not be concerning if all instances of very high prices were attributable to strong competition between bidders with robust business cases. However, our research shows that many of these outcomes were due to policy decisions, not market forces.

SPECTRUM PRICING TRENDS FROM 2008-2016



3 These include auctions of spectrum in coverage (i.e. below 1 GHz) and capacity (i.e. above 1 GHz) bands

The impact of rising prices

The cost and quality of mobile broadband services depend on many factors, including various aspects of technology, policy, business, economics and geography, among others. No single factor perfectly correlates with better, lower cost services. The secret is focusing on the right recipe of factors – this research demonstrates that spectrum pricing is a key ingredient.

Spectrum prices and network investment

Network investment is at the heart of fast mobile broadband services with good coverage. As such, there is a growing interest from governments and regulators in adopting policies that incentivise heavy network investment by mobile operators. It is therefore relevant to explore the role of spectrum prices in driving incentives for network investment. Recent academic research suggests that high spectrum costs reduce incentives for network investments. To test this link, we created a 'wireless score' for each country in our sample, which measures service quality (ie. average speed and coverage) and 4G uptake. This score is a proxy for investment data, which is not widely published.

The study found a significant statistical link between countries with higher spectrum prices and lower wireless scores. This link was most pronounced in high and medium income countries. There was also a correlation in low income countries, but it was less clear as the sample size was small (owing to lack of data points), 4G rollouts are less mature and the countries differ so widely. It can be expected that low income countries will follow the path of high and medium income countries.

Spectrum prices and the cost of mobile data

The need for affordable mobile broadband access is undeniable and is a primary focus for all telecom regulators. However, empirical evidence from behavioural economics research suggests that firms with high sunk costs are more reluctant to engage in price competition. High upfront fees for spectrum licences can thus lead to higher consumer prices.

To test whether this relationship holds, the study compared spectrum costs and observed prices in September 2016 for wireless data for each sampled country. This required creating a 'representative plan' for 1 GB of data in every mobile network operator within a country.

The results showed a statistically significant correlation between lower spectrum costs and lower consumer data prices in high and medium income countries. There was also a correlation in lower income countries, but it was not statistically significant (for the same reasons as in the investment study). We anticipate that low income countries will follow the same path as the others studied, and further work will be done to watch this as more data becomes available. These results support the hypothesis that high spectrum costs suppress price competition.

High spectrum prices and lost consumer welfare

High spectrum prices can have serious economic consequences by driving up consumer data costs which in turn restricts broadband demand. The financial cost of these lost consumer welfare benefits can be calculated. Naturally, these lost benefits need to be weighed against the greater treasury revenues that accrue from higher priced spectrum.

To explore this, the study used an econometric model[4] of mobile data demand to calculate the potential welfare gains from lower spectrum costs (via lower consumer prices). It measured the extent of the consumer welfare gains if those countries where spectrum prices were above the median had in fact sold spectrum at the median price level instead.

Across a sample of 32 countries, 15 had costs above the median for their peer group (i.e. higher, medium and lower income countries). The lost welfare gains across these countries amounted to $445bn. This would come at the expense of $192bn in reduced treasury revenues. Thus, the net welfare gain from lower spectrum prices would be $253bn or $118 per person.[5]

These statistics may understate the negative economic impacts. More expensive, lower quality mobile broadband services will also constrain the growth of industries that rely on mobile communications and thus also reduce the ability of governments to earn higher revenues through taxation across the economy.

4 Based on Hazlett and Muñoz's respected methodology in A Welfare Analysis of Spectrum Allocation Polices (2004).

5 All these figures are adjusted to account for differences in purchasing power across the countries.

4. Mistakes in spectrum pricing

We have identified many examples of awards generating prices well above average levels, and the instances of such high price outliers have increased in recent years. The variations in price are simply too great to be explained by differences in local mobile market conditions, such as market penetration or revenues per user.

Sometimes, high prices may simply be the result of strong competition between current and aspiring mobile operators. This should not generally be a concern for regulators. However, in recent years, more often than not, high prices can be linked to decisions by local policymakers, in particular with regards to reserve prices. This in turn implies that many countries are implementing pricing policies that discourage roll-out of next-generation mobile services and constrain consumer welfare.

The study identified three broad policy mistakes:

1. **Setting spectrum prices that are above the true market value**
   - High upfront reserve prices: Distort the market by artificially inflating prices leading to in-demand spectrum selling at above market rates or going partially – or completely – unsold. Instances of unsold spectrum are increasing which means higher prices can result in lower state revenues as well as the lost welfare benefits when spectrum goes unassigned.
   - High annual fees: Distort the market by discouraging interest in licences and/or raise operator costs to a level that risks creating more expensive, lower quality services.
2. **Limiting spectrum supply or creating uncertainty over future availability**
   - Holding back spectrum from the market: Artificially inflates demand and therefore prices. Causes may include a general failure to license enough spectrum for mobile services, or the use of spectrum caps or set-asides that create artificial scarcity for a subset of operators.
   - Failing to provide a roadmap for future spectrum releases: Demand is artificially inflated when bidders do not know when future opportunities to acquire spectrum will arise.
3. **Inappropriate award rules**
   - Onerous or ambiguous licence obligations: Reduce the value of licences to operators, leading to reduced participation or risk of subsequent failure in meeting the licence terms.
   - Rules that promote insincere or anti-competitive bidding: Including those allowing non-binding bids or where the price of one licence determines the cost of subsequent licences. These allow bidders to adopt tactics to increase the amount their rivals pay.
   - Rules that put enterprise value on the line: Prices for spectrum can become extremely high when bidders judge that failure to win spectrum would put the value of their company, or their ability to successfully offer services, in jeopardy.

Excessively high prices or failed auctions are often caused by more than one of these policy errors. For example, if spectrum availability is artificially constrained, this may support excessive reserve prices and create options for bidders to foreclose competition.

5. Spectrum pricing policy best practice

The goal of pricing policies should be to award spectrum to those who will use it most efficiently to deliver maximum benefits for society. This study shows how policy decisions that distort market-based spectrum awards by artificially inflating prices discourage efficient use and destroy consumer welfare. With 5G and advanced 4G technologies requiring ever increasing amounts of spectrum, those countries that artificially inflate prices are impeding broadband access and stifling their digital economies. As such, governments and regulators need to carefully assess how their policies impact spectrum prices.

Mobile communications is one of a wide range of industries dependent on essential inputs provided by public authorities. We surveyed other industries – such as airport slots and mineral extraction rights – and compared their approaches to pricing and allocation to policies used in the mobile sector.[6] We observed that In those industries with similar attributes to mobile, regulators engaged in best practice rely on the market to set prices, encourage full utilisation of the resource, take measures to mitigate risk for operators and adopt a long-term perspective to social value creation.

The report offers the following four key policy recommendations:

1. **Set modest reserve prices and annual fees:**
   - Set reserve prices below a conservative estimate of the market value to enable competition and price discovery.
   - Annual fees should typically be set at modest levels, for example sufficient to recover spectrum-management costs. If a regulator decides or is required to impose higher annual fees, they become an important component of the reserve price, and expectations for potential auction prices should be moderated accordingly.
   - Exercise caution when using international benchmarks to estimate market value owing to inevitable differences in local conditions. High price outliers should typically be ignored as they usually have unique explanations that are often rooted in policy error.
2. **License spectrum as soon as it is needed**
   - License spectrum bands as soon as local operators have a business case to deploy them. This supports better value, faster, more widespread mobile broadband services
3. **Avoid rules which increase operator risks thus jeopardising investment:**
   - Avoid award rules which encourage anti-competitive bidding activity (e.g. non-binding bids or allowing the price paid for once licence to determine the price of others).
   - Use coverage obligations carefully (e.g. focus on lower frequency bands and avoid needless duplication of networks in non-commercial areas).
   - Adopt long licences (e.g. 20-25 years or guaranteed renewal rights).
4. **Publish long-term spectrum award plans that prioritise welfare benefits over state revenues:**
   - Create a national broadband plan focused on maximising the long-term socioeconomic benefits from mobile services. This should prioritise stimulating competition and investment, not maximising short-term state revenues.
   - Publish a long-term roadmap for future spectrum releases so operators understand their options over time and can thus value spectrum with greater certainty.
   - Delegate spectrum pricing decisions to an independent regulator and use cost-benefit analysis frameworks to ensure decisions focus on the long-term benefits for society

Countries which artificially inflate spectrum prices are damaging broadband access and their digital economies.

6 An entire chapter in the full report is dedicated to lessons from non-telecom regulators.

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