Multiband Auction 2013

Comments on essential points of criticism addressed in the high-court proceedings

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1 Introduction

The largest frequency auction ever held in Austria started on 9 September 2013 and concluded on 21 October 2013. The auction raised revenues of approx. EUR 2 billion. All 28 frequency blocks were auctioned off. A1 Telekom secured four blocks of the digital dividend, among them block A3 that provides for increased coverage requirements for rural areas. T-Mobile acquired the two other blocks of the 800 MHz band. The 900 MHz band saw three winners: A1 Telekom and T-Mobile obtained three blocks each, Hutchison acquired one block. There were also three winners for the 1800 MHz band. Hutchison and T-Mobile bought four blocks each, A1 Telekom bought seven blocks (see also Telekom und Post Newsletter 05/2013 of 21.10.2013, https://www.rtr.at/de/komp/NewsletterTK052013).

Frequencies	**A1 Telekom**	**T-Mobile**	**Hutchison**
800 MHz (5 blocks)	3 blocks	2 blocks	-
800 MHz (increased coverage requirements)	1 block	-	-
900 MHz (7 blocks)	3 blocks	3 blocks	1 block
1800 MHz (15 blocks)	7 blocks	4 blocks	4 blocks
Total	**2x70 MHz**	**2x45 MHz**	**2x25 MHz**
Total price (in EUR)	**EUR 1,029,895,738**	**EUR 654,482,816**	**EUR 330,082,913**

Table 1: Distribution of the frequency blocks after the auction

Two of the three successful bidders filed complaints against the auction result with the high courts. The ruling of the Austrian Administrative Court of 4 December 2014 now constitutes the final eagerly expected high-court decision in this matter. Previously, the high courts had rejected petitions to have a suspensive effect recognised for the complaints. Likewise, the Austrian Constitutional Court had refused to deal with complaints against the mobile auction in March, assigning them to the Administrative Court.

Now, the Administrative Court ruled and confirmed the official decisions of the multiband auction. In view of the occasion, the regulatory authority wants to readdress the essential points of complaint and criticism and summarize the regulatory authority's major arguments in respect of these points of criticism.[1]

2 The remaining terms of the GSM frequencies

One of the central points of complaint related to the remaining terms of the assigned GSM frequencies. It was pointed out that the terms laid down by the Telecom-Control-Commission (TKK) within the framework of the multiband auction were unlawful, as some of the currently assigned frequencies would be valid longer than assumed by the TKK. Thus, the shortening of the terms, *inter alia*, violated the integrity of property.

To understand this legal dispute one has to go back to the beginnings of second-generation mobile telecommunications (GSM). As from the mid-1990s four 2G mobile communications licences were allocated step by step, the last one to tele.ring in 1999. These licences entitled the operators to provide 2G mobile services. As the provision of such a service also required frequencies, along with the licence, the operators were also granted the right to use certain

[1] In this connection, the interested reader may be also referred to the Telekom und Post Newsletters that were issued in the run-up to the auction. The Newsletter of 19 March 2013, for example, deals with the selected auction design (https://www.rtr.at/de/komp/NewsletterTK022013).

frequencies. The licence and thus the right to use the frequencies were limited to a specific period of time (approx. 20 years). Since the demand for mobile services developed by far more rapidly than originally foreseeable, further frequencies were subsequently allocated to the GSM operators (mostly through auctions). The terms of these frequencies were linked to the respective licence terms. From the TKK's point of view, all GSM frequencies of an operator were to expire once the licence for the provision of GSM services expired.

With the enactment of the Telecommunications Act 2003 (TKG 2003) and the associated repeal of the TKG 1997 the "licence" as legal concept was abolished and turned into a so-called general authorisation. An operator did no longer require an explicit approval to provide a telecommunications service. Thus, the provision of such a service was no longer limited in time. Now the question came up how the changed regime would affect individual rights of frequency use. Would the time limit cease to apply to those as well? If not, for how long may the operator then use those frequencies? Individual operators now hold the legal view that some usage rights are now valid longer than they would be if the licences originally granted were still in force.

From the regulatory authority's point of view, the legislator took a clear position on these questions. Art. 133 Par. 6 TKG 2003 stipulates that the rights and obligations under the mobile communications licences according to the TKG 1997 valid at that time shall remain unaffected. Thus, in the TKK's opinion, the legislator also froze the terms of the frequencies, along with other rights and obligations such as the coverage requirements, which had been valid when the TKG 2003 took effect. Thus, the TKG 2003 evidently assumes that the legal position for mobile operators in respect of their frequency usage rights existing at that time (on 20.08.2003) shall not change by the abolishment of mandatory licensing, neither to their disadvantage, nor to their advantage. If the abolishment of mandatory licensing were to lead to an extension of the frequency usage rights, the holder of the frequency usage rights would undoubtedly enjoy a privilege (to a different degree for each operator) that had not been intended by the legislator.

3 Considerations regarding the knockout risk

Individual operators criticised the high knockout risk in the auction. As it had been theoretically possible for a single bidder to acquire half of the spectrum offered, it could have happened that one of the bidders did not acquire any frequencies and, thus, effectively would have been ousted from the market. To safeguard against this knockout risk, bidders had to submit excessive bids or follow their own knockout strategy. This led to extremely high prices not corresponding to the value of the frequencies. In fact, one bidder only just escaped the knockout: if that bidder had reduced its bid by only a relatively small amount, it would have won no spectrum. It was sheer luck that the bidder did not end up empty-handed.

Even though the theoretical possibility existed that in view of the spectrum caps defined by the TKK a bidder would end up with nothing, the TKK regarded the risk of achieving such a result as low. As a matter of fact, no bidder was able to assume with certainty that a bid for a package exhausting the spectrum caps would actually lead to a knockout in the auction. This becomes absolutely clear if one looks at the auction result, where A1 Telekom won frequencies in the amount of the spectrum cap without one of the other two operators being ousted.

For every single bidder the knockout risk in the auction was controllable. In particular, a bidder who is active until the end of the clock stage can make sure that it will at least win its final clock package by appropriately raising its final clock bid (and correspondingly structuring other supplementary bids). The amount by which the bidder must raise its final clock bid to have this guarantee results from the price constraints other bidders are subject to in submitting their supplementary bids. The bidder can determine the (amount of the) supplementary bid by means of which it can avoid a knockout.

To actually contribute to ousting a bidder from the auction it would have been required for at least two bidders to fully exhaust their spectrum caps until the end of the clock stage, forcing the third bidder to submit a zero bid. Only then could that bidder have been effectively ousted. This was evidently not the case. One bidder reduced its bidding eligibility already in the first clock round, another bidder followed in round three and then the third bidder in round 12. In round 58, all three bidders had reduced their bidding eligibility to such an extent that there was room in the spectrum for three bidders. As from this round, it was clear that each of the three bidders was able to successfully defend itself against a knockout by submitting a corresponding safe bid (so-called knockout bid). This bidding behaviour is irreconcilable with the hypothesis that the bidders had tried to eliminate each other.

The course of the clock stage shows that evidently – contrary to the public discussion – none of the three bidders pursued a sustained knockout strategy, and that was for a good reason: From the authority's view, it is not permitted to put the knockout in the auction on a level with ousting from the mobile communications market. This becomes immediately clear if one visualises how much spectrum would have been available to each operator if it had ended up empty-handed in the auction (see the following Table 2). The amount of spectrum results from the remaining terms of the existing allocations in the 900 MHz, 1800 MHz, 2.1 GHz and 2.6 GHz ranges.

Operator/Year	2014	2015	2016	2017	2018	2019
A1 Telekom	2x80.4 (30%)	2x80.4 (30%)	2x48.2 (18%)	2x48.2 (18%)	2x45 (17%)	2x45 (17%)
T-Mobile	2x73.2 (31%)	2x73.2 (31%)	2x51.8 (19%)	2x51.8 (19%)	2x51.8 (19%)	2x51.8 (19%)
Hutchison	2x79.8 (30%)	2x79.8 (30%)	2x79.8 (30%)	2x79.8 (30%)	2x50 (19%)	2x50 (19%)

All values in MHz

Table 2: Share in the currently available paired mobile spectrum over time if the stated operator had not acquired any spectrum in the multiband auction

The table shows that none of the three operators would have found itself without frequencies in the next few years if it had failed in the auction. The share controlled by A1 Telekom would have dropped gradually from 30% to 17% over the period from 2014 to 2019, the ones of Hutchison and T-Mobile to 19%. During the stated period it can be expected also in any case that further mobile frequencies will be allocated.

It may be now countered that the spectrum remaining in the case of a failure in the auction would be too small to act as an effective competitor on the market. To be able to classify the spectrum amounts with a view to competition, a comparison with Hutchison is recommended. Nobody will deny that prior to the merger Hutchison was a major driver of competition for the Austrian mobile market for many years even though, at times, the company controlled not even 6% of the spectrum dedicated to mobile communications.

Of course, an operator ending up empty-handed in the auction would have to face losses in market share in the long term. However, this is not relevant for assessing the risk of being ousted from the mobile communications market. If the legislator had been anxious to keep each operator's market position safe, it would not have provided for an auction as allocation mechanism but would have extended the existing allocations.

In the authority's view, also the argument is inappropriate that the high auction revenue is due to the fact that the bidders took into account the higher profit of a two-operator market in their prices. Even if the bids for packages containing the maximum permitted spectrum amount consider in pricing the remote possibility of a two-operator market, this cannot be the

case at least for the winning bids of T-Mobile and Hutchison. This means that these bids expressly correspond to the valuation of frequencies in a three-operator market.[2] Since, moreover, all successful bidders paid less than their bid amounts, the value of the frequencies for the bidders in a three-operator market must be higher than the prices paid. The allegation that 50% of the prices were only paid to escape ousting is therefore wrong. In view of the bidding progress, all bidders had to assume that they would end up in a three-operator market and would not be able to enforce a two-operator market. All bidders knew that the other bidders were active at the end of the clock stage and that they would be able to secure at least their final clock packages by appropriately increasing the supplementary bids. So, submitting supplementary bids assuming that one of the bidders would leave the auction without frequencies would have been extremely risky and, moreover, could have been done only on the assumption that one of the other bidders made a serious bidding error.

In this connection, it was repeatedly argued that the bidders would have to encourage the knockout of the other bidders so as to protect themselves against a knockout. It is perhaps easy, but wrong, to assume that a bidder who reduces its eligibility at higher round prices can bid relatively more for larger packages than bidders who reduce their demand already at lower clock prices, and that this would protect them against a potential knockout. The weakness of such reasoning is easy to demonstrate. Let us take a look at two different packages for bidder A and bidder B each: a “small” package (k) that allows for distribution of the spectrum not won by a third bidder among the bidders and a “large” package (g) that leads to a bidder’s knockout. The corresponding bids are assumed to be D(k) and D(g) for bidder A, and T(k) and T(g) for bidder B. “Small” packages, for example, are the final clock packages where the bids for these small packages can be increased as desired. Bidder A would be ousted if $T(g) > D(k) + T(k)$ or $T(g) – T(k) > D(k)$. Bidder B would be ousted if $D(g) – D(k) > T(k)$. This means that by higher caps bidder B can at most ensure that it will become more expensive for other bidders to oust it. On the other hand, it can protect itself against a knockout only by bidding more on smaller packages than the other bidders can bid on incremental spectrum. Since all bidders were active in the last round, the bids for incremental spectrum are limited by the price caps. In contrast, the last clock bid (a small package) can be increased without limit. So, if a bidder actually tries to prevent a knockout by being the last to reduce the bidding eligibility in order to enforce the knockout of other bidders, this strategy might lead to exactly the opposite result.

4 Considerations regarding the spectrum caps

Individual operators criticised the TKK because of the spectrum caps, arguing that the spectrum caps selected by the TKK were too liberal and, thus, were not compatible with the provisions of the TKG 2003 with regard to the promotion of competition.

It is the purpose and objective of a frequency auction to allocate the frequencies to the bidders who value the frequencies most highly. Moreover, the frequency auction shall enable the companies to select and aggregate the frequency packages they value most highly. Comparably phrased objectives geared to the classical Pareto efficiency can also be found in documents of many regulatory authorities. For example, Ofcom, the UK regulatory authority, remarks on the recent multiband auction as follows:[3]

“*This format is designed to achieve the most efficient outcome – putting the spectrum in the hands of the bidders who value it most highly, while also ensuring they pay a competitive price. Below is a guide to how the format works.*“

[2] The bidders have to assume that if one of their package bids with 6 or 14 eligibility points wins out in the end, a second bidder will also win frequencies even if the remaining third bidder utilises the spectrum caps to the full extent. To bid for a package with 6 or 14 eligibility points, assuming a two-operator market valuation, would be inconclusive and grossly negligent.

[3] Ofcom, 2013, “Bidding in 4G auction under way“; available at: http://media.ofcom.org.uk/2013/01/23/bidding-in-4g-auction-under-way/

In addition, the FCC, the US regulatory authority, states the following:[4]

"Auctions maximize benefits to consumers by assigning licenses to the parties that value them most highly and fostering efficient spectrum use. Well-designed auctions are more likely than comparative hearings to assign licenses to the parties that value them most highly."

However, this objective may be in tension with the objective of creating competition on the downstream markets. This will be the case if the private valuation of bidders deviates from the social value. One reason for this strong contrast, for example, is the existence of market power if, perhaps, a bidder in its private valuation makes allowance for monopolisation of the downstream mobile communications market. To prevent negative effects on competition, instruments for safeguarding competition, such as spectrum caps, explicit reservation of spectrum for a bidder or spectrum floors, are required. These instruments help ensure that a sufficiently large number of bidders have sufficient amount of spectrum to be able to operate on the market effectively. Spectrum caps limit the amount of frequencies that a bidder may acquire in a frequency auction. Such caps can be defined for specific bands and may overlap (e.g. a limit on the total amount of spectrum a bidder may acquire in the auction, combined with a limit on the frequency spectrum below 1 GHz). With a given number of bidders, spectrum caps may be also defined to be as tight that spectrum will be implicitly reserved and the operators will have the opportunity to buy this spectrum at the minimum bid.

Mechanisms for safeguarding competition, however, are potentially in strong contrast with the requirements of the TKG. Art. 55 TKG 2003 provides that the bidder who demonstrates the highest willingness to pay for a frequency block ("offers the highest usage fee") shall be awarded the block. Since these restrictions shall specifically prevent the bidder who values a specific frequency block most highly from being awarded the block (because, otherwise, they would not be necessary), they are in potential conflict with the requirements of Art. 55 TKG 2003. Therefore, they have to be effective and proportionate in order not to unduly restrict individual companies and must be carefully weighed against potential disadvantages and inefficiencies. Potential disadvantages and inefficiencies may result from the fact, for example, that bidders who are to get easier access to frequencies by such a measure do not make use of this offer and spectrum remains unsold, or if restrictions unreasonably prevent individual bidders from acquiring an efficient number of blocks in a specific band (e.g. number of frequency blocks for efficient LTE usage) or individual operators cannot cover their capacity requirements and might inappropriately be restricted in competition and growth. Very tight caps may also have the drawback of encouraging individual bidders to reduce the demand for additional spectrum more significantly than would be desirable from efficiency points of view (because they can buy part of the spectrum at the minimum bid).

The TKK defined the "overall cap" (cross-band spectrum cap) primarily with a view to the thresholds and further test criteria of general competition law and the capacity requirements of the operators. As can be seen in Table 3, at the time of the auction A1 Telekom had a market share of 44.2% (measured in terms of SIM cards), at the time the caps were defined the market share was 46%. In the course of the Orange takeover by Hutchison the competition authorities examined whether A1 Telekom would reach significant market power with a market share of 46%. This was not the case. From the TKK's point of view, A1 Telekom was therefore also to be given the opportunity to acquire a share in the total paired mobile spectrum, which roughly corresponded to its market share (but nevertheless not more than 50% of the spectrum offered). The overall cap was correspondingly defined, considering the spectrum in other bands. Ultimately, fully exhausting the overall cap in the auction, A1 Telekom (after expiry of the remaining licence periods) will control approx. 42.6% of the total paired mobile radio spectrum in the long term. This share is slightly below the current (SIM card) market share of A1 Telekom (see the following Table 3). For the other two operators, too, the share in the spectrum correlates with the market share. A restriction of available

[4] FCC, 2001, "AUCTIONING SPECTRUM RIGHTS"; available at: http://wireless.fcc.gov/auctions/data/papersAndStudies/aucspec.pdf

capacities, ordered by the authority, to a level below the market shares could be criticised as market share regulation and would, in fact, constitute barriers to expansion.

	A1 Telekom	T-Mobile	Hutchison
800 MHz band	2x20 MHz	2x10 MHz	-
900 MHz band	2x15 MHz	2x15 MHz	2x5 MHz
1800 MHz band	2x35 MHz	2x20 MHz	2x20 MHz
2100 MHz band	2x20 MHz	2x15 MHz	2x25 MHz
2600 MHz band	2x25 MHz	2x20 MHz	2x25 MHz
Total	2x115 MHz	2x80 MHz	2x75 MHz
Spectrum share	**42.6%**	**29.6%**	**27.8%**
Market share[1]	**44.2%**	**30.9%**	**24.9%**

[1] Source: RTR Telecom Monitor 4/2013

Table 3: Long-term share (after expiry of the remaining terms) in the total paired mobile radio spectrum in relation to the market share

Due to the fragmentation in the 900 MHz and 1800 MHz ranges in respect of time and frequencies, in the next few years the frequencies in these bands can be used for broadband services only to a limited extent. Usage for broadband technologies (LTE or, where applicable, UMTS) requires that complete 5 MHz blocks are available to an operator. The operators are affected by this fragmentation to greatly varying extents. While, for example, Hutchison has a very large contiguous range in the 1800 MHz band, the assignments of the other operators are by far more strongly fragmented in this range. An operator, such as A1 Telekom, that is affected quite heavily by fragmentation in the 1800 MHz range and, moreover, controls few frequencies in this range can compensate this drawback only by acquiring a greater amount of spectrum (perhaps in the 800 MHz range), which, however, requires correspondingly liberal caps. A look at only the “broadband capable“ share in the paired mobile frequency spectrum over time reveals a clearly more balanced picture for the next years than the result of the multiband auction may suggest at first glance (see the following Table 4).

Operator/ Year	2014	2015	2016	2017	2018	2019
A1 Telekom	33%	33%	31%	31%	37%	37%
T-Mobile	26%	26%	28%	28%	31%	31%
Hutchison	30%	30%	31%	31%	28%	28%
Not usable	11%	11%	9%	9%	4%	4%

All values in MHz

Table 4: Share of “broadband capable“ 5 MHz blocks in the currently available paired mobile radio spectrum over time

The frequencies below 1 GHz deserve special consideration. They are scarcer in quantity than frequencies above 1 GHz and are particularly suited for the efficient roll-out of a network with very high area coverage and service quality (in particular, coverage in buildings). In addition, all bands below 1 GHz currently dedicated to mobile services were auctioned off in the multiband auction. By imposing specific sub-1 GHz caps it was ensured that this frequency range cannot be monopolised by one operator and that at least two operators will roll out LTE in the 800 MHz range. However, the TKK (after the merger) refrained from implicitly reserving spectrum in this frequency range for a third provider. From a regulatory point of view, tighter caps in the low-frequency range would have served primarily to allow preferential access to sub-1 GHz spectrum for operators, such as Hutchison and, formerly, Orange, whose radio networks are designed for spectrum above 1 GHz.[5] In the course of the Orange takeover, Hutchison sold almost the entire sub-1 GHz spectrum. Due to the takeover, Hutchison obtained a large number of base stations that allow the company to substitute coverage spectrum below 1 GHz with a denser network of spectrum above 1 GHz. Tight caps in the sub-1 GHz range would have entailed, *inter alia*, the risk of inefficient assignment or, possibly, even of blocks remaining unsold.

In the discussions surrounding the spectrum caps an important aspect is frequently overlooked. The frequencies in the 900 MHz and 1800 MHz ranges put up for assignment have different remaining terms. The operators will lose their legacy spectrum holdings at different times and in the auction were faced with the challenge of buying spectrum that would be complementary in time in order to ensure business continuity.[6] At the same time, however, for efficiency reasons due to heavy fragmentation of the spectrum, redistribution (contiguous frequency ranges of 5 MHz blocks) was required as the current assignments constitute a considerable barrier to future broadband use. The assignment of contiguous frequency blocks was one target specified in the usage conditions submitted by the BMVIT to be achieved through the auction design.

A central challenge of the multiband auction was therefore to enable efficient redistribution of the GSM frequencies, at the same time ensuring business continuity. The optimum solution depends on the individual investment decisions of the operators, e.g. on the desired technology mix. For instance, an operator can substitute the lack of broadband LTE spectrum in the 1800 MHz range without time constraints with a greater amount of 800 MHz spectrum, and vice versa. A look at the frequency assignments in the 900 MHz and 1800 MHz bands shows that here the operators started from quite different points of departure.[7] To allow efficient reorganisation in respect of broadband services, however, a high degree of flexibility is needed in the auction. Tight caps – above all frequency-specific caps – would have posed a barrier to this. In particular, they would not have been an appropriate instrument to ensure protection of the legacy spectrum holdings, as was frequently requested in this connection (unless the inefficient current assignments had been, in fact, extended). Assuming that the caps had been set in a way so that every bidder would have won at least a certain number of blocks even if its competitors had utilised their caps to the full extent: This would have far from guaranteed that the operator would actually win these frequencies in the specific range that would have been necessary to continue business activities. What would have been the benefit of the implicitly reserved frequencies for A1 Telekom if this spectrum will be usable only from 2020 onwards, whereas A1 Telekom will lose nearly all of its frequencies in the frequency ranges concerned at the end of 2015?

To prevent a negative effect of spectrum caps on the efficiency of frequency usage, the technological framework has to be taken into account. A larger contiguous frequency range

[5] As the mobile radio networks of A1 Telekom and T-Mobile are dimensioned for frequencies below 1 GHz, usage of such frequencies offers a relative advantage for these companies, which is reflected in a correspondingly higher valuation that makes complete elimination of these companies from this range very unlikely.

[6] The frequency assignments of A1 Telekom will expire at the end of 2015, with the exception of 3.2 MHz in the 900 MHz range, those of Hutchison at the end of 2017 and the frequencies of T-Mobile partly at the end of 2015 and partly at the end of 2019.

[7] The frequency assignments are available on the website of RTR-GmbH at: https://www.rtr.at/de/tk/FRQ_spectrum

permits the provision of higher peak data rates, thus offering more responsive applications to customers. The 800 MHz and the 1800 MHz bands are both LTE bands. It can be expected that in the long term LTE will be used in the 900 MHz range as well. From a technological point of view, LTE can be operated at present in the 800 MHz and 1800 MHz ranges, using up to four contiguous blocks. These four blocks allow highly efficient usage, as therewith a higher peak data rate can be provided in relation to the required investments than with a smaller number of frequency blocks. In the 900 MHz and 1800 MHz ranges, (at least temporary) additional demand for spectrum may arise, as it will be temporarily necessary for several technologies to co-exist (GSM, LTE and, where applicable, UMTS). The simultaneous auctioning of three bands usable for LTE in the long term enables the bidders to concentrate on specific bands in order to aggregate an efficient number of frequency blocks for LTE there (preferably four but, where applicable, also two or three blocks). The spectrum caps take account of this fact in two ways: On the one hand, they were selected such that the highest possible number of bidders can aggregate an efficient number of blocks in one band (core band strategy), which, in fact, did happen both in the 800 MHz and the 1800 MHz ranges. On the other hand, the fact was accounted for that an operator's demand for additional blocks beyond the efficient number of blocks might decline sharply. This refers, in particular, to three blocks in the 1800 MHz range (if three bidders buy four blocks each, twelve blocks will have been sold, with three of a total of 15 blocks remaining). Also, the overall cap was, *inter alia,* selected such that against the backdrop of different result scenarios each of the three bidders was able to buy these three blocks and, thus, it was ensured that the entire available spectrum could be assigned.

The relatively liberal spectrum caps allowed the bidders to express their valuations for very large packages. In taking this opportunity, for one, the bidders may have wanted to drive the competitors' opportunity costs in order to achieve a relatively better outcome in the auction. This fact, however, is irrelevant for the knockout discussion. On the other hand, A1 Telekom also took the chance and secured a larger frequency package containing a relatively large amount of spectrum in the 1800 MHz range. Larger amounts of spectrum usually entail synergy effects. For example, a bidder who has seven blocks in the 1800 MHz range is able to roll out several technologies in parallel (e.g. GSM and LTE). The amount of spectrum to be utilised on a carrier is usually limited, which is why it is cost-efficient to acquire also larger additional amounts of spectrum for another carrier. These complementary effects lead to non-linear valuations and are reflected in the incremental valuations of large packages. Combinatorial procedures such as the CCA are selected for just that reason because such non-linear evaluations due to specific technological characteristics exist. Under these conditions, non-combinatorial procedures show efficiency problems.

5 Collusion and information policy

Individual bidders criticised the information policy chosen by the TKK in the auction. Usually, in a CCA the aggregate demand is revealed after each round of the clock stage. The TKK decided to restrict transparency at the beginning of the auction. Also in other countries, such as in Canada or in Slovakia, transparency was partly restricted.

Frequency auctions were initially handled with a high degree of transparency, also in Austria. After each auction round the bids and the identity of the individual bidders were revealed. This was due not only to procedural reasons but also had an auction theory background: Revealing the competitors' bids is to contribute to reducing so-called "common value uncertainty". The valuations of bidders in frequency auctions typically comprise an operator-specific component (private values) and a component that is the same for all bidders (common value, CV). In terms of the CV component, the bidders have to make estimates. If bidders are able to observe how other bidders behave in a multi-round auction, they may adjust their estimates on the basis of the information obtained about the other bidders' estimates. But already the price development that can be observed in an open multi-round auction contains information about CV components. For example, the relative value of the

different bands can be determined by factors that are identical for all bidders (e.g. a band's ecosystem). From knowing the aggregate demand the bidders may derive additional information. If there is only a small number of bidders whose private values for blocks in the different spectrum categories, moreover, differ widely (due to the given amounts of spectrum and network structures), even the detailed knowledge of the other bidders' bidding behaviour does not contribute much to improving one's own valuation. In the specific case, the question was which information could be derived from knowing the aggregate demand. It was to be expected that the number of bidders would be strictly limited. Due to different legacy spectrums and network structures, the incumbent operators considerably differ from each other in their potential private valuations of the different frequencies and, thus, the bidding behaviour of one bidder has a relatively low information content in terms of improving another bidder's CV estimate. The TKK assumed that the loss of information by restricted transparency would be comparably small.

As long as a relatively large number of bidders take part in an auction and/or a relatively small number of licences or usage rights are allocated, high transparency does not involve any risks for the auction. If, however, only very few bidders compete in the auction for a relatively large number of frequency blocks, there is the risk that the bidders reduce their demands for strategic reasons or try to keep the price low by means of collusive practices. This involves not only losses in revenue but there is also the risk that the result will be inefficient. This is the reason why the information policy in auctions has changed in the course of time. Even though the combinatorial clock auction is a comparably resistant auction format, such concerns apply to this format as well. There are incentives for bidders in the clock stage to reduce the demand more strongly than they should according to their "true valuation", thus keeping the prices low. If bidders reduce their demand to prices below their actual valuation for additional spectrum and this causes a loss of bidding eligibility or a premature end of the clock stage, later, because of the relative price caps, the bidders will no longer be able to express their full valuations for larger packages. Such a "self-restriction" may be useful for the bidder if, as part of a collusive strategy, such self-restriction is supposed to prevent the bidder from additionally increasing its demand in the supplementary round.

Eventually, however, the decision about transparency always depends on how much the provision of more information contributes to reducing value uncertainty and whether the collusion risk is assessed to be high. The aggregate demand itself already constitutes restricted information. The bidder, for example, does not know in general how many of the other bidders are willing to pay a price above the current price, even though it can draw conclusions about how many other bidders are still active. The decision merely to provide information about the aggregate demand (as is usually the case in the CCA) rather than on each individual bidder's bids already indicates that the information policy in an open multi-round auction is always a matter of consideration: more transparency means more information that contributes to reducing common value uncertainties, if any, but at the same time facilitates collusive behaviour and, thus, puts an efficient auction result at risk.

Following consideration, the TKK decided to restrict transparency at the beginning of the clock stage in order to lower the risk of collusion. The risk was assessed to be high, not least due to the merger that had taken place immediately prior to the auction, whereas the information loss due to partial restriction of transparency was rated to be comparatively small.

6 The auction revenue by international comparison

It was regularly maintained in public discussions that the Austrian multiband auction had been the most expensive by far and that the auction revenue was many times the amount that had been achieved in other - also expensive – more recent auctions in other countries.

One bidder claimed that, by international comparison, the revenue was excessive by at least EUR 1 billion.

The regulatory authority holds the view that the auction revenue is not a relevant factor of success in the assessment of a frequency auction. Neither maximisation nor minimisation of the revenue is a design goal of a frequency auction. On the contrary, in a frequency auction efficient distribution of the scarce resource of frequency spectrum shall be achieved, reflecting the valuations of the bidders.

Furthermore, the regulatory authority believes that directly comparing the revenues of the multiband auction with the revenues generated in other auctions in the more recent past provides a distorted picture. In the individual countries partly different frequency bands were assigned at conditions that were not always comparable. For example, the timing of the auction may play a not insignificant role. In the past two to three years, perceivable changes took place especially in the GSM bands with regard to the ecosystem, i.e. the availability of technologies and terminals, which resulted in revaluations of the frequencies.[8] Also, in this connection, the economic crisis cannot be disregarded. While some countries auctioned off the frequencies at the peak of the economic crisis, in Austria the auction took place at a time when the economy was generally expected to recover.

Apart from the timing of the auction and the technical characteristics of the frequencies, the price of frequencies is influenced by a number of further factors. For example, the expected level of competition on the downstream mobile market has a decisive impact on profitability and, thus, on the value of the frequencies. In many countries, there were four (or even more) active mobile operators at the time of the auction, while in other countries, such as Austria, there were only three incumbent operators left at the time of the auction. According to the economic theory, *ceteris paribus* competition declines with a decreasing number of providers while the value of the frequencies goes up.[9] Other factors influencing the value of the frequencies are, for instance, market development, a country's purchasing power, minimum bids, location costs, the degree of liberalisation of the usage rights, coverage obligations, reputation and incumbency effects by existing users, and the importance of mobile communications within the entire telecom sector.

One of the decisive factors, however, is not least the competition in the auction (number of bidders, tendency to collusion). Here, considerable differences between the auctions can be seen. Some frequency auctions ended after a short time for lack of bidding competition at a price corresponding to the minimum bid. In Belgium, for instance, three bidders competed for three (equivalent) frequency packages, each bidder being allowed to buy only one package. In this as well as in some other auctions the winners obtained the frequencies at the minimum bid. These auctions provide more information on how the regulatory authorities rate the value of the frequencies than on the market price of the frequencies. Quite the reverse: The stronger the bidding competition in a frequency auction, the more the market prices approach the value the operators actually attribute to the frequencies.

From the regulatory authority's point of view, only the digital dividend auctions (800 MHz band) allow reasonably objective international comparison. In contrast to the 900 MHz and 1800 MHz bands that were assigned under comparable conditions (technology-neutral allocation for LTE, LTE availability) only in very few countries, the auctions of the digital dividend permit a broader comparison that also comprises greater variability in terms of the aforementioned factors. Frequencies of the digital dividend were allocated for the first time in the U.S.A. in 2008 and then, from 2010 onwards, also in Europe under quite comparable

[8] In this respect, see the discussion in connection with LTE 1800 for the iPhone 5 in autumn 2012 and the discussion on the significance of the 1800 MHz band triggered by this. See e.g. https://www.rtr.at/de/komp/NewsletterTK052012

[9] From an economic point of view, the value results from the scarcity of the frequencies. The ceiling is determined by the present value of the expected profit streams over the usage period of the frequencies, taking into account the cost of capital.

conditions (usage for LTE). However, to be able to compare the Austrian auction result (or that of other multiband CCAs) with other countries a calculation method is required that allows to estimate that share from the base price (a package price for frequencies of different bands or categories), which is attributable to the blocks in the 800 MHz band. In this context, the authority relies on schemes and calculations of Ofcom (estimation of band-specific prices by means of linear reference prices).[10]

The following Table 5 shows average prices per MHz per population (MHz-Pop), achieved in auctions of the digital dividend in western European countries (where available), the U.S.A., Canada, Hong Kong and New Zealand.[11]

Country	Year of the auction	Price in EUR per MHz-Pop	Price/minimum bid**
U.S.A.	2008	0.85	6.53
Germany	2010	0.77	238.43
Hong Kong	2011	1.34	32.08
Sweden	2011	0.39	2.28
Spain	2011	0.49	1.27
Italy	2011	0.85	1.40
Portugal	2011	0.44	1.00
France	2011	0.72	1.40
Denmark	2012	0.30	2.48
Great Britain*	2013	0.51	1.40
Austria*	2013	0.98	2.60
Belgium	2013	0.53	1.00
Canada	2014	1.48	5.87
New Zealand	2014	0.41	1.31
Greece	2014	0.48	1.00

* Estimated by means of linear reference prices
** The price in relation to the minimum bid

Table 5: How expensive was the digital dividend in other countries compared with Austria?

The second column shows the year of the auction and the fourth column the price in relation to the minimum bid. Here, considerable differences between the countries can be observed. While the revenue in some countries, such as Germany and Canada, was many times above the minimum bids, prices not exceeding the minimum bid were achieved in Belgium and Portugal.

The third column shows the respective average price per MHz per population. The highest average price was achieved in the auction in Canada with EUR 1.48 per MHz-Pop, followed

[10] See DotEcon, 2013 "800 MHz and 2.6 GHz linear reference prices and additional spectrum methodology", Report prepared for Ofcom, September 2013; available at: http://stakeholders.ofcom.org.uk/consultations/900-1800-mhz-fees/

[11] For some other countries eligible for the comparison, such as Switzerland, the Netherlands and Australia, no average prices for the digital dividend are available.

by Hong Kong and Austria; the lowest price was achieved in the auction in Denmark with 30 cents per MHz-Pop.[12] The following Figure 1 shows the results in chart form.

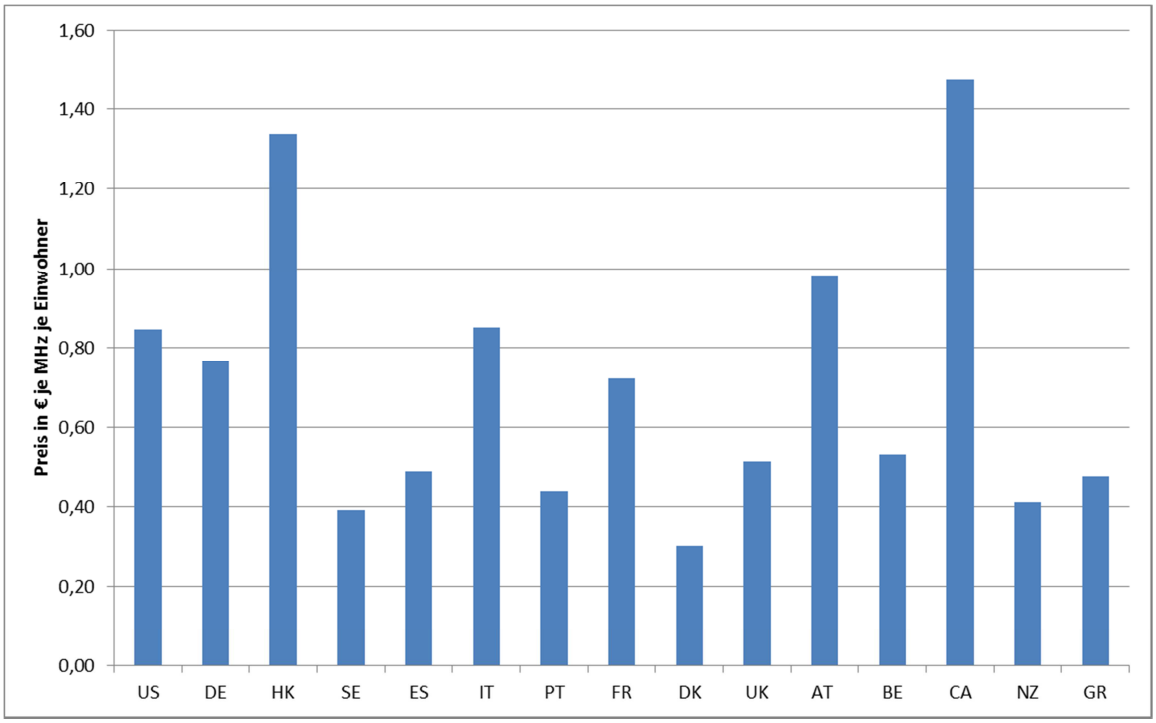

Figure 1: How expensive was the digital dividend in other countries compared with Austria?

The average prices show a considerable dispersion. This is not unusual and was observed already in the UMTS auctions around the turn of the millennium.[13] These statistics show Austria as the most expensive country among the European countries; however, the auction in the Netherlands is not included in these statistics.

In the Netherlands, in 2012 a similar CCA multiband auction as in Austria took place. In the course of this auction, in addition to the three bands auctioned off in Austria, two more blocks each from the UMTS band and (residual) frequencies from the unpaired ranges were sold. The unpaired frequencies are of negligible value and are not included in the following evaluation (see Table 6).[14]

Country	Operator	800 MHz	900 MHz	1800 MHz	2100 MHz	MHz	Price in EUR per MHz-Pop
Netherlands	Tele2*	2x10				20	0.48
Netherlands	T-Mobile**		2x15	2x30		90	0.61

[12] In Denmark, a special auction design was used that enabled the bidders to trade a higher coverage obligation for a lower price.
[13] In fact, the price differences were much higher in the UMTS auctions than in the LTE auctions. In Western Europe, for example, factor 32 was between the cheapest UMTS auction and the most expensive one. In the case of the LTE auctions, it is factor 3.
[14] In some European countries, there was no or only very little market demand for these unpaired frequencies. In other countries, on the other hand, a very low price was achieved. For example, the price for TDD spectrum in the 2 GHz range in Germany in the 2010 auction was below 1 cent per MHz per population. The price for TDD spectrum in the 2.6 GHz range was only insignificantly higher in many countries (including Austria).

Austria	Hutchison		2x5	2x20		50	0.78
Austria	T-Mobile	2x10	2x15	2x20		90	0.86
Austria	A1 Telekom	2x20	2x15	2x35		140	0.87
Netherlands	KPN**	2x10	2x10	2x20	2x5	90	0.90
Netherlands	Vodafone	2x10	2x10	2x20	2x5	90	0.92

* Tele2 acquired the frequency package reserved for a new entrant, which incumbents were not allowed to place bids for.

** The companies also acquired unpaired frequencies. These frequencies are of very little value and have therefore not been included in the table. If the unpaired frequencies were valued at the market value achieved in the more recent auctions in Europe, the average prices shown here would be lower by approx. 0.7% to 1.5%.

Table 6: How expensive were the frequency packages for the Austrian operators by comparison?

As can be seen in the table, the operators KPN and Vodafone paid a higher average price in the Netherlands than the operators in Austria.

In the U.S.A., an auction in the ranges 1695–1710 MHz, 1755–1780 MHz and 2155–2180 MHz (AWS-3 auction) is currently under way. In total, 65 MHz are being auctioned off. The auction started on 13 November 2014. The highest bids of the current round 91 amount to USD 43.5 billion. This corresponds to a price of approx. EUR 1.7 per MHz-Pop.

The international comparisons show that even though the Austrian auction result is very high it is not beyond of what LTE auctions yielded in other countries.

In this connection, the great importance of mobile communications for the telecommunications industry, by international comparison, shall not go unmentioned. In Austria, for example, 85% of all calls are made from mobile terminals. In addition, data traffic handled via mobile radio is still on the rise, showing high growth rates. While at the beginning of 2005 the share of data traffic was only 1% of total mobile communications, it increased to 94% until the end of 2013. The number of mobile broadband connections (modems, smartphones) is correspondingly high, with 5.5 million connections compared with approx. 2.2 million fixed broadband connections at the end of 2013.

7 Price increases on the mobile communications market

It is a widespread misunderstanding in the context of frequency auctions that auctions would result in higher prices for mobile services. It is argued that the costs for frequencies would be passed on to the mobile customers, that the tariffs would be lower if the operators obtained the frequencies at a lower price or free of charge. This reasoning is in contradiction to the economic theory as well as to empirical studies.

Where price decisions are at issue, the economic standard theory distinguishes between two categories of costs: costs that vary with the output quantity and costs that can no longer be recovered once they have been incurred. The costs of the second category are referred to as sunk costs. The price that an operator pays in a frequency auction also falls into this category. According to the economic standard theory, sunk costs, however, do not have an influence on company decisions such as price and quantity decisions. Where frequency costs play a role in the calculation of prices, it is not the historical costs that are considered but, rather, the opportunity costs. The same are determined by the revenues that the operator foregoes if it uses the frequencies rather than reselling them. However, the opportunity costs are determined by the current demand for and the current supply of frequencies rather than by a historical payment. It is therefore not reasonable why an

operator were to obtain frequencies at a reduced price or free of charge shall offer more inexpensive consumer tariffs.

The economic theory furthermore suggests that a bidder will intentionally never bid more than the present value of the expected profit streams over the usage period of the frequencies, taking into account the cost of capital. This is the only way an operator can ensure that it will be also able to cover its costs. In practice, usually only one part of the excess profits is attributed to the intangible property of spectrum.

An essential parameter of the investment consideration in the course of valuation of frequencies is the expected future price level on the downstream markets (e.g. the mobile retail market). The lower the expected price level, the lower is the value of the frequencies. In Austria, frequencies used to be more inexpensive in the past than in many other European countries, and that regardless of the selected auction design. The fact that the revenue of the multiband auction 2013 now ranks among the highest in Europe can be taken as an indication that with market consolidation the operators expect profitability to improve clearly. This is also consistent with the economic theory. The economic theory suggests that on concentrated markets the competitive level is lower and the price level is higher.

A winner in a frequency auction can usually retain part of the excess profits. To win in an auction a bidder needs to submit a bid that is only slightly higher than the second best bidder's willingness to pay. This coincides with the aforementioned scheme of opportunity costs. The combinatorial clock auction employed by the TKK uses a modified second price rule that directly implements the opportunity cost scheme. Experience shows that a substantial part of the value of the frequencies remains with the operators. Besides, regulatory authorities seek to minimise the risks bidders are exposed to by employing advanced auction procedures. Among these risks are, for example, the winner's curse risk, the substitution risk but also the aggregation risk. Nevertheless, it may occasionally happen that a bidder overestimates the value so much that, subsequently, it is no longer able to cover its costs. However, this is nothing unusual in business and normally leads to write-offs, restructurings and possibly a change in ownership but not necessarily to increasing prices.

The authority is not aware of any empirical studies that contradict this economic evidence. If, for example, the European countries are divided into two groups, one group of countries where the 2G and 3G licences were assigned by means of a beauty contest at low prices, and another group of countries where the 2G or 3G licences were allocated by means of an auction, it can be seen that either group contains countries with high and with low price levels. It is obvious that the type of frequency allocation has no impact on the tariff level. The U.S. regulatory authority conducted a thorough analysis on this topic and found out that spectrum auctions do not lead to higher tariffs for mobile services.[15]

In the more recent past, the Austrian mobile operators have repeatedly increased their tariffs. Due to the proximity in time, the price increases are attributed to the multiband auction. However, apart from the remarks above, this assumption disregards two essential facts: First, the initial price increases took place already shortly after the merger, i.e. more than ten months before the auction. Second, in reviewing the merger the European Commission considered competitive problems to be likely and therefore approved the merger only subject to a number of commitments and remedies. So far, none of these obligations and remedies has become materially effective. From the authority's perspective, it is primarily the merger of H3G and Orange that is responsible for the price increases. The high revenue of the frequency auction is therefore not the cause for the rise in prices but a symptom that competition on the Austrian mobile market has decreased because of the merger.

[15] FCC: "Spectrum Auctions Do Not Raise the Price of Wireless Services: Theory and Evidence", October 2000, available at the FCC website:
http://wireless.fcc.gov/auctions/data/papersAndStudies/SpectrumAuctionsDoNotRaisePrices.pdf

8 Conclusion

The decision of the Administrative Court eliminated the last legal uncertainties in connection with the multiband auction. Now, the operators can concentrate on the roll-out of the LTE networks.