Best practice in spectrum pricing

13 November, 2017

Nairobi, Kenya

Our studies on spectrum pricing

- NERA conducted a global study on best practice in spectrum pricing for GSMA
- The report was launched as part of the GSMA World Congress Ministerial Programme in Barcelona 2017

325 AWARDS

Across 60 COUNTRIES From 2000-2016

To explore the link between spectrum prices and consumer outcomes, the GSMA and NERA Economic Consulting analysed 325 awards of spectrum bands across 60 countries from 2000-2016

Background to the study

- Widespread operator concern about spectrum prices
  - Many examples of very high prices and perception that prices in general are rising
  - Revenue-focused public authorities don't see downsides of high prices
    - Strong belief in simple 'sunk cost' theory which says consumers are not negatively affected
    - View that competitive markets ensure consumer bills stay low and network investment high even when spectrum prices are high
  - Current prices for spectrum in many countries are unsustainable:
    - Spectrum demand is growing - especially with 5G coming
    - In mature markets, ARPUs are flat and scope to expand revenues is uncertain

SCOPE OF STUDY

What is the right price for spectrum?	What is happening in practice?
What are the common mistakes in spectrum pricing?	What can we learn from practice in other industries?

RECOMMENDATIONS FOR BEST PRACTICE

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What is the right price for spectrum?

The price of spectrum

- The price of spectrum consists of up to three elements:

UPFRONT RESERVE PRICE + COMPETITIVE PREMIUM (IN AUCTION, IF ANY) + ANNUAL FEES (NPV OVER LICENCE TERM)

- This is distinct from the value that a mobile operator could realise from acquiring any particular spectrum licence, which is influenced by:

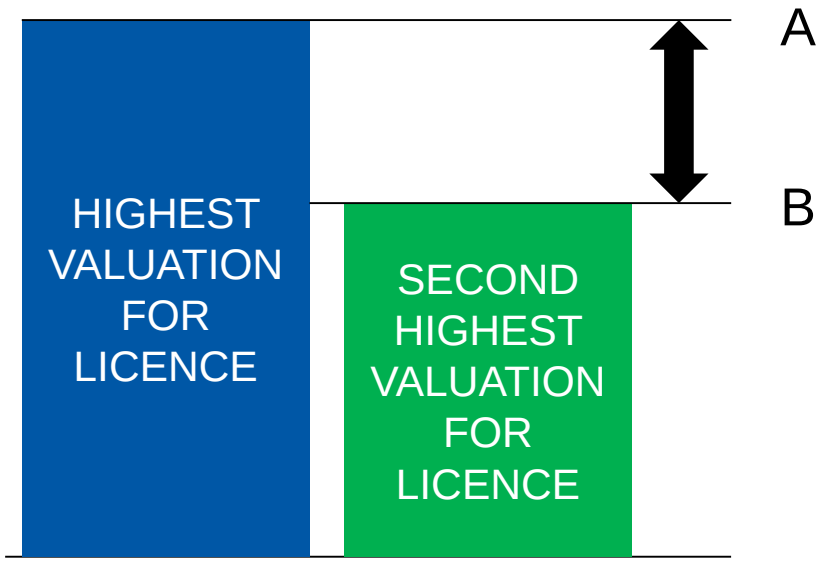
REVENUE EXPECTATIONS (MARKET SHARE, ARPU, COMPETITION, ETC..) & SUPPLY ALTERNATIVES (OTHER SPECTRUM OR NETWORK INVESTMENT) & LICENCE CONDITIONS (COVERAGE OBLIGATIONS, RENEWAL OPTIONS, ETC..)

- In a properly functioning market, companies bid to acquire spectrum when its expected value exceeds the price

Efficiency and revenues

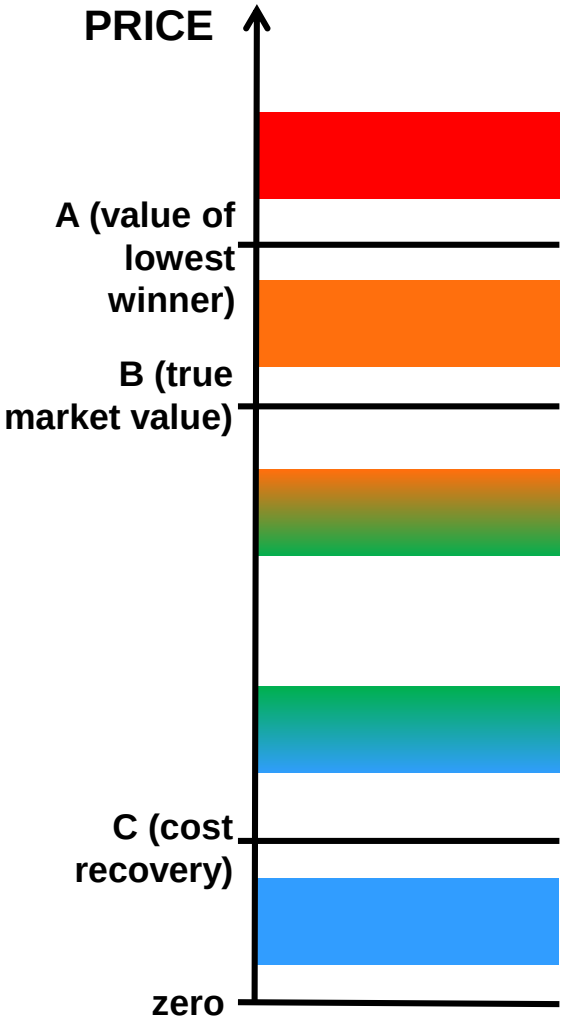
- Economic literature emphasises the importance of “efficiency” in allocating scarce public resources
- This is reflected in the mandate of most regulators to allocate spectrum to those who can use it best
- In a spectrum award, the purpose of pricing is to identify the efficient user(s)
- Revenues should always be a secondary objective, as:
  - Benefits to consumers flow from efficient outcomes
  - At high prices, efficient outcomes may not be realised

AUCTION FOR A SINGLE LICENCE



- **To avoid unsold spectrum, regulators should prioritise ensuring price is below A**
- **As is it is inherently difficult for regulators to estimate prices, best way to achieve efficiency is to use auction to identify true market value, B**
- **This requires reserve price (including annual fees) is set below conservative estimate of B**

What is the right price for spectrum?



Award Failure – Spectrum will go unsold, as marginal winners cannot afford spectrum

Spectrum may sell, but with maximum risk and financial burden on operators, and associated disincentives for competition and investment

Effective Pricing Zone – trade off between:

- higher prices (more revenues but higher burden on operators and their customers)
- lower prices (lower financial burden but less revenues and demand reduction concerns)

Absent positive externalities, government should not proceed on these terms, as revenues do not cover costs of award

IMPLICATIONS FOR REGULATORS

- Best practice: Set reserve price in the green zone and rely on auction to determine market price
- Bad practice: Attempting to price in the orange or red zones
  - High risk that award will fail with spectrum going unsold, at expense of consumer benefits from spectrum use
  - Even if spectrum sells, consumer benefits may be destroyed owing to disincentives for investment and competition

Sunk cost theory does not provide a rationale for high spectrum prices

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- Prevailing school of thought amongst many policymakers that upfront spectrum prices are sunk:
  - No impact on investment and pricing
  - Higher fees always preferable to lower ones provided outcome is efficient
  - Auction revenues are a distortion free tax and preferable to direct taxation
- Such arguments are flawed:
  - High prices are inherently risky, as they are more likely to be associated with inefficient allocations & award failure
  - They ignore more sophisticated evidence from economic and financial theory regarding impact of repeat events and access to capital
  - They ignore empirical observation that firms with high sunk costs do adjust pricing decisions

1. Hold-up problem (Economic theory)	▪ 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 financial constraints (Financial theory)	▪ High spectrum spend may exhaust existing funds and require financing ▪ Investment by multinational parents or external sources may be redirected towards more profitable markets or ventures
3. Observed pricing decisions (Behavioural economics)	▪ In sectors with naturally constrained competition, firms with high sunk costs may engage less in price competition ▪ High spectrum spend may act as a signal for firms not to lower prices

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What is happening in practice?

Questions we set out to answer

#1	Are spectrum prices increasing?	Yes – both reserve prices and final prices for spectrum have been trending upwards since 2008 Average final prices are up 250% from 2008 to 2016
#2	Do high spectrum costs affect the level of investment in 4G networks?	Yes – high spectrum costs are correlated with lower levels of investment in 4G (contrary to simple sunk cost theory)
#3	Do high spectrum costs affect downstream pricing decisions?	Yes – high spectrum costs are correlated with higher prices for mobile data (again, contrary to simple sunk cost theory)
#4	What is the welfare impact of high spectrum prices on consumers?	Our econometric model implies that consumers are losing out on billions of dollars in welfare owing to high spectrum prices

- Our results are based on an analysis of 325 spectrum band releases across 60 countries from 2000-2016

#1 Prices in the 4G era are trending upwards …

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- Since 2007, large increase in number of spectrum awards:
  - Driven by the need to find new bands and repurpose old ones for 4G mobile broadband
  - This period coincides with a take-off in consumer demand for mobile data services
- Average prices have climbed steadily since 2008:
  - Upward trend in level of reserve prices (see next slide)
  - Increase in number of awards of sub-1GHz (coverage spectrum)
  - Growth in number of high price outliers for both coverage and capacity spectrum
- Operators in many countries are spending a greater proportion of revenues on spectrum than ever before

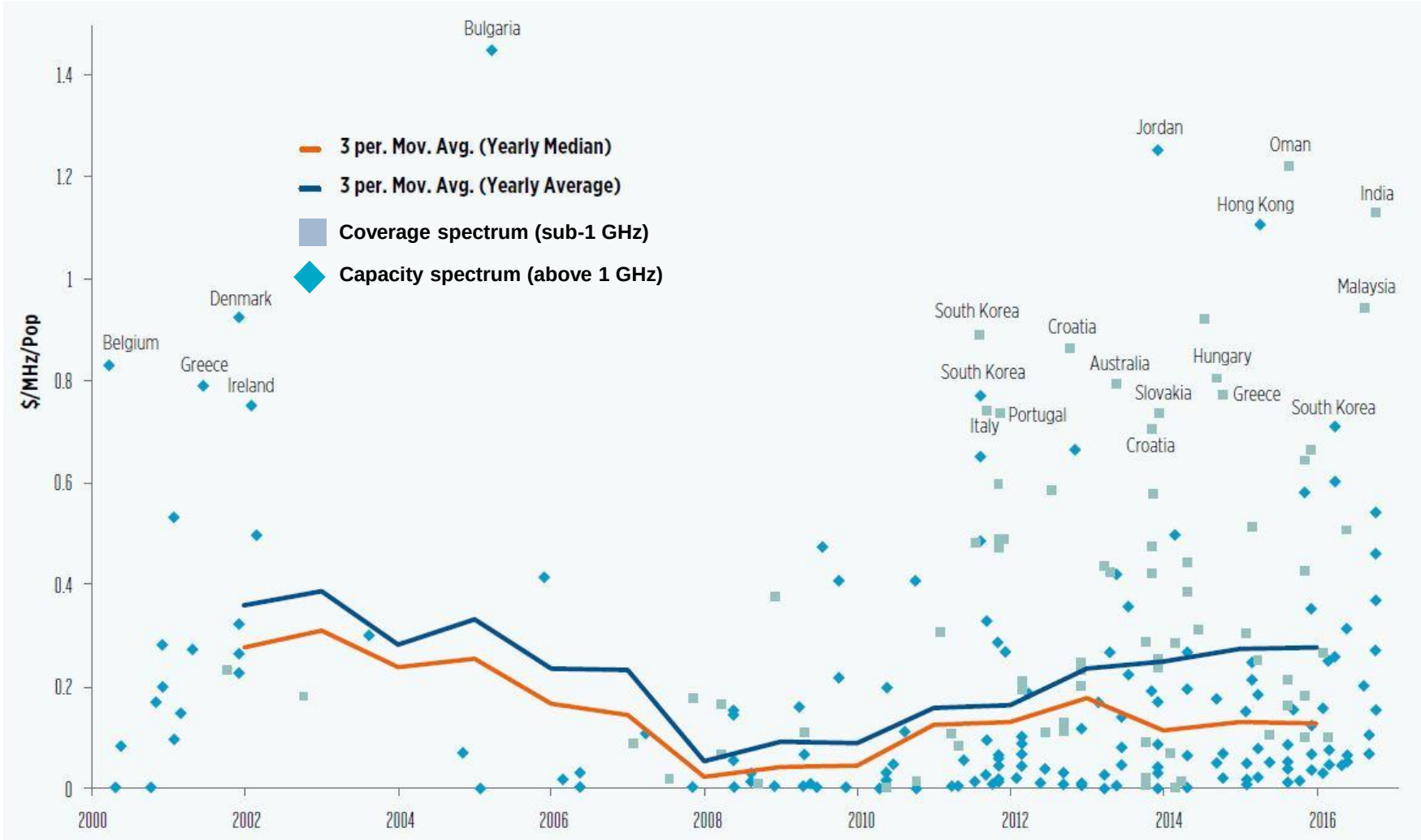
GLOBAL TRENDS IN SPECTRUM PRICES, BY BAND AND AUCTION, 2000-2016

NOTES: Prices per MHz pop are adjusted for inflation and were converted to USD using IMF purchasing power parity (PPP) rates. Prices are also adjusted for licence duration, based on a standard 15 years, using a 5% discount rate.

#1 … as are reserve prices

- Reserve prices have increased at a faster rate than spectrum prices
  - Since 2012, there have been a large number of very high reserve prices
  - Coincides with growing confidence regarding the need for operators to acquire more spectrum to deliver data services
  - High reserves may be linked to use of benchmarks incorporating high price outcomes

GLOBAL TRENDS IN SPECTRUM RESERVE PRICES, BY BAND AND AUCTION, 2000-2016



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#2 We developed a ‘wireless score’ to rank each country’s investment in 4G networks

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- As a proxy for 4G network investment, we developed a ‘wireless score’
- It has three components that collectively measure the quality and uptake of next-generation data services

3G/4G COVERAGE (%)

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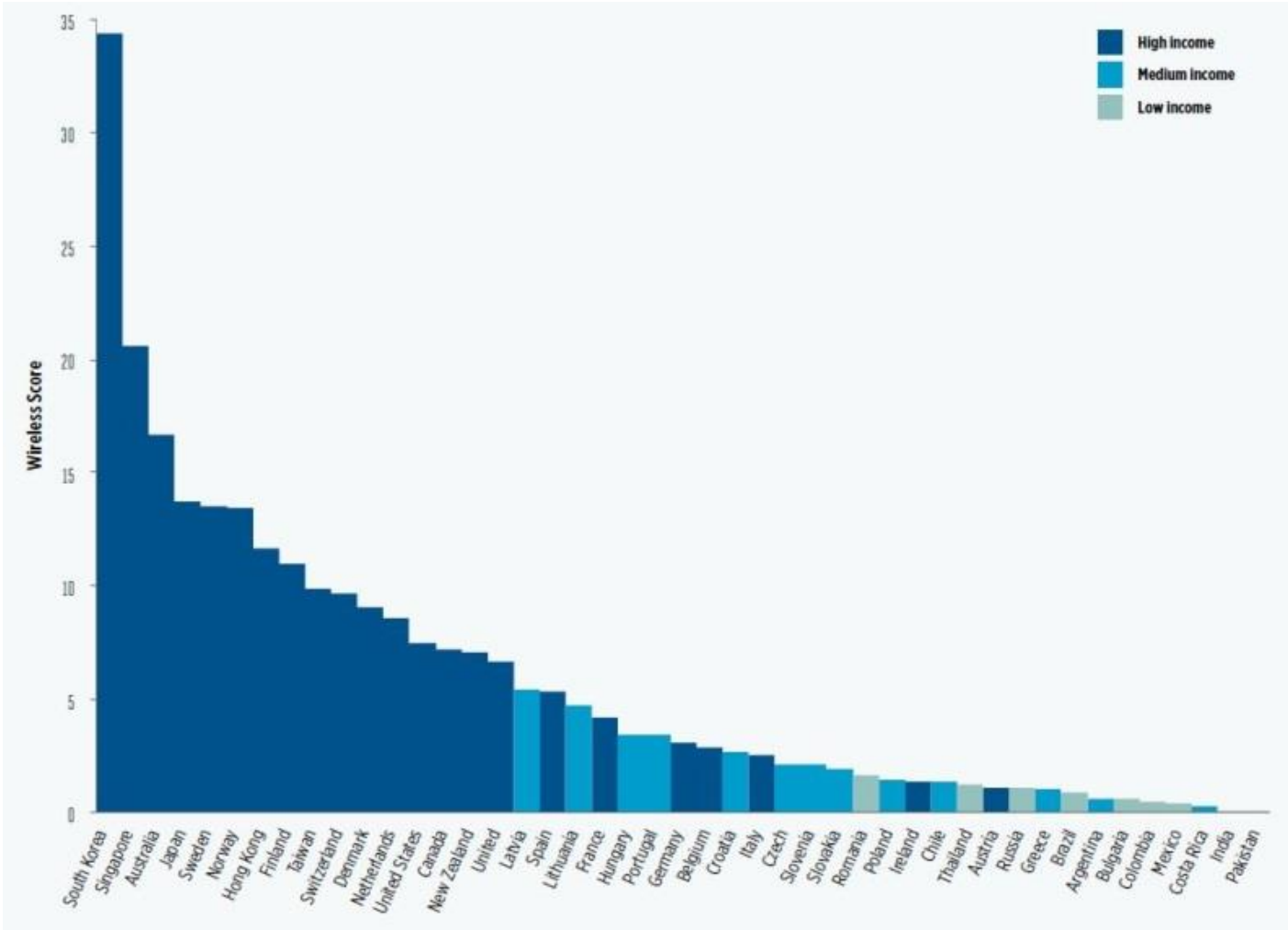
4G SUBSCRIBERS (%)

*

AVERAGE SPEED (Mbps)

Wireless score by country



Source: NERA Economic Consulting, using data from OpenSignal.com and Telegeography GlobalComms database

#2 High spectrum costs are correlated with low wireless scores

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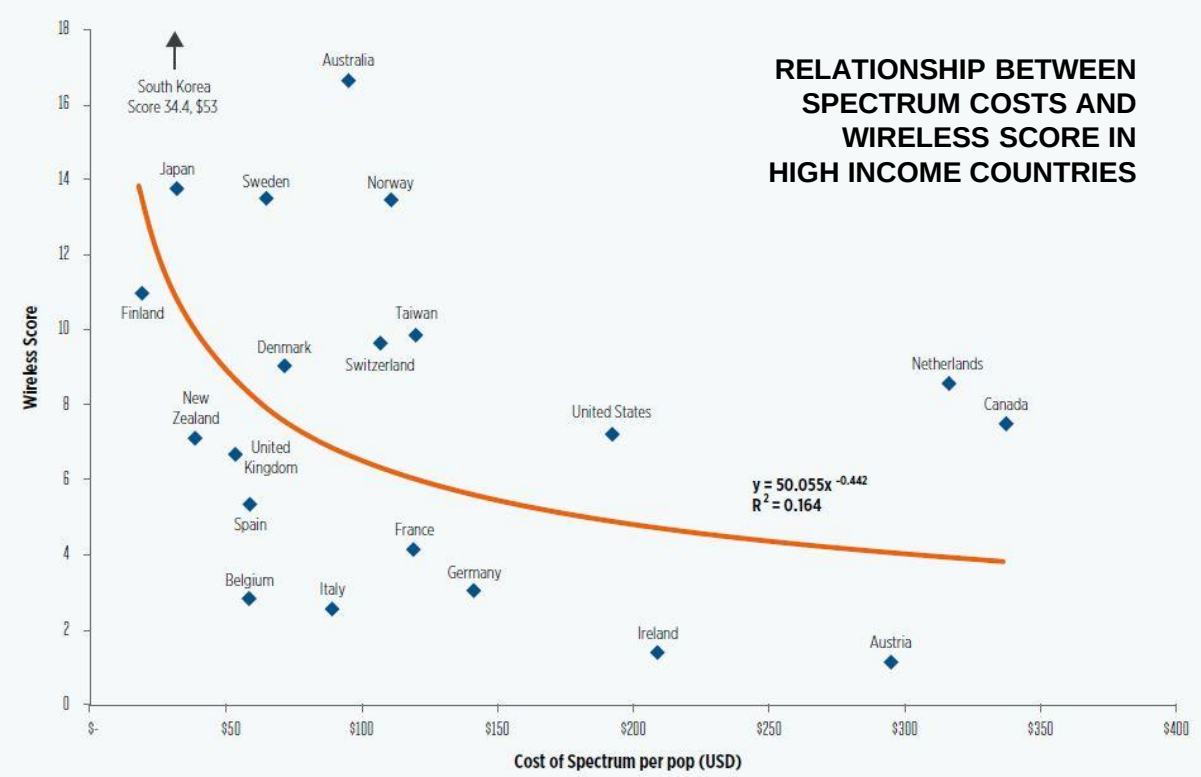
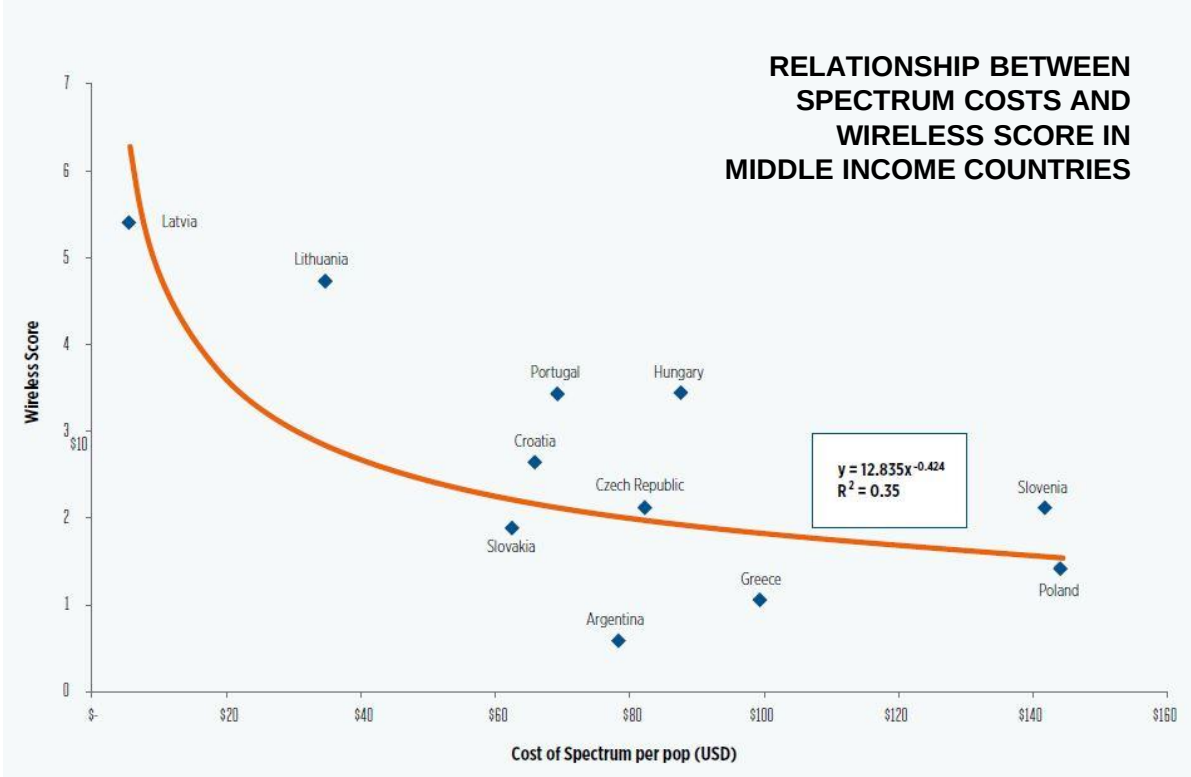
- We observed that, for groups of higher income and middle income countries:
  - There is a statistically significant, **negative relationship between total spectrum spend and the wireless score**
- This evidence supports both broader theoretical and empirical work linking high input costs for scarce resources to lower rates of investment



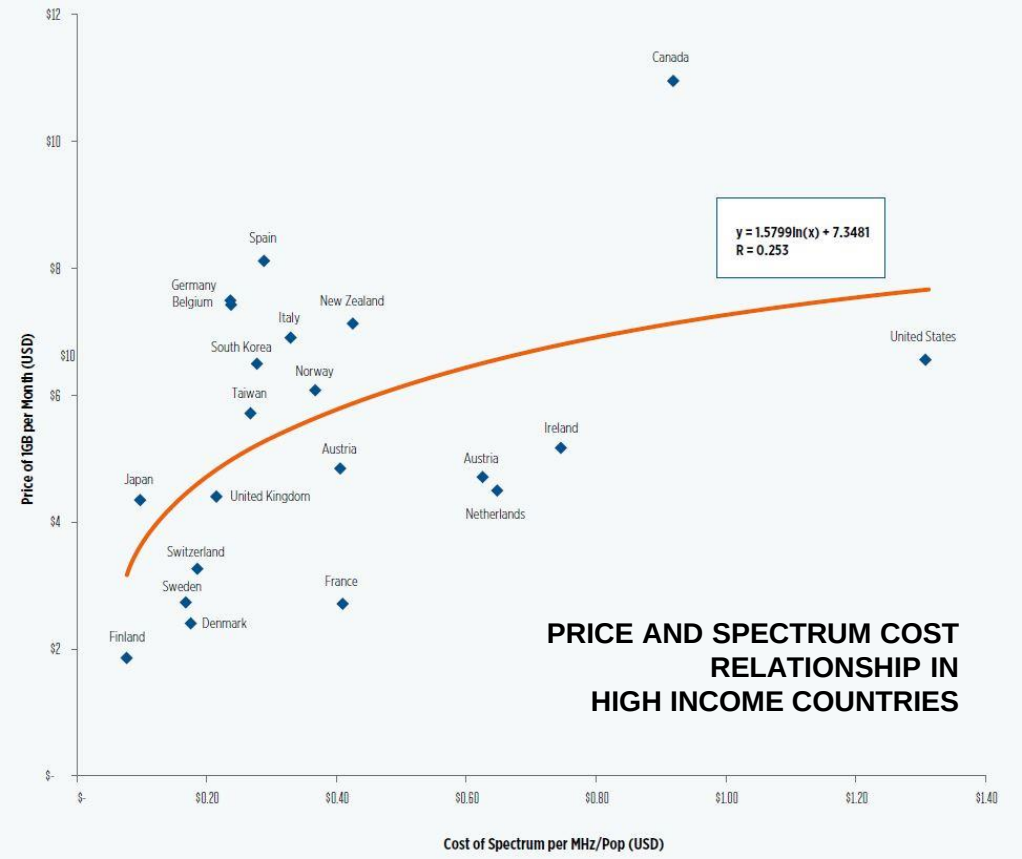
Notes: South Korea is located off the top left hand side of the graph; it has an exceptionally high wireless score (29.5) and modest cost of spectrum per pop ($53). We excluded Hong Kong and Singapore from our analysis, as they are city states and much easier to cover with 4G

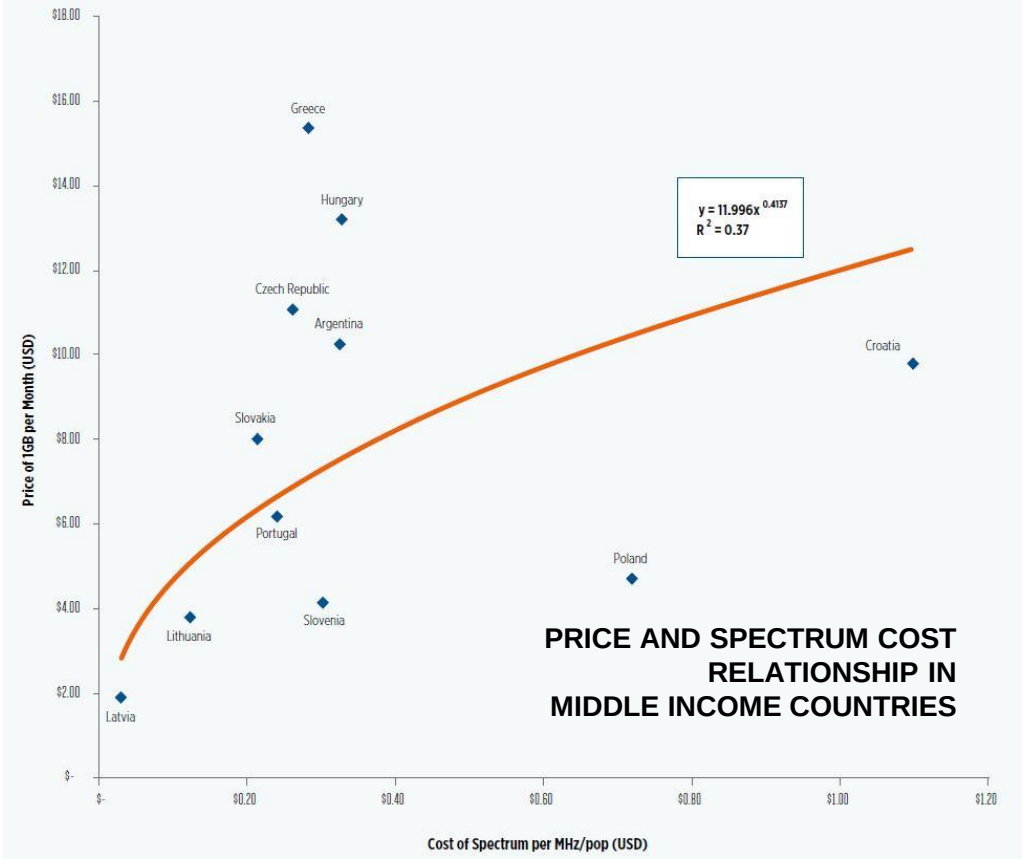


Notes: Excludes Chile, which is an outlier owing to late adoption of 4G, which depresses its wireless score

#3 We also identified a relationship between high spectrum costs and higher downstream data prices

- We built a price index based on the average cost of 1 GB in each country
- We observed that, for groups of higher income and middle income countries, there is a statistically significant, **positive correlation between the cost of spectrum and the prices that consumers pay for data**
- This evidence supports both broader theoretical and empirical work linking high input costs to disincentives for price competition





#4 Indicative consumer welfare losses from high spectrum prices total billions of dollars

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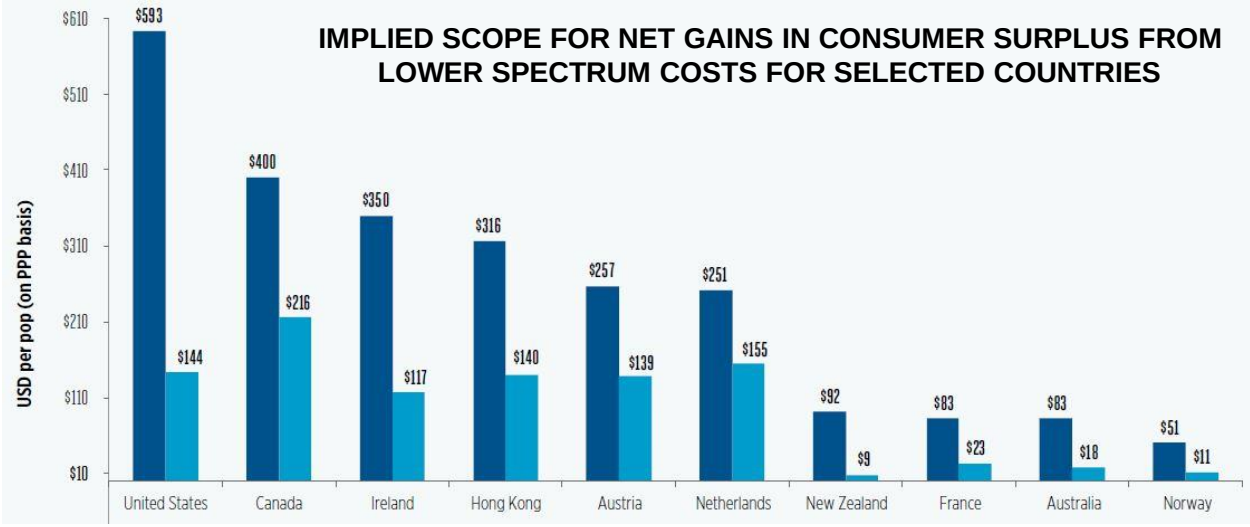
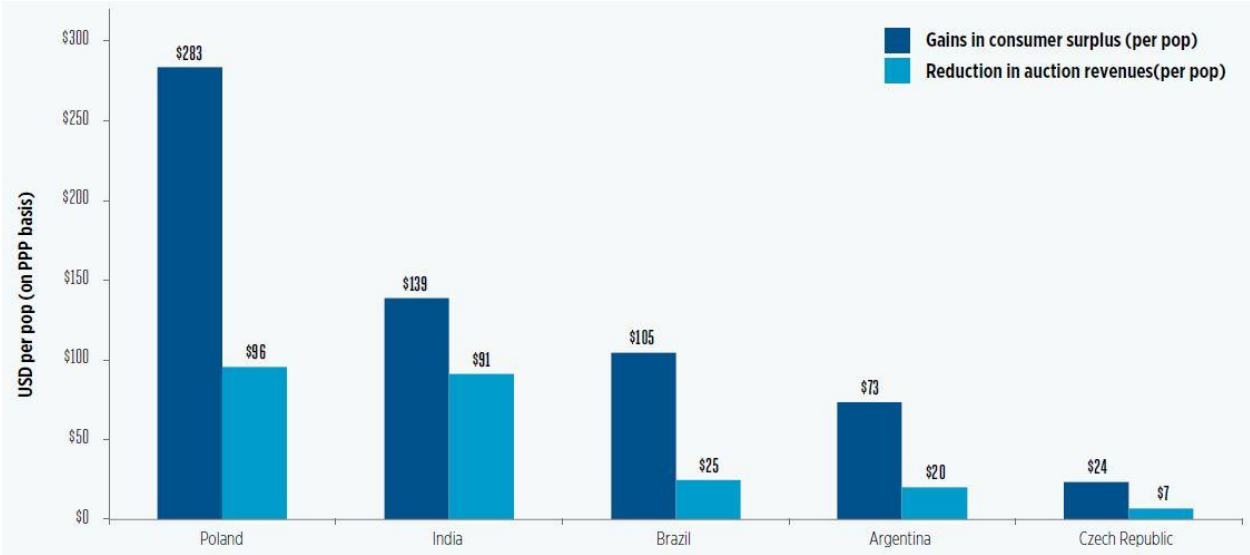
- We used an econometric model to calculate the potential welfare gains from a reduction in spectrum prices across 15 sample countries with prices above the median level:

	TOTAL on PPP basis	Per capita on PPP basis
Consumer surplus	$445bn	$208
Auction revenues	($192bn)	($90)
Unrealised gains in consumer welfare	$253bn	$118

- All $ amounts expressed in purchasing power parity terms
- Charts display a break down of welfare gains per capita by country
  - These are indicative examples
  - Actual lost welfare may be significantly higher or lower owing to local factors





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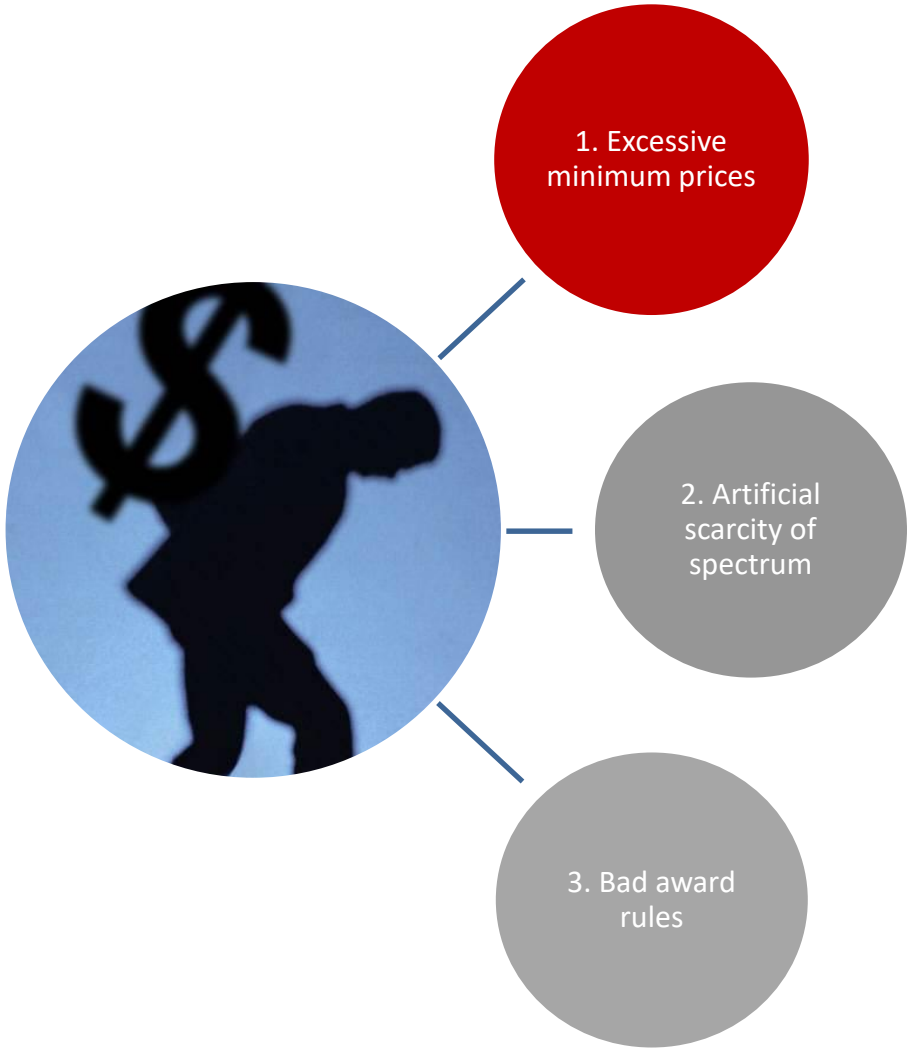
Common mistakes in spectrum pricing

Common mistakes in spectrum pricing

1. Excessive minimum prices
   - Upfront reserve prices too high
   - Annual fees too high
2. Artificial scarcity of spectrum
   - Too little spectrum released
   - Spectrum roadmap uncertain
3. Bad award rules
   - Onerous or ambiguous licence conditions
   - Enterprise value at risk
   - Incentives to foreclose competition

Excessive minimum prices

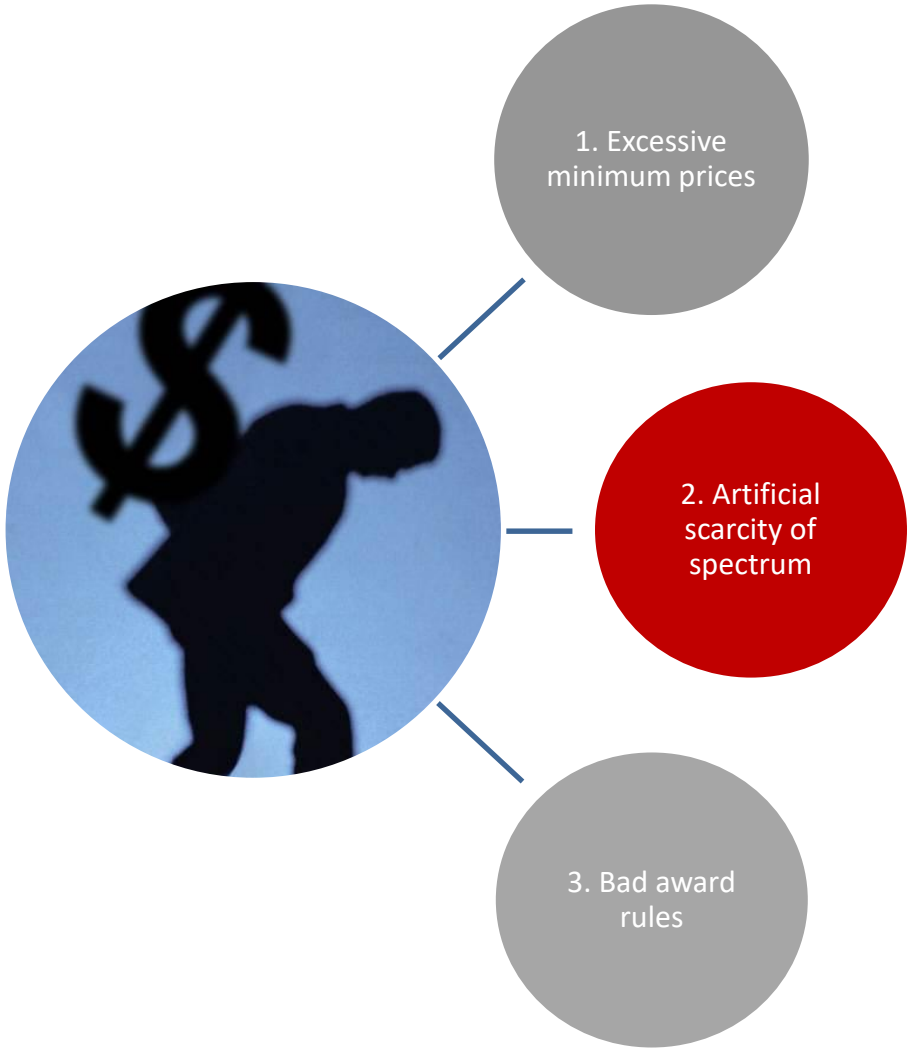


- Why does it happen?
  - Governments intervene or place pressure on regulator to maximise revenues
  - Regulators rely on inappropriate benchmarks
  - High annual fees set by statute
- Implications:
  - Auctions fail or are delayed because operators and regulators in dispute
  - Spectrum often goes unsold
    - Valuable spectrum goes unused, depriving consumers of benefits from enhanced 4G
    - Bad for competition – large operators buy but smaller operators refuse
    - High prices create enduring barrier to entry and market expansion
  - Financial burden on operators introduces disincentives to invest and compete

Case studies

France 3G	Ghana 4G	Mexico AWS	Morocco 4G
• Excessive fixed price • Unsold spectrum • 10 years to fully allocate band	• Unsold 800 MHz owing to high price • Only one incumbent bought spectrum • What next?	• High annual fees set by statute • Regulator has little flexibility on reserve price • One lot went unsold	• Multi-band auction with modest reserve prices (50% level of Ghana) • All spectrum sold and all incumbents acquired 4G spectrum

Artificial scarcity



- Why does it happen?
  - Domestic regulatory challenges or local incumbency issues
  - Capacity deliberately held back to increase scarcity
  - Regulators do not provide a roadmap for future spectrum releases
- Implications:
  - Valuable spectrum goes unused, denying benefits to operators and consumers
  - Artificial scarcity and/or uncertainty over future inflates price of spectrum
    - Bad for competition – large operators buy but smaller operators lose out
    - Financial burden on operators introduces disincentives to invest and compete
  - Used to justify high reserve prices for future awards, which may fail

Case studies

India 2G, 3G & 4G

- Drip feeding spectrum to market created artificial scarcity
- This led to high prices, and encouraged government to set successively higher reserve prices
- Culmination: failure to sell lower frequency bands in recent auctions, even though these offer the greatest welfare benefits

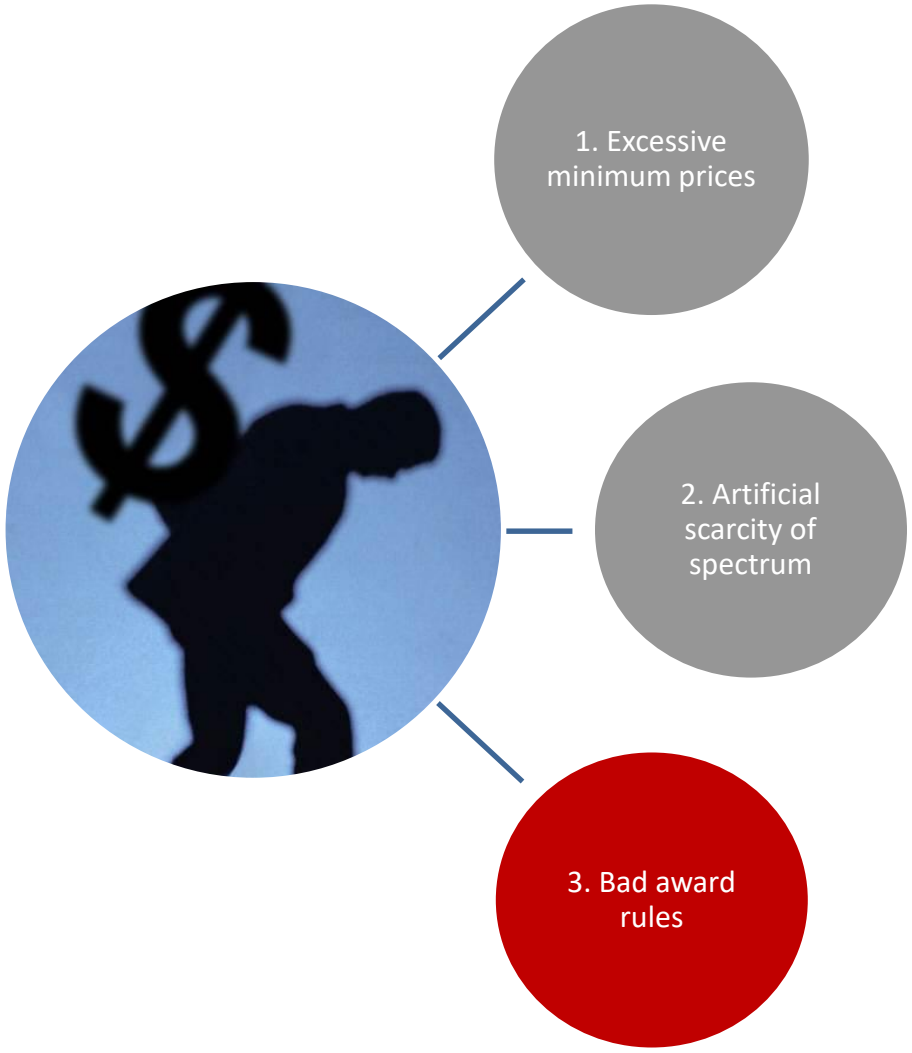
Argentina 4G

- No auctions for 15 years
- Lack of roadmap for future creates high uncertainty for operators
- All spectrum sold despite high reserve price but entrant license subsequently revoked owing to non payment

EU 4G

- Objective: harmonised availability of new bands for mobile across EU
- New bands typically signposted years ahead
- Legal obligations (not always met!) and EC monitoring on timely release

Bad award rules



- Why does it happen?
  - Reserve prices not adjusted to account for onerous conditions attached to licences (e.g. coverage)
  - Too much spectrum sold simultaneously without adequate competition safeguards
  - Governments create opportunities to foreclose competition
- Implications:
  - Spectrum goes unsold because licence terms are unattractive
  - Wasteful duplication of network infrastructure in marginal areas
  - Bidders overpay as enterprise value at risk or values are inflated by option to foreclose competition
  - Consumer welfare losses

Case studies

Brazil 4G	Austria 4G	Turkey 1800	Sweden 4G

• Very onerous obligations on all operators:
  • rural coverage
  • clearance costs
• Uncertain start date
	• Big multiband CCA with minimal spectrum caps and no transparency
	• Bidding war between three incumbents, each vulnerable to enterprise value loss
		• Auction rules were anti-competitive
		• Winner of first licence set price that blocked second licence from selling
			• Quick to market with single band auctions
			• Predictable formats, modest reserve prices
			• 25 year licences and innovative approach to coverage obligations

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Best practice for spectrum pricing recommendations

The road to success in four steps

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Set modest reserve prices and annual fees, and rely on the market to set prices

License spectrum as soon as it is needed, and avoid artificial spectrum scarcity

Avoid measures which increase risks for operators

Publish long-term spectrum award plans that prioritise welfare benefits over state revenues.