



**Results of an Interconnection
Benchmarking Study
for the
Telecommunications Sector of
Trinidad and Tobago
2019**



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List of Abbreviations

BEREC	Body of European Regulators of Electronic Communications
BU-LRIC	bottom-up long-run incremental cost
BVI	British Virgin Islands
CPP	calling party pays
EU	European Union
FDC/FAC	fully distributed/allocated costs
FICC	fixed international carriage charge
FTR	fixed termination rate
GDP	gross domestic product
ICC	international carriage charge
IFTR	international fixed termination rate
IMTR	international mobile termination rate
LCU	local currency unit
LRAIC	long-run average incremental cost
LRIC	long-run incremental cost
MICC	mobile international carriage charge
MTR	mobile termination rate
NRA	national regulatory agency
RIAO	Reference Interconnection and Access Offer
RPP	receiving party pays
SMS	short message service
TCI	The Turks and Caicos Islands
TR	transit rate
TTD	Trinidad and Tobago dollars
USD	US dollars

Executive Summary

In accordance with regulation 15(2) of the Telecommunications (Interconnection) Regulations (2006), (the Interconnection Regulations) mandating the establishment of “costing benchmarks, as determined by the Authority, that comport with internationally accepted standards for such benchmarks”, the Telecommunications Authority of Trinidad and Tobago (the Authority) contracted an independent consulting firm, Sepulveda Consulting Inc. (SCI), in 2016, to undertake an interconnection benchmarking study (the SCI Study). The Authority summarised the SCI Study in its *Results of an Interconnection Benchmarking Study for the Telecommunications Sector of Trinidad and Tobago* (the 2017 Report), which was issued for public consultation on March 28, 2017, in compliance with its *Procedures for Consultation in the Telecommunications Sector of Trinidad and Tobago (ver. 2.0, 2010)*.

Following the consultative process, the Authority contracted SCI to assist in the preparation of responses to interested parties’ comments on the benchmarking methodology, data, rationale and results and the revision of the 2017 Report. This current document, *Results of an Interconnection Benchmarking Study for the Telecommunications Sector of Trinidad and Tobago 2019* (the Revised Report) reflects the amendments made to the 2017 Report, based on comments received in the first round of consultation. Detailed responses to parties’ individual comments on the 2017 Report are contained in the Authority’s decisions on recommendations (DoRs) (see Appendix IV).

The objective of this consultative process is to establish recommended interconnection costing benchmarks for the domestic mobile termination rate (MTR), the domestic fixed termination rate (FTR), the mobile international carriage charge (MICC) and the fixed international carriage charge (FICC)¹. These costing benchmarks, once finalised, will serve as reference points that may be utilised by concessionaires when setting their interconnection rates when “the relevant data for the establishment of the costing methodologies, models or formulae are unavailable within a reasonable time”². These benchmarks are rate maxima, meaning that operators are free to set interconnection rates that are lower.

In summary, the benchmarking process was undertaken in the following seven steps:

- i. The first step was the establishment of a benchmark sample using a set of six sample selection criteria that would ensure maximum comparability with Trinidad and Tobago. The resulting benchmark sample included 23 Caribbean jurisdictions, which is referred to as the “full benchmarking sample”³. However, several jurisdictions were also grouped together as a single jurisdictional observation. The effect of these groupings was to reduce nine initially separate

¹ The Authority has not made any recommendations for other interconnection rates including, inter alia, short message service (SMS), transit and directory assistance.

² Regulation 15(2) of the Interconnection Regulations

³ For sensitivity and cross-check purposes, 36 European jurisdictions were also considered.

sample jurisdictions to three grouped jurisdictions, resulting in a net reduction of the full benchmarking sample size from 23 to 17.

- ii. The second step involved the collection of interconnection rates for mobile and fixed termination for each jurisdiction included in the full benchmarking sample, for the ten-year period April 2008 to March 2017.
- iii. In the third step, a detailed analysis of these interconnection rates was conducted. This revealed that the “vintage” of the interconnection rates in effect as at the first quarter of 2017 in a number of benchmark sample jurisdictions was dated, i.e., the rates had been set many years earlier and had not been updated for at least five years. Given the pronounced historical downward trend in interconnection rates observable in the Caribbean and elsewhere (e.g., Europe)⁴, the then current rates in such jurisdictions were very likely overstated. To ensure the benchmarking exercise was based on more current costing benchmarks, two benchmarking sub-samples were established for MTRs and FTRs. The first considered selected benchmark jurisdictions where interconnection rates had been set in 2012 or later, referred to as the “post-2012 sub-samples” (for MTRs and FTRs), and the second was a subset of those same jurisdictions where interconnection rates had been set on a cost basis, referred to as the “cost-based sub-samples” (for MTRs and FTRs).
- iv. In the fourth step, to develop forward-looking recommended costing benchmarks, statistical trend analyses were used to project benchmark rates for both the post-2012 and cost-based sub-samples out three years, i.e., the projection extended out to fiscal year end 2019/20 or March 2020. Levels and trends in European interconnection rates were also considered as a further cross-check for this purpose. On this basis, recommended costing benchmarks for end-point March 2020 MTRs and FTRs were established.
- v. In the fifth step, with respect to implementation, a three-year glide path (involving roughly equal rate reductions step-wise) was developed for the establishment of MTRs and FTRs for fiscal years 2017/18 and 2018/19, to provide a transition period. Such multi-year glide-path approaches are common in other jurisdictions and also consistent with the trend line projections for the benchmark rates.
- vi. In the sixth step, an assessment of the benchmark sample data on international MTRs (IMTRs) and international FTRs (IFTRs) and, where available, MICCs and FICCs, was conducted to develop recommended costing benchmarks for the MICC and FICC. (The MICC and FICC are elements of the IMTR and IFTR, respectively.) A glide-path approach was also used for these interconnection rate elements.

⁴ See Figures 1 through 5 in this Revised Report and Appendix I.

vii. In the seventh step, additional sensitivity and normalisation analyses were carried out to further assess the reasonableness of the recommended costing benchmarks. Based on the results, no additional adjustments were found to be warranted.

Table E1 summarises the recommended costing benchmarks for fiscal years 2017/18, 2018/19 and 2019/20.

**Table E1: The Authority’s Recommended Costing Benchmarks
(TTD/USD per minute)⁵**

Interconnection Rates	Currency*	Rates Prevailing December 2016	Recommended Costing Benchmarks		
			April 2017 to March 2018	April 2018 to March 2019	April 2019 to March 2020
Domestic Mobile Termination Rate (MTR)	TTD	■	0.226	0.177	0.129
	USD	■	0.0350	0.0275	0.0200
Domestic Fixed Termination Rate (FTR)	TTD	■	0.042	0.035	0.029
	USD	■	0.0065	0.0055	0.0045
Mobile International Carriage Charge (MICC)	TTD	■	0.355	0.226	0.097
	USD	■	0.0550	0.0350	0.0150
Fixed International Carriage Charge (FICC)	TTD	■	0.084	0.052	0.019
	USD	■	0.0130	0.0080	0.0030

*Note: The recommended costing benchmarks were calculated and determined in USD. The TTD equivalent in this table is provided for illustrative purposes only and is based on the USD/TTD exchange rate (0.155) in effect at the time the SCI Study was conducted. USD/TTD exchange rates may change over the course of the three-year glide-path period. If so, at the start of each of the three glide-path years, interconnection rates could be restated in TTD, based on the TTD/USD exchange rate at that time.

The benchmarking results indicate that the domestic MTR and FTR as well as the MICC and FICC in Trinidad and Tobago are higher than the corresponding recommended costing benchmarks and, therefore, above cost. The Authority considers that the implementation of the recommended costing benchmarks would offer significant potential consumer benefits. Reductions in domestic interconnection rates will allow for potential reductions in average retail call prices. To the extent that lower interconnection rates do, in fact, lead to lower average retail call prices, increased use of mobile and fixed services by end users should be expected. This could also promote greater inter-operator (intra-modal) competition as well as fixed-mobile (inter-modal) competition. Additionally, to the extent that

⁵ Given that the operators in Trinidad and Tobago have expressly deemed local interconnection rates as confidential, the current Trinidad and Tobago rates are redacted from this Revised Report and will be made available to local operators only, upon request.

reduced interconnection rates lead to lower average retail prices, increased take-up of both fixed and mobile wireless services could be expected.

1. Introduction

In accordance with regulation 15(2) of the Telecommunications (Interconnection) Regulations (2006) (the Interconnection Regulations) mandating the establishment of “costing benchmarks, as determined by the Authority, that comport with internationally accepted standards for such benchmarks”, the Telecommunications Authority of Trinidad and Tobago (the Authority) contracted an independent consulting firm, Sepulveda Consulting Inc. (SCI), in 2016, to undertake an interconnection benchmarking study (the SCI Study). The Authority summarised the SCI Study in its *Results of an Interconnection Benchmarking Study for the Telecommunications Sector of Trinidad and Tobago* (the 2017 Report), which was issued for public consultation on March 28, 2017, in accordance with the *Procedures for Consultation in the Telecommunications Sector of Trinidad and Tobago (ver. 2.0, 2010)*.

Following the consultative process, the Authority contracted SCI to assist in the preparation of responses to interested parties’ comments on the benchmarking methodology, data, rationale and results and in revising the 2017 Report. This current document, *Results of an Interconnection Benchmarking Study for the Telecommunications Sector of Trinidad and Tobago 2019* (the Revised Report) reflects the amendments made to the 2017 Report, based on comments received in the first round of consultation. Detailed responses to parties’ individual comments on the 2017 Report are contained in the Authority’s decisions on recommendations (DoRs) in Appendix IV.

As in the 2017 Report, this Revised Report provides the methodology, data, rationale and results for the Authority’s recommended costing benchmarks for the domestic MTR and FTR and the mobile international carriage charge (MICC) and fixed international carriage charge (FICC).

Ensuring that prices for interconnection services are cost-based is a standard policy objective of national regulatory authorities (NRAs) around the world. It is commonly accepted that moving wholesale call termination rates closer to costs promotes both static and dynamic (that is, longer term) economic efficiency and, as a result, competition. In addition, moving termination rates closer to costs may have the effect of lowering consumer prices which may, in turn, stimulate consumer demand for operators’ services.

1.1. Review Cycle

This document will be revised periodically to meet changing needs, taking account of market developments. The Authority will update the benchmarking exercise as necessary, and in consultation with stakeholders, to ensure that it is guided by relevant policy guidelines and objectives. Questions or concerns regarding the maintenance of this document may be directed to the Authority via e-mail to info@tatt.org.tt.

1.2. Consultation Process

In accordance with its *Procedures for Consultation in the Telecommunications Sector of Trinidad and Tobago (ver. 2.0, 2010)*, the Authority sought the views of the general public and industry stakeholders on the first draft of this document, which was published on March 28, 2017. The comments and recommendations received from the first round of consultation and the Authority's decisions on these comments and recommendations have been compiled in the decisions on recommendations (DoRs) in Appendix IV.

This Revised Report is based on comments and recommendations received from the first consultative round and is structured as follows:

- a. **Section 2** presents the legislative basis for the recommended costing benchmarks.
- b. **Section 3** sets out the selection criteria for benchmark sample jurisdictions⁶.
- c. **Section 4** identifies and discusses the specific interconnection rate and related data collected for benchmarking analysis, sensitivity and normalisation purposes.
- d. **Section 5** presents the full-sample benchmarking results for MTRs and FTRs.
- e. **Section 6** describes the methodology used to benchmark domestic MTRs and FTRs and presents the Authority's corresponding recommended costing benchmarks.
- f. **Section 7** describes the methodology used to benchmark MICCs and FICCs and presents the Authority's corresponding recommended costing benchmarks.
- g. **Section 8** gives an assessment of the potential impacts of the recommended costing benchmarks, including risks and the flow-through effects.
- h. **Appendices I to III** provide supplementary or more detailed information.
- i. **Appendix IV** is the Authority's DoRs.

⁶ Jurisdictions can refer to countries and/or regions.

2. Legislative Basis

On the subject of network interconnection, section 25(2)(m) of the Telecommunications Act, Chap. 47:31 (the Act) states that:

“... the Authority shall require a concessionaire to ... disaggregate the network and, on a cost oriented basis such as the Authority may prescribe, establish prices for its individual elements and offer the elements at the established prices to other concessionaires of public telecommunications networks and public telecommunications services”.

Furthermore, regulation 5(1) of the Interconnection Regulations indicates that interconnection between parties should be provided under non-discriminatory terms, as specified hereunder:

5. (1) A concessionaire shall provide interconnection under the same terms and conditions and of the same quality as it provides for its own networks and services, the networks and services of its subsidiaries and partners, or the networks and services of any other concessionaire to which it provides interconnection.

In addition, regulation 15 (2) and (3) of the Interconnection Regulations, cited below, define the parameters for the setting of interconnection rates in the local telecommunications industry:

15 (2) Where the relevant data for the establishment of the costing methodologies, models or formulae are unavailable within a reasonable time, the concessionaire may set interconnection rates with reference to such costing benchmarks, as determined by the Authority, that comport with internationally accepted standards for such benchmarks.

(3) A concessionaire shall within twenty-eight days of a written request from the Authority, unless this period is expressly extended by the Authority in writing, supply to the Authority such data as the Authority may require, for the purpose of determining that its interconnection rates are in accordance with this regulation.

3. Benchmark Sample Selection Criteria

3.1. Sample Selection Criteria

The selection of the jurisdictions to be included in the full benchmarking sample is the first and one of the most critical steps in the process of a benchmarking analysis. With the objective that the selected jurisdictions be appropriately comparable to Trinidad and Tobago, the following benchmarking sample selection criteria were applied⁷:

- i. **Regional Geography:** Only states in the Caribbean region were included in the sample. This criterion ensures a reasonable degree of comparability because operators are providing service in relatively similar geographic and climatic conditions.
- ii. **Physical Geography:** Only island nations and jurisdictions are included in the sample to ensure that operators face comparable cost conditions specifically related to island states, which may be different from those that apply in continental states.
- iii. **Calling Party Pays (CPP) versus Receiving Party Pays (RPP) Regimes:** CPP and hybrid RPP/CPP regime jurisdictions are included in the benchmark sample, whereas “pure” RPP regimes are excluded. RPP and CPP regimes are conceptually different and, as a result, interconnection rates under these two regimes may not be comparable. Therefore, this criterion excludes jurisdictions in which pure RPP regimes are in effect but includes those jurisdictions that have hybrid RPP/CPP regimes, and where some or all interconnection rates in such cases are deemed to be reasonably comparable for benchmarking purposes⁸.

⁷ The sample selection criteria draw on selection criteria established in previous SCI studies in the Caribbean, including two consultations conducted by Turks and Caicos Islands Telecommunications Commission, which led to the following decisions: Telecommunications Decision 2011-2, *Decision on the Mobile Termination Rate Review*, Turks and Caicos Islands Telecommunications Commission, January 24, 2011 and Telecommunications Decision 2014 – 4, *Decision on the Review of Interconnection Rates*, Turks and Caicos Islands Telecommunications Commission, June 20, 2014.

⁸ As stated in the DoRs in response to an operator’s comment on section 3.1 of the 2017 Report, the Authority reasserts the appropriateness of this selection criterion. There are 23 jurisdictions included in the full benchmarking sample, only two of which are hybrid RPP/CPP jurisdictions: The Bahamas and Barbados. This selection criterion specifically addresses the nature of interconnection regimes in place in jurisdictions considered for inclusion in the benchmarking sample. While the criterion calls for the exclusion of jurisdictions with pure RPP regimes, since they would not be comparable to CPP regimes, it recognises that jurisdictions with hybrid RPP/CPP regimes, where some or all interconnection rates are deemed to be reasonably comparable for benchmarking purposes, can and should be included in the benchmarking sample. As indicated in the DoRs, the interconnection regimes in The Bahamas and Barbados are comparable to those in place in the other Caribbean jurisdictions in the benchmarking sample. That said, the Authority has included new sensitivity analyses related to this selection criterion. (Refer to section 6.3.)

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- iv. **Number of Operators:** Only jurisdictions with two or more mobile operators are included in the benchmarking sample. Therefore, this criterion excludes jurisdictions that have a single mobile operator.
 - v. **Availability of Interconnection Rates:** Only jurisdictions where interconnection rates are publicly available and can be independently verified are included in the benchmarking sample. This criterion excludes jurisdictions where the interconnection rates are not publicly available or where they cannot be independently confirmed.
 - vi. **Confidentiality of Interconnection Rates:** This criterion excludes jurisdictions where interconnection rates were claimed to be commercially confidential by all operators. However, in jurisdictions where some but not all operators claimed confidentiality, the interconnection rates of those who did not claim confidentiality or who disclosed their rates were used⁹.

It should be noted that, for jurisdictions meeting these sample selection criteria, no restrictions were applied with respect to the methodology used to set interconnection rates, i.e., whether they had been set on a cost versus alternative basis, or by a regulator, court or through commercial negotiation. The objective was to include all interconnection rates in effect in each of the selected benchmark sample jurisdictions.

These selection criteria allowed for the establishment of a benchmarking sample of reasonable scope, thereby limiting the influence of any one jurisdiction on the results, while at the same time maintaining an appropriate degree of comparability to Trinidad and Tobago.

⁹ As explained in the DoRs in response to an operator's comment on section 3.1 of the 2017 Report, the Authority reasserts the appropriateness of this selection criterion. The application of this criterion only eliminated jurisdictions where all operators' interconnection rates were confidential. It did not eliminate jurisdictions where interconnection rate information for at least one operator was available. Excluding useful partial country information would unnecessarily limit the size of the benchmarking sample. Furthermore, in the context of multi-operator markets, confidential interconnection rates for one competitor are likely to be very similar to the publicly available interconnection rates of other competitors in the same jurisdiction. Consequently, the Authority considers that including jurisdictions with partial interconnection rate information was appropriate. The only jurisdiction with partial information in the benchmarking sample was British Virgin Islands (BVI), where the MTR was publicly available for two of the three operators. As explained in the DoRs, the inclusion or exclusion of BVI will have no impact on the Authority's recommended costing benchmarks.

3.2. Full Benchmark Sample Jurisdictions

The application of the benchmark selection criteria resulted in a benchmarking sample of 23 Caribbean jurisdictions:

1. Anguilla
 2. Aruba
 3. The Bahamas
 4. Barbados
 5. British Virgin Islands (BVI)
 6. The Cayman Islands
 7. The Dominican Republic
 8. Dominica
 9. Grenada
 10. St. Kitts and Nevis
 11. St. Lucia
 12. St. Vincent and the Grenadines
 13. Guadeloupe
 14. Martinique
 15. St. Barts
 16. St. Martin
 17. Jamaica
 18. Bonaire
 19. Curacao
 20. St. Maarten
 21. Saba
 22. St. Eustatius
 23. Turks and Caicos Islands (TCI)
-
- Eastern Caribbean Telecommunications Authority (ECTEL) Member States**
- French West Indies (FWI)**
- Former Netherlands Antilles (excluding Aruba)**

There are several other notable Caribbean island jurisdictions that were excluded from the benchmark sample because they failed to satisfy one or more of the selection criteria, namely:

1. Antigua and Barbuda, Haiti and Montserrat — interconnection information not publicly available and/or confidential
2. Bermuda, Puerto Rico and The U.S. Virgin Islands — pure RPP regimes
3. Cuba — monopoly provision of mobile service

3.3. Benchmark Sample Jurisdiction Groupings

These 23 benchmark sample jurisdictions all met the selection criteria. However, there were instances where groupings of the jurisdictions were more appropriate for benchmarking purposes. For instance, the jurisdictions included in the ECTEL member states, the French West Indies (FWI) and the former Netherlands Antilles all have strong political, economic and, above all, regulatory commonalities. This raised the question as to whether, for benchmarking analysis purposes, some of the jurisdictions should have been treated separately or put into one or more groups. Any grouping would have reduced the effective sample size under some analytical scenarios while reducing the relative weight of each jurisdiction.

It was determined that each of the ECTEL member states should be treated as a separate jurisdictional observation, given that they each had different interconnection rates despite those rates having been recommended by a single regional regulatory body (ECTEL) to the respective national regulators. On the other hand, the five former Netherlands Antilles jurisdictions (excluding Aruba) each had the same interconnection rates and those rates had been set through a legal decision by the same court. Therefore, these five jurisdictions were grouped together as a single jurisdictional observation. In the case of FWI, there were two sets of interconnection rates corresponding to the operators in Guadeloupe and Martinique and in St. Barts and St. Martin. Therefore, these four jurisdictions were grouped into pairs of jurisdictional observations.

This resulted in the following three benchmark sample groupings:

1. **Former Netherlands Antilles Grouping:** Bonaire, Curacao, St. Eustatius, Saba and St. Maarten
2. **FWI Group 1:** Guadeloupe and Martinique
3. **FWI Group 2:** St. Barts and St. Martin

The effect of these groupings was to reduce these nine initially separate sample jurisdictions to three grouped jurisdictions, resulting in a net reduction of six sample observations. Consequently, the effective full benchmark sample size was reduced from 23 to 17.

3.4. Supplementary Benchmarking Data

While only Caribbean jurisdictions meeting the selection criteria were included in the benchmarking sample, relevant interconnection rate information for European countries was also considered, for sensitivity and cross-check purposes only¹⁰.

4. Benchmarked Interconnection Rates

4.1. Interconnection Data Compilation Process

As noted earlier, this Revised Report includes benchmark data for four interconnection services: domestic and international MTRs and FTRs, which include, in the latter cases, the corresponding MICCs and FICCs.

The primary sources for interconnection rate information were decisions and orders issued by the respective NRAs and/or operator-specific Reference Interconnection and Access Offers (RIAOs). In the first case, NRA decisions (which are generally public documents and are usually made available on NRA websites) typically focus on primary interconnection services (MTRs and FTRs) and, to a lesser extent, MICCs and FICCs.

The data compilation process for the SCI Study was carried out from mid-October to mid-December 2016, with data up to December 2016 considered as “actual”. The process involved the assessment of publicly available data from NRA websites (see the References section for full bibliographic details) and correspondence with NRAs. Data for the period January to March 2017 used in the 2017 Report were based on a short-term assessment of a continuation of actual 2016 rates or expected first quarter of 2017 rate changes, as indicated by NRAs (i.e., via website information and/or correspondence). The interconnection rate information for the first quarter of 2017 has been updated to actual for this Revised Report¹¹.

¹⁰ European countries are generally not directly comparable to Trinidad and Tobago. Most are far larger in size in terms of population and geographic scale and also have significantly different socio-economic characteristics, telecommunications markets and regulatory histories. Appendix I includes interconnection rate information for the 28 members of the European Union (EU) along with eight other European countries, for a total of 36 countries. The Authority also reviewed the USA and Canada jurisdictions and did not consider these directly comparable to Trinidad and Tobago.

¹¹ As stated in the DoRs in response to an operator’s comment to section 4.2 of the 2017 Report, the data-collection process included collecting publicly available information and, where necessary, SCI also called and/or emailed some NRAs to clarify and ensure proper understanding of the decisions and related documents available on the public record. The content of any such calls and/or email exchanges is private and no confidential interconnection rate information was

A copy of the benchmarking database for domestic MTRs and FTRs is available to local operators from the Authority, on request, in Excel spreadsheet format.

4.2. Other Benchmarking-Related Data

For sensitivity and normalisation purposes (see section 6.4), data were collected on a wide range of demographic, economic, market-related, technological, regulatory and other variables for each of the jurisdictions included in the benchmark sample:

- 1. Demographic/Geographic/Topographic Variables**
 - a. population
 - b. population density
 - c. land area
 - d. maximum elevation

- 2. Demographic/Geographic Variables**
 - a. currency exchange rates (to convert local currencies to US dollars)
 - b. gross domestic product (GDP) per capita (measured in US dollars)

- 3. Market Characteristic Variables**
 - a. number of mobile and fixed competitors
 - b. number of mobile and fixed subscribers
 - c. mobile and fixed penetration

relied on to develop the Authority's recommended costing benchmarks in this Revised Report. They are based entirely on publicly available information. In addition, with the objective of having data for the full 2016/2017 fiscal year, the SCI Study also assessed whether the interconnection rates in force in December 2016 would continue without change or were scheduled to change via NRA directive during the period January to March 2017. In this respect, there were two jurisdictions (FWI and Jamaica) for which SCI considered it reasonable to include new interconnection rates for the January to March 2017 period and these were included in the 2017 Report. In 2015, the NRA in the FWI had established that, in January 2017, there would be a change in MTRs and FTRs in the corresponding FWI jurisdictions. SCI was able to confirm that these MTRs and FTRs had actually been implemented as scheduled, in January 2017. Additionally, based on correspondence with the NRA of Jamaica, SCI included a decrease in the FTR that was scheduled to take effect in March 2017. SCI confirmed that the change in the FTR did indeed take place, but it had been delayed and implemented in two stages, the second of which did not take place until April 2018. Only the FTR was affected; the MTR was set based on a different process and timeline. The Authority notes this update has no material effect on its recommended costing benchmarks. The Authority has, however, included new sensitivity analyses related to the treatment of first quarter 2017 interconnection rates. (Refer to section 6.3 and Appendix II.)

4. Regulatory Variables:

- a. party(ies) setting the interconnection rates (e.g., an NRA, court or arbitration panel, or the operators themselves)
- b. basis of the interconnection rates (e.g., whether they have been set on a long-run incremental cost (LRIC), fully distributed cost approach, commercial negotiation, benchmarking or other approach)
- c. vintage of the interconnection rates (i.e., the time period when the rates were last set, which also reflects the current relevance or weighting of those rates)

5. Full-Sample Benchmarking Results

This section presents the full-sample benchmarking analysis for MTRs and FTRs. As discussed above, these results are presented for completeness only and do not constitute the recommended costing benchmarks (illustrated in subsequent sections). Two issues should be borne in mind to appreciate the full-sample benchmarking results for MTRs and FTRs.

The first issue relates to interconnection rate units. Interconnection rates are typically expressed on a per-minute basis. All the benchmark sample jurisdictions state their domestic MTRs in this manner. However, for domestic FTRs, in a minority of jurisdictions, there is a combination of per-call set-up and other per-minute charges or differential time-of-day charges. To make these rates comparable to those of the other jurisdictions that only have per-minute charges, such multi-part or time-of-day rates were converted into average per-minute rates using a standard three-minute call and time-of-day traffic assumptions¹². Such an approach is commonly used in benchmarking studies to allow rate comparability across jurisdictions and, importantly, the benchmarking results are not sensitive to reasonable changes to these assumptions¹³.

¹² Such an approach is common when benchmarking or comparing interconnection rates across jurisdictions. For example, one of the other two consultations conducted by Turks and Caicos Islands Telecommunications Commission led to the following decisions: Telecommunications Decision 2011-2, *Decision on the Mobile Termination Rate Review*, Turks and Caicos Islands Telecommunications Commission, January 24, 2011 and Telecommunications Decision 2014 – 4, *Decision on the Review of Interconnection Rates*, Turks and Caicos Islands Telecommunications Commission, June 20, 2014.

¹³ As stated in the DoRs in response to an operator's comment on section 4.2 of the 2017 Report, the Authority reasserts the appropriateness of this methodology. SCI used a set of generally accepted global assumptions to convert any applicable local rates into equivalent average per-minute rates. This conversion requirement only applied to FTRs in a limited number of jurisdictions and for a limited duration. The conversion factor assumptions used were as follows: average call time = 3.0 minutes; time-of-day/week distribution: day = 50%; evening = 25%; weekend = 25%. As noted in the DoRs, the Authority considers the use of global conversion factors to be preferable to local conversion factors. Furthermore, time-of-day/week interconnection charges are rapidly disappearing in favour of uniform per-minute FTRs, as has long been the case with MTRs. The Authority considers that the use of global rather than local conversion factors

The second issue concerns currency exchange rates. Most exchange rates are reported in local currency units (LCU). All such LCU rates were converted to their US dollar value. Of the jurisdictions in the benchmark sample, four were denominated in USD (i.e., The Bahamas, BVI, the Dominican Republic and TCI) and 13 others had fixed official exchange rates during the period under investigation. In these latter cases, the official fixed exchange rates are used. FWI and Jamaica have floating exchange rates and Trinidad and Tobago has a managed floating exchange rate. With the objective of being able to separate changes in exchange rates from changes in LCU interconnection rates, a single, long-term (nine years) average exchange rate (weighted more heavily for the last two years) was used for each of these latter jurisdictions, including Trinidad and Tobago¹⁴. As discussed below, the benchmarking results are not sensitive to reasonable changes in these exchange-rate assumptions.

The full-sample benchmarking results, excluding Trinidad and Tobago, are shown in Figures 1 and 2. The results for both domestic MTRs and FTRs show a general downward trend in average rates over the period investigated¹⁵.

Figure 1 shows the MTR benchmarking results for the full-sample benchmark period April 2008 to March 2017, covering a total of nine years for all 17 benchmark sample jurisdictions. The figure also shows (in red) the MTR full benchmark sample average.

for benchmarking purposes is reasonable and appropriate. As explained in the DoRs, in practice, the choice of conversion factors had no material impact on the Authority's recommended costing benchmarks.

¹⁴ All foreign exchanges rates were sourced from the International Monetary Fund (IMF). The local currency-USD exchange rates used are 1.25 in the case of FWI, 0.0100 for Jamaica and 0.1550 for Trinidad and Tobago.

¹⁵ Given that the operators in Trinidad and Tobago have expressly deemed local existing interconnection rates to be confidential, the assessment of the full-sample benchmarking results were redacted from this Revised Report and will be made available to local operators only, upon request.

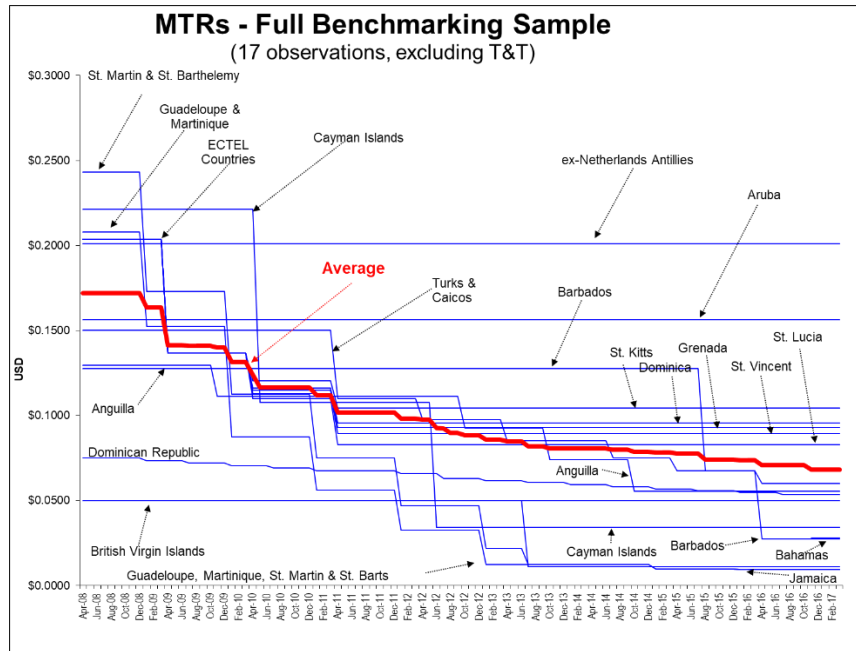


Figure 1. MTRs - full benchmarking sample (17 observations, excluding Trinidad and Tobago)

Figure 2 shows the results of the FTR benchmarking for the full sample of 17 benchmark jurisdictions over the period April 2009 to March 2017. The figure also shows the FTR full benchmark sample average (shown in red).

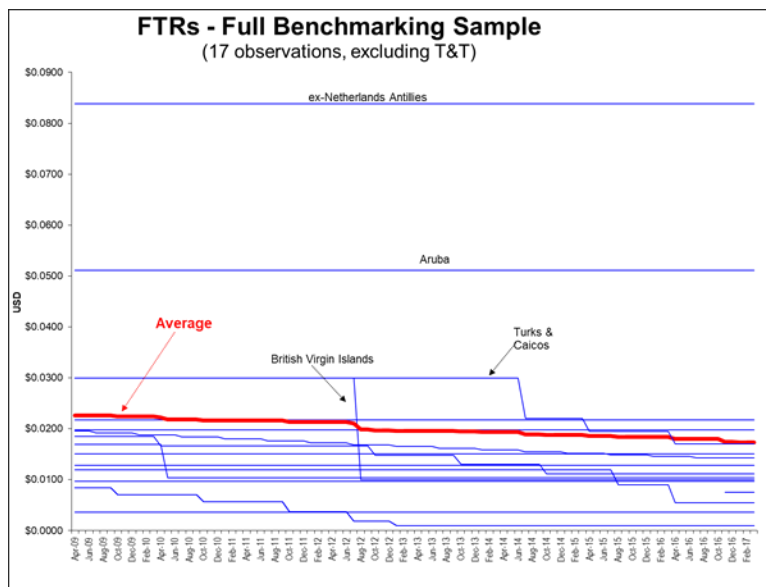


Figure 2. FTRs - full benchmarking (17 observations excluding Trinidad and Tobago)

To account for the effect of outliers, Figure 3 presents the same FTR full-sample benchmark data excluding Aruba and the ex-Netherlands Antilles (solely to better illustrate the relative rate levels in the remaining jurisdictions).

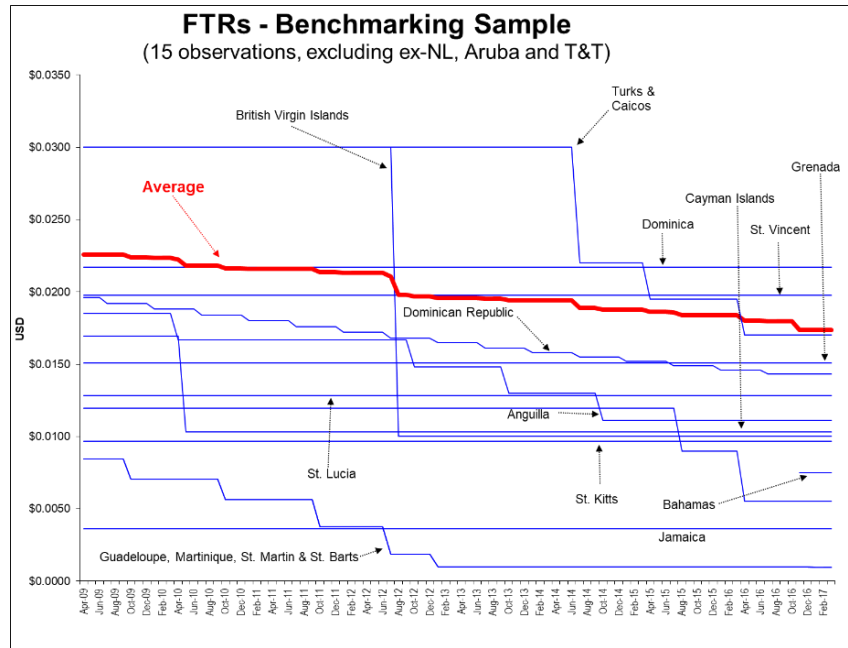


Figure 3. FTRs - full benchmarking sample (15 observations, excluding Ex-NL, Aruba and Trinidad and Tobago)

6. Domestic MTR and FTR Recommendations

This section presents the benchmarking analysis methodology and recommended costing benchmarks for domestic MTRs and FTRs.

6.1. Benchmarking Analysis Methodology

To conduct a relevant, sound and reliable assessment of the benchmarking data, several factors were considered:

1. The vintage of the interconnection rates in each benchmark sample jurisdiction
2. The historical and projected trends in interconnection rates
3. The use of alternative benchmark sub-samples for the purposes of sensitivity and robustness

Each of these factors is discussed in the following sub-sections.

6.1.1. The vintage of interconnection decisions in the benchmark sample jurisdictions

There were variations in the vintage of current interconnection rates in each of the benchmark sample jurisdictions. “Vintage” refers to the date of the decision that determined the interconnection rates at the time of the study. Some decisions on interconnection rates had been relatively recent, i.e., issued a few years prior to when the SCI Study was concluded in early 2017. In contrast, some decisions dated back to 2007 and 2009 and, moreover, the data and information underlying these vintage decisions were older still. The average vintage of the observed interconnection rates was around 2012 (i.e., five years prior to the issuance of the 2017 Report).

The greatest weight was given to relatively recent decisions, i.e., those issued in 2012 or later, as these better reflected more up-to-date cost levels. The rates set in 2011 and earlier were considered too dated to provide a reliable basis for developing recommended contemporary interconnection rates. They were also out of step with more recently established rates in the Caribbean and internationally¹⁶. It is also worth noting that, in many cases, the pre-2012 vintage rates (e.g., in the five ECTEL member states), were under review in 2017 and were expected to be reduced¹⁷. It was, therefore, decided that any rates that had been determined in 2011 or earlier should not form part of the basis for the Authority’s recommended costing benchmarks.

Of the 17 full-sample benchmark jurisdictions, the following met this post-2012 vintage threshold for the domestic MTRs:

1. Anguilla
2. The Bahamas
3. Barbados
4. The Cayman Islands
5. The Dominican Republic
6. Guadeloupe and Martinique
7. Jamaica
8. St. Barts and St. Martin
9. The Turks and Caicos (TCI)

These nine benchmark sample jurisdictions are referred to as the post-2012 sub-sample for domestic MTRs.

¹⁶ See Appendix I showing, for instance, historical rate levels and trends in Europe.

¹⁷ The Authority confirmed that, in April 2018, ECTEL recommended significantly reduced domestic MTRs and FTRs to the ECTEL member states.

The following benchmark sample jurisdictions met the threshold for the domestic FTRs:

1. Anguilla
2. The Bahamas
3. Barbados
4. The British Virgin Islands (BVI)
5. The Dominican Republic
6. Guadeloupe and Martinique
7. St. Barts and St. Martin
8. The Turks and Caicos (TCI)

These eight benchmark sample jurisdictions are referred to as the post-2012 sub-sample for domestic FTRs.

6.1.2. Historical trends in benchmark sample interconnection rates

Interconnection rates have been trending downward for many years. This is evident not only from the Caribbean benchmark sample included herein but also from trends in international jurisdictions such as those in Europe, as set out in Appendix I. This trend is expected to continue beyond the historical period (April 2008 to March 2017) used for this benchmarking exercise. Therefore, as part of the benchmarking analysis, benchmark sample average rates were statistically projected out three years to March 2020, on a “best-fit” statistical trend line basis. These historical trends and related projections informed the Authority’s recommended costing benchmarks.

6.1.3. Alternative benchmark sample averages considered

To ensure that the Authority’s recommended costing benchmarks were based on a robust multi-input methodology, the Authority considered three alternative benchmark sample averages.

The first benchmark average was based on the post-2012 sub-sample for domestic MTRs (nine sample jurisdictions) and for domestic FTRs (eight sample jurisdictions). This sub-sample average was calculated for the period March 2012 to 2017 and also projected to March 2020.

The second benchmark average was based on the subset of post-2012 sub-sample jurisdictions that have cost-based interconnection rates (that is, pure LRIC, LRAIC or some other cost standard). Of the nine post-2012 sub-sample jurisdictions for domestic MTRs, the following have cost-based rates:

-
1. The Bahamas
 2. Barbados
 3. The Cayman Islands
 4. Guadeloupe and Martinique
 5. Jamaica
 6. St. Barts and St. Martin

This group of six jurisdictions is referred to as the cost-based sub-sample for domestic MTRs¹⁸.

Of the eight post-2012 sub-sample domestic FTR jurisdictions, the following have cost-based rates:

1. The Bahamas
2. Barbados
3. Guadeloupe and Martinique
4. St. Barts and St. Martin

This group of four jurisdictions is referred to as the cost-based sub-sample for domestic FTRs¹⁹.

The third benchmark average was based on the European interconnection rate experience. The European benchmarks were used as a reasonableness check. A detailed summary of the European benchmark data is provided in Appendix I.

6.1.4. Glide path to recommended interconnection rates

It is recommended that interconnection rate changes be phased in over a three-year period. This is a common practice in other jurisdictions. The proposed glide path is also consistent with the projected rate trends. Therefore, the Authority's recommended costing benchmarks are based on a three-year glide path to the end-point date of March 2020. The recommended end-point rates for MTRs and FTRs are reflective of their respective post-2012 sub-sample average projections to March 2020 (the first benchmark average above), which, in both cases, are above the respective second and third benchmark averages.

¹⁸ The other jurisdictions determine their rates based on benchmarking or commercial negotiation.

¹⁹ Ibid.

6.1.5. Recommended costing benchmarks for domestic MTR and FTR

The recommended costing benchmarks for the Trinidad and Tobago domestic MTR and FTR are presented below.

For the domestic MTR and FTR, respectively, Figures 4 and 5 show the sample averages and projections for the post-2012 sub-sample (in red), cost-based sub-sample (in blue), the European country sample (in grey) and the Authority's recommended costing benchmarks (in green)²⁰. Table 1 summarises the recommended costing benchmarks.

Table 1. The Authority's recommended costing benchmarks (TTD/USD per minute)²¹

Interconnection Rates	Currency*	Rates Prevailing December 2016	Recommended Costing Benchmarks		
			April 2017 to March 2018	April 2018 to March 2019	April 2019 to March 2020
Domestic Mobile Termination Rate	TTD	█	0.226	0.177	0.129
	USD	█	0.0350	0.0275	0.0200
Domestic Fixed Termination Rate	TTD	█	0.042	0.035	0.029
	USD	█	0.0065	0.0055	0.0045

*Note: The recommended costing benchmarks were calculated and determined in USD. The TTD equivalent in this table is provided for illustrative purposes only and is based on the USD/TTD exchange rate (0.155) in effect at the time the SCI Study was concluded. USD/TTD exchange rates may change over the course of the three-year glide-path period. If so, at the start of each of the three glide-path years, interconnection rates could be restated in TTD based on the TTD/USD exchange rate at that time.

With respect to the rationale for the Authority's recommended costing benchmarks for the domestic MTR, the Authority notes that, as shown in Figure 4, the post-2012 sub-sample average and projection decreased from USD\$0.09 in 2012 to USD\$0.03 in 2017. The post-2012 sub-sample statistical trend line projection shows a further decrease to about USD\$0.02 by 2020. The cost-based sub-sample average is stable at around USD\$0.02 over the 2014 to 2017 period and is projected to remain at this level up to 2020. The two projections intersect at USD\$0.02 in 2020. As a reasonableness check, the European average declined from USD\$0.05 in 2008 to below USD\$0.02 in 2016. It is likely to decrease further but, as a conservative measure, a flat-line projection of the 2016 figure to 2020 has been used.

Based on these benchmark projections, a three-year MTR end point of USD\$0.020 is considered reasonable and appropriate and is, therefore, the Authority's recommended costing benchmark for

²⁰ The European country MTR and FTR historical sample averages are discussed in Appendix I.

²¹ Given that the operators in Trinidad and Tobago have expressly deemed local interconnection rates as confidential, the current rates are redacted from this Revised Report and will be made available to local operators only, upon request.

2019/20. As noted above, it is considered reasonable to transition from the domestic MTR that prevailed in March 2017 to the recommended end point in three equal steps, in line with the general downward trend in the post-2012 sub-sample average. Consequently, the Authority’s recommended costing benchmarks for 2017/18 and 2018/19 are USD\$0.0350 and USD\$0.0275, respectively. Table 1 summarises these values in both USD and TTD equivalents.

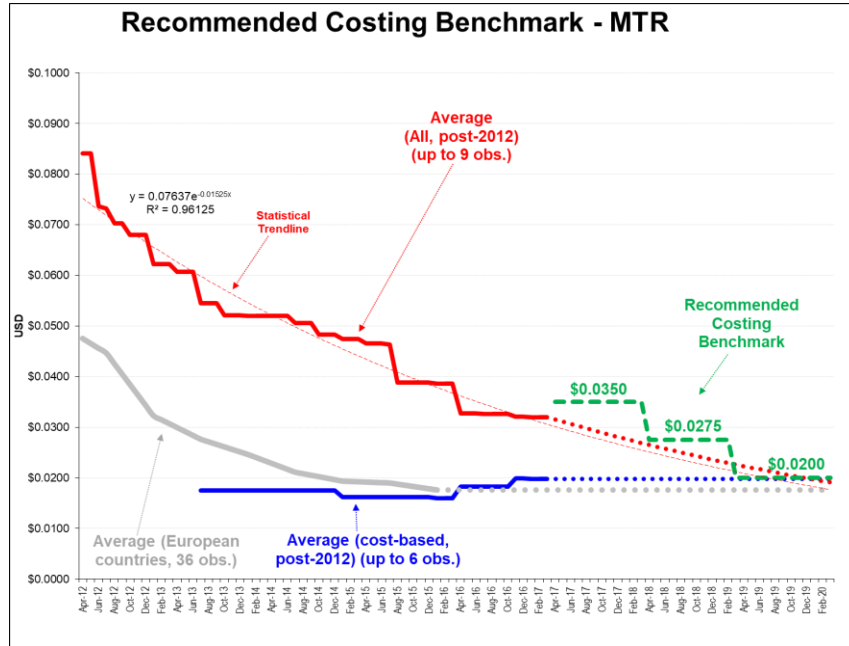


Figure 4. MTR recommended costing benchmark

The same rationale is applicable to the Authority’s recommended costing benchmark for the domestic FTR shown in Figure 5, where a three-year FTR end point of USD\$0.0045 is considered reasonable and appropriate and, therefore, is the Authority’s recommended costing benchmark for 2019/20. As noted above, it is considered reasonable to transition from the domestic FTR that prevailed in March 2017 to the recommended end point in three equal steps. Therefore, the Authority’s recommended intermediate costing benchmarks for 2017/18 and 2018/19 are USD\$0.0065 and USD\$0.0055, respectively. Table 1 summarises these values in both USD and TTD equivalents.

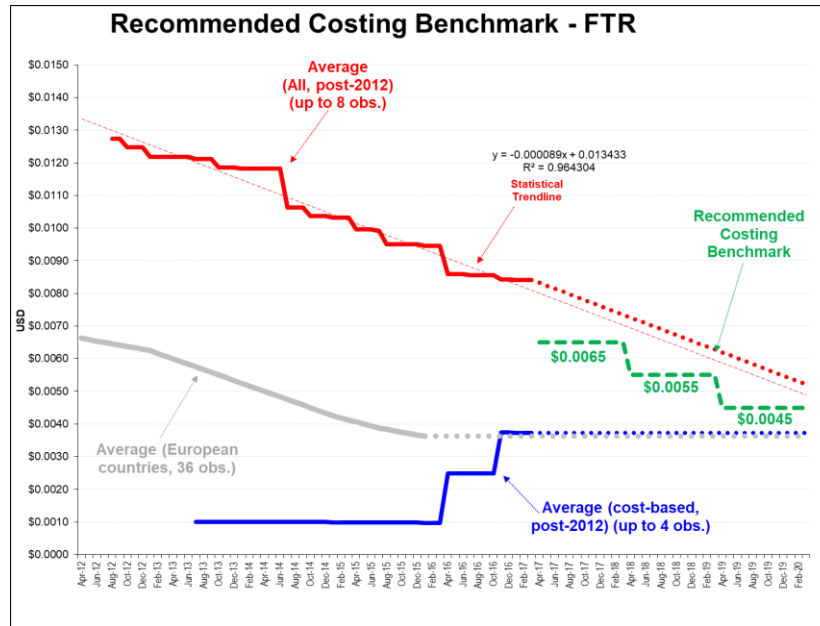


Figure 5. FTR recommended costing benchmark

6.2. Sensitivity Analyses

In response to comments received on the 2017 Report, the number of sensitivity analyses conducted was increased from two to six. These six sensitivity analyses for the domestic MTR and FTR are presented in this Revised Report. The detailed results are included in Appendix II and a further discussion of them is included in the DoRs (Appendix IV).

The six sensitivity analyses applied to both the MTR and FTR recommended costing benchmarks involved the following considerations:

1. Exchange rate assumptions
2. Benchmark sample scope (i.e., reliance on the full benchmarking sample rather than post-2012 and cost-based sub-samples)
3. Exclusion of outlier observations
4. The treatment of FWI as four rather than two observations
5. The exclusion of hybrid RPP/CPP jurisdictions (i.e., The Bahamas and Barbados)
6. The exclusion of projected first quarter 2017 MTRs and FTRs

As explained in Appendix II and the DoRs, in relation to Sensitivity #2, the Authority found that reliance on the full benchmark sample did not provide a valid basis for developing the recommended costing benchmarks for either the MTR or FTR. In relation to the five other sensitivity analyses, the Authority found that they had no significant impact on the recommended costing benchmarks. Therefore, the

Authority considers that the results of these sensitivity analyses provide support for the appropriateness of its recommended costing benchmarks.

6.3. Normalisation Analysis

Although the benchmarking sample used for this study included only Caribbean island jurisdictions, to ensure maximum comparability to Trinidad and Tobago, the Authority recognised that, even within the Caribbean region, there are differences amongst the benchmark jurisdictions in terms of demographic, topographic, socio-economic and environmental factors. Therefore, the Authority sought to determine whether any such factors would warrant a normalisation adjustment (i.e., either increases or decreases) to the recommended costing benchmarks for the domestic MTR and/or FTR.

For normalisation analysis purposes, the following variables were considered:

1. population size
2. land area (square kilometres)
3. maximum elevation (metres)²²
4. population density (a/b)
5. income measured as GDP per capita (USD)
6. fixed subscribers
7. mobile subscribers
8. fixed density (f/a)
9. mobile density (g/a)
10. number of mobile service providers (as a measure of market competitiveness)
11. indication of whether or not interconnection rates were set on the basis of costs or some other approach²³

Table 2 depicts these variables for each jurisdiction in the full MTR and FTR benchmark samples and the post-2012 MTR and FTR sub-samples, along with sample averages in each case. It also includes correlation coefficients between the domestic MTRs and FTRs and each of the 11 noted demographic, topographic, socio-economic and environmental variables²⁴. Trinidad and Tobago is listed separately at the bottom of the table and is not included in any of the benchmark sample averages.

²² Based on a comment from an operator on this section of the 2017 Report, this variable was added to the analysis.

²³ See discussion in section 6.1.

²⁴ The correlation coefficients in Table 2 were calculated using the Excel CORREL function which calculates how strongly two variables are correlated with one another. A correlation coefficient ranges from -1 (perfect negative correlation) to +1 (perfect positive correlation), and a correlation coefficient of 0 represents no correlation whatsoever. Further details

A comparison of variables for Trinidad and Tobago and the benchmark sample jurisdictions, whether on the basis of the full sample or post-2012 sub-samples, revealed the following:

- i. Trinidad and Tobago's population density (261/km²) is relatively close to the full-sample and post-2012 sub-sample averages (274 and 266, respectively). There is very little correlation between these demographic variables and either the domestic MTRs or FTRs in the other benchmark jurisdictions in the full sample²⁵. The correlation is somewhat higher in the case of the post-2012 sub-samples but still limited, with a correlation coefficient of -0.50.
- ii. In terms of maximum elevation, some jurisdictions are considerably higher than Trinidad and Tobago, such as the Dominican Republic and Jamaica, and some much lower, such as the Cayman Islands and TCI, while others are very similar, like St. Kitts and Nevis and St. Lucia. Whether considered on the basis of a full-sample or post-2012 sub-sample jurisdictions, Trinidad and Tobago, at 940 m, is slightly higher than the average (by less than 100 m in both cases), and there is no significant correlation between the variables, i.e., the correlation coefficients are near zero in both instances.
- iii. Trinidad and Tobago's GDP per capita (roughly USD\$17,000) is very close to the full-sample average and somewhat lower than the post-2012 sub-sample averages. Here again, there is virtually no correlation between this economic variable and the level of either the MTRs or FTRs in the other benchmark jurisdictions.
- iv. Trinidad and Tobago's fixed subscriber density (20%) is below the full-sample and post-2012 sub-sample benchmark averages (roughly 30% for both samples). On the other hand, mobile subscriber density (156%) is higher than the benchmark averages (about 115% in both samples). Once again, there is very little correlation between subscriber density and either the MTRs or FTRs in the other benchmark jurisdictions.
- v. Simply splitting the benchmark jurisdictions between those with two mobile operators and those with three mobile operators showed that, on average, the MTR was lower in jurisdictions with more operators. Jurisdictions with less mobile competition generally had higher MTRs. The same finding could very likely apply to the fixed market as well.
- vi. Examination of the jurisdictions with cost-based versus other MTRs and FTRs, as itemised above in section 6.1.1, showed that jurisdictions with cost-based rates had lower MTRs

regarding the CORREL function are available at <https://support.office.com/en-us/article/correl-function-995dcef7-0c0a-4bed-a3fb-239d7b68ca92>

²⁵ The measured correlation coefficients are close to zero.

and FTRs on average. Therefore, examining costs and setting interconnection rates on the basis of a cost study generally resulted in lower MTRs and FTRs.

While the first four findings in the above comparison provided little basis for implementing a normalisation adjustment of any magnitude (whether positive or negative), considerations v) and vi) suggested a downward adjustment to the benchmark rates might be warranted. However, no normalisation adjustment either way to the Authority's recommended costing benchmarks is proposed. For this reason, the Authority considers that its benchmarks are conservative in nature.

Table 2. Benchmark jurisdiction variables

Jurisdictions	Population	Land Area (km ²)	Max Elevation (m)	Population Density	GDP/cap (USD)	Fixed Subs	Mobile Subs	Fixed Density	Mobile Density	Mobile Operators	Costs	FTR (USD) DEC-16	MTR (USD) DEC-16
Anguilla	15,000	91	63	165	\$21,493	6,000	26,000	40%	173%	2	No	0.0111	0.0556
Aruba (NA)	103,889	180	188	577	\$25,751	35,000	141,000	34%	136%	3	No	0.0511	0.1564
Bahamas	388,019	10,010	63	39	\$22,817	120,925	311,175	31%	80%	2	Yes	0.0075	0.0279
Barbados	284,215	430	336	661	\$15,429	156,857	334,792	55%	118%	2	Yes	0.0055	0.0275
British Virgin Islands	30,117	151	521	199	\$30,502	12,000	42,000	40%	139%	3	No	0.0100	0.0500
Cayman Islands	59,967	264	43	227	\$58,808	33,534	93,244	56%	155%	2	Yes	0.0103	0.0341
Dominican Republic	10,529,391	48,310	3,098	218	\$6,468	1,304,968	8,797,247	12%	84%	3	No	0.0143	0.0536
ECTEL - Dominica	72,680	750	1,447	97	\$7,116	15,123	77,254	21%	106%	2	Yes	0.0217	0.0956
ECTEL - Grenada	106,825	340	840	314	\$9,212	27,034	119,767	25%	112%	3	Yes	0.0151	0.0930
ECTEL - St. Kitts & Nevis	55,572	260	1,156	214	\$15,772	19,748	73,009	36%	131%	3	Yes	0.0097	0.1043
ECTEL - St. Lucia	184,999	610	950	303	\$7,736	34,874	187,741	19%	101%	2	Yes	0.0128	0.0830
ECTEL - St. Vincent	109,462	390	1,324	281	\$6,739	24,865	113,371	23%	104%	2	Yes	0.0198	0.0894
FWI - Guadeloupe & Martinique	865,884	2,829	1,467	306	\$24,068	348,651	1,383,797	40%	160%	3	Yes	0.0010	0.0095
FWI - St. Barthelemy & St. Martin	39,121	79	286	493	\$20,186	15,855	10,783	41%	28%	3	Yes	0.0010	0.0095
Jamaica	2,725,941	10,830	2,256	252	\$5,232	252,630	3,137,213	9%	115%	2	Yes	0.0036	0.0110
Turks & Caicos Islands	34,339	950	49	36	\$23,615	4,000	39,342	12%	115%	2	No	0.0078	0.0600
ex-Netherlands Antilles (exc. Aruba)	221,952	806	887	275	\$21,898	7,007	263,271	32%	119%	2.1	No	0.0838	0.2011
Full Sample Average	930,964	4,546	881	274	\$18,991	142,298	891,236	31%	116%	2.4		0.0168	0.0683
Correlation Coefficient (FTR)	-0.08	-0.09	-0.04	0.14	0.03	-0.14	na	-0.05	na	na	na		
Correlation Coefficient (MTR)	-0.16	-0.18	-0.04	0.06	-0.11	na	-0.20	na	0.13	na	na		
Post-2012 Sub-Sample Average	1,660,099	8,199	851	266	\$22,013	249,269	1,570,399	33%	114%	2.3		0.0069	0.0321
Correlation Coefficient (FTR)	0.51	0.54	0.12	-0.45	0.13	0.44	na	-0.16	na	na	na		
Correlation Coefficient (MTR)	0.26	0.29	-0.10	-0.50	0.06	na	0.19	na	0.25	na	na		
Trinidad & Tobago	1,360,088	5,130	940	261	\$17,322	270,872	2,123,374	20%	156%	2	No	0.0078	0.0419

Sources: GSMA-WI, World Bank, UN Data, FWI; INSEE/ARCEP. Note that the demographic, topographic and socio-economic variables were measured for the most recently available year, typically 2015 or 2016.

"na" implies that the calculation of a correlation coefficient is not relevant, given the two variables at play. For example, the correlation coefficients between fixed subscribers and MTRs and mobile subscribers and FTRs are not relevant and, therefore, not calculated.

Note: correlation coefficients are calculated using the Excel "CORREL" function. Details on the specification and interpretation of the CORREL function and results are available at <https://support.office.com/en-us/article/correl-function-995dcef7-0c0a-4bed-a3fb-239d7b68ca92>.

7. International MICC and FICC Recommendations

This section presents the benchmarking analysis methodology and recommendations for the MICC and FICC charges.

Only two countries in the full benchmark sample — Barbados and Jamaica — had “explicit” ICCs directly comparable to those in Trinidad and Tobago. The other benchmark jurisdictions did not have explicit ICCs. Therefore, with the objective of increasing the sample size for benchmarking purposes, “implicit” ICCs were derived. In this regard, the Authority noted that the latter jurisdictions in the benchmark sample had established international MTRs and FTRs (i.e., IMTRs and IFTRs). The IMTR and IFTR typically consisted of two or three components:

- i. An IMTR consists of (1) a domestic MTR, (2) an MICC and (3) a transit charge (which applies when a call transits over a fixed network for termination on a mobile network).
- ii. An IFTR consists of (1) the domestic FTR and (2) an FICC.

Based on the relationship between MICCs and IMTRs and between FICCs and IFTRs, the Authority derived the implicit MICC and FICC for all jurisdictions without explicit rates. However, because these were implicit ICCs, the Authority did not consider it appropriate to do only a “direct” comparison for benchmarking purposes. The Authority, therefore, also included “indirect” comparisons of the ratios between international and domestic MTRs and FTRs to determine the recommended costing benchmarks for the MICC and FICC.

Table 3 shows the results of this analysis, which was based on the compilation of relevant benchmarking data on actual or implicit MICCs and FICCs for each benchmark country (i.e., IMTR-MTR and IFTR-FTR, respectively). These are presented for the full benchmark sample and the post-2012 benchmark sub-samples, including/excluding a domestic transit charge (where applicable). These are the direct benchmarks. Table 3 also includes two types of indirect benchmarking: the IMTR/MTR and IFTR/FTR ratios and the MICC/FICC ratio.

Table 3. International interconnection benchmarking results (USD)²⁶

	Formula for MICC (equiv. for FICC)	MICC*	FICC*	MICC/FICC Ratio
Trinidad and Tobago	IMTR/MTR	■	■	
	IMTR – MTR = MICC	\$0.076	\$0.019	4.1:1
Benchmark: Full Sample**	IMTR/MTR	1.38	1.34	
	IMTR – MTR = MICC	\$0.0180	\$0.0030	6.0:1
Benchmark: Post-2012 Sub-Sample***	IMTR/MTR	1.73	1.77	
	IMTR – MTR = MICC	\$0.0230	\$0.0050	4.6:1
Mid-Points of Benchmarks	IMTR/MTR	1.55	1.55	
	IMTR – MTR = MICC	\$0.0205	\$0.0040	5.1:1
2019/20 Domestic MTR/FTR Recommended Costing Benchmarks		\$0.0200	\$0.0045	4.4:1
2019/20 MICC and FICC Recommended Costing Benchmarks	IMTR/MTR	1.33	1.50	
	IMTR – MTR = MICC	\$0.0150	\$0.0030	5.0:1
<p>Notes: * is the average of the “with” and “without” domestic transit IMTRs and IFTRs, respectively. ** The full sample had an average of 16 observations with an average vintage of the corresponding decision of between October 2011 to January 2012. ***The post-2012 sub-sample had an average of six observations with an average vintage of the corresponding decisions of between April to August 2015.</p>				

Starting with the MICC, the table shows that the Trinidad and Tobago IMTR/MTR of 2.80 is relatively high compared to the 1.38 and 1.73 ratios for the two benchmark sample averages. This ratio analysis suggests that Trinidad and Tobago’s MICC included in the IMTR is relatively high compared to the benchmarks. This was confirmed when examining the benchmark MICCs. Trinidad and Tobago’s MICC of USD\$0.076 is relatively high compared to the implicit MICCs of USD\$0.018 and USD\$0.023 for the benchmark averages. A similar finding applies to the FICC. Trinidad and Tobago’s FICC is also relatively high, from both a ratio and an implicit perspective, relative to the corresponding benchmark averages.

²⁶ Given that the operators in Trinidad and Tobago have expressly deemed local existing interconnection rates to be confidential, the full assessment of IMTRs and IFTRs were redacted from this Revised Report and will be made available to local operators only, upon request.

For the reasons noted above, the Authority is of the view that it should consider both direct and indirect benchmarking analysis perspectives in setting the recommended costing benchmarks for the MICC and FICC. As such, it was guided by the following benchmarking results/criteria:

- 1) The benchmark IMTR/MTR and IFTR/FTR ratios ranged from 1.38 to 1.73 and 1.34 to 1.77, respectively, with both ratios having a mid-point of 1.55.
- 2) The implicit MICC benchmark ranged from USD\$0.018 to USD\$0.023 (mid-point, USD\$0.020) and the implicit FICC benchmark ranged from USD\$0.003 to USD\$0.005 (mid-point of USD\$0.004).
- 3) The implicit MICC/FICC ratio ranged from 4.6:1 and 6.0:1 (mid-point, 5.1:1).

Taking into account the recommended costing benchmarks for the domestic MTR and FTR and the three benchmarking results noted above, an iterative process was carried out to determine a reasonable and appropriate MICC and FICC for Trinidad and Tobago. The process began by setting the MICC and FICC at the mid-points of the respective implicit benchmarking results of USD\$0.020 and USD\$0.004, and then making the necessary iterative adjustments to ensure the rates were generally consistent with the above-noted three benchmarking results/criteria.

On this basis, the Authority determined that the recommended costing benchmarks for the MICC and FICC for 2019/20 should be **USD\$0.0150** and **USD\$0.0030**, respectively. These are included in Table 4 for comparability with the benchmark ratios and differences²⁷.

Consistent with the Authority's recommended costing benchmarks for the domestic MTR and FTR, these 2019/20 MICC and FICC costing benchmarks should also be phased in over three years, in three equal steps. The Authority's recommended costing benchmarks for MICC and FICC 2017/18 to 2019/20 are summarised in Table 4.

²⁷ The process used to determine the recommended costing benchmarks for the MICC and FICC is further discussed in the DoRs (see Appendix IV), in response to an operator's comments on section 7 of the 2017 Report.

Table 4. The Authority's recommended costing benchmarks (TTD/USD per minute)²⁸

Interconnection Rates	Currency*	Rates Prevailing December 2016	Recommended Costing Benchmarks		
			April 2017 to March 2018	April 2018 to March 2019	April 2019 to March 2020
Mobile International Carriage Charge (MICC)	TTD	█	0.355	0.226	0.097
	USD	█	0.0550	0.0350	0.0150
Fixed International Carriage Charges (FICC)	TTD	█	0.084	0.052	0.019
	USD	█	0.0130	0.0080	0.0030

***Note:** The recommended costing benchmarks were calculated and determined in USD. The TTD equivalent in this table is provided for illustrative purposes only and is based on the USD/TTD exchange rate (0.155) in effect at the time the SCI Study was concluded. USD/TTD exchange rates may change over the course of the three-year glide-path period. If so, at the start of each of the three glide-path years, interconnection rates could be restated in TTD based on the TTD/USD exchange rate at that time.

8. Potential Impacts of Recommended Costing Benchmarks

This section provides an assessment of the likely impacts of the recommended costing benchmarks on operators and, ultimately, consumers in Trinidad and Tobago.

8.1. Impact on Operators

There are two mobile network operators in Trinidad and Tobago — TSTT/BMobile and Digicel — and a number of fixed network operators, including TSTT, Digicel Fixed (Digicel Play), CCTL/Flow and Lisa Communications. Reducing the relevant interconnection rates that held in March 2017 to the recommended costing benchmarks would have the effect of reducing all fixed and mobile domestic call-traffic interconnection payments and, correspondingly, revenues.

The Authority has reviewed traffic and revenue data shared between operators and has undertaken an extensive impact analysis based on the application of the recommended costing benchmarks. Due to the confidential nature of this data, this impact analysis was excluded from the 2017 Report as well as this Revised Report. In general, the impacts and/or the resultant benefit/loss of reducing the relevant interconnection rates to the recommended costing benchmarks for an individual operator would depend on relative call-traffic volume flows between operators.

²⁸ Given that the operators in Trinidad and Tobago have expressly deemed local interconnection rates as confidential, the current rates are redacted from this Revised Report and will be made available to local operators only, upon request.

8.2. Impact on Consumers

Reducing the relevant interconnection rates to the recommended costing benchmarks should, in principle, bring about a number of positive benefits to consumers or end users, the most important of which are discussed in the following sub-sections.

8.2.1. Price and usage benefits from reduced domestic MTR and FTR

There are potential benefits to consumers from reducing the domestic MTR and FTR to the recommended costing benchmarks.

First, a decrease in domestic interconnection rates would lower the off-net²⁹ call termination costs to originating operators and, therefore, allow for potential reductions in average retail call prices and, perhaps to even a greater degree, in average retail call prices for off-net calling (where such differentials exist). In effect, the cost floor for such calls would be less as a result of lower interconnection rates and, therefore, retail call prices could potentially also be reduced.

There is debate as to whether the savings associated with lower call-termination costs would, in fact, be passed on to consumers, since an operator's cost savings can be offset by reduced revenues from the call termination services provided on its own network. Thus, the net benefit to consumers could be limited. This potential outcome or effect is referred to in the regulatory economics literature as the "waterbed effect". According to this theory, above-cost prices for call termination may allow an operator to subsidise the prices of other services. Conversely, if interconnection rates are reduced, then other prices may increase. However, the empirical literature that has attempted to confirm the existence, and measure the magnitude, of this effect is mixed and inconclusive³⁰.

Second, to the extent reductions in interconnection rates do in fact lead to lower average retail calling prices, increased usage of mobile and fixed services by end users should also be expected, based on the price-elasticity effects of a price decrease³¹. For instance, if reduced interconnection rates result in lower retail off-net calling prices, then increased off-net call volumes would be expected³². The reduction in

²⁹ Calls terminated on another operator's network

³⁰ See, for instance, C. Genakos and T. Valletti, "Mobile regulation and the waterbed effect," January 4, 2010 at <https://voxeu.org/article/mobile-regulation-and-waterbed-effect>.

³¹ In addition, there could also be some indirect effects based on the behavioural response amongst some or all affected consumers. The specific avenues via which such effects take place, and their individual and cumulative impact on demand, are the subject of behavioural economics, and are outside the scope of this Revised Report.

³² It should also be noted that any such retail-price change driven by call-traffic stimulation would have impacts on operators' retail revenues and wholesale revenues/payments. In the latter case, operators' net call termination

retail off-net call prices would result in a decrease in the off-net/on-net differentials (to the extent they exist), which would promote greater inter-operator (intra-modal) competition as well as fixed-mobile competition (inter-modal) competition.

Third, to the extent that reduced interconnection rates lead to lower average retail prices, increased take-up of both fixed and mobile wireless services could be expected.

On the subject of reducing MTRs to cost levels, Ofcom, the national regulatory agency in the United Kingdom, concluded, in 2010, that³³:

“Reduction in MTRs ... will reduce call prices and promote competition, furthering the interests of consumers.

Our proposals continue a long-term trend during which time MTRs have fallen from more than 23 ppm in 1995 to less than 5 ppm today ... During that time mobile penetration has increased enormously, prices have fallen considerably and MCPs [Mobile Communications Providers] have invested heavily in delivering new services, such as mobile broadband.

As with previous MTR charge controls, the mobile industry will continue to face steady and sustained reductions in MTRs. We anticipate that the market will be capable of adapting to these changes, which will be implemented over four years and which are broadly in line with previous trends. As the market adapts, we believe that further reductions in termination rates will promote competition, the development of innovative tariff packages and the growth of genuinely converged fixed and mobile services.”

Ofcom’s conclusions support the view that competition would be promoted by, and end users would benefit from, a reduction in interconnection rates to cost-based levels.

revenues/payments could be affected, depending on the nature of any such call-traffic volume changes and, as suggested by the operator impact analysis above, some operators may be better off while others are worse off. However, retail revenue impacts from such retail price changes would normally be far larger than any underlying wholesale call-termination revenue/payment impacts.

³³ Ofcom, *Wholesale mobile voice call termination, Market Review* (Volume 1 – Executive summary). Published April 1, 2010, paragraphs 1.11 to 1.13

8.2.2. Empirical evidence of price and usage benefits

There is evidence to support the benefits discussed above. In 2010, SCI conducted an empirical analysis on the relationship between retail call prices and interconnection rates (specifically MTRs) in the Caribbean region³⁴. The summary of this analysis is presented in Appendices III. The analysis included data collected for 14 Caribbean jurisdictions³⁵ on postpaid and prepaid mobile-to-mobile, on-net and off-net retail average calling prices and fixed-to-fixed and fixed-to-mobile average calling prices in each jurisdiction³⁶. The analysis shows that there was a statistically significant relationship between termination rates and retail prices, i.e., the call-termination rates were positively correlated with retail call prices. More specifically, the results of the analysis³⁷ indicated the following:

1. Mobile-to-Mobile Retail Calls

- a. Off-net postpaid calling prices were correlated with the level of the MTR. Off-net call prices tended to be lower when the underlying MTR was lower. While the statistical relationship was not strong, it nevertheless suggested that end users benefitted from lower MTRs.
- b. On the other hand, on-net postpaid calling prices were not correlated with the level of the MTR. On-net call rates did not appear to be influenced by the level of the underlying MTR.
- c. The ratio of off-net to on-net postpaid pricing was higher in countries with higher MTRs. This finding is consistent with the expectation that allocative efficiency is negatively affected, and intra-modal (mobile-mobile) competition hindered, by higher MTRs.

³⁴ This analysis was conducted for the Turks and Caicos Islands Telecommunications Commission in 2010, as part of a public consultation process to review the level of the MTR in TCI.

³⁵ Anguilla, Barbados, British Virgin Islands, the Cayman Islands, the Dominican Republic, ECTEL member states (Dominica, Grenada, St. Kitts and Nevis, St. Lucia and St. Vincent and the Grenadines), French West Indies (Guadeloupe and Martinique), Trinidad and Tobago and the Turks and Caicos Islands

³⁶ Details of the empirical analysis are provided in the Turks and Caicos Islands Telecommunications Commission, Review of Mobile Termination Rate Consultation Document, issued July 19, 2010, available at: http://www.telecommission.tc/content/root/files/20100719112927-TCI-MTR-Consultation-Documents_July-19-2010.pdf. (See Appendix III for empirical evidence on consumer benefits.)

³⁷ Ibid.

2. Fixed-to-Mobile Retail Calls

- a. Fixed-to-mobile, off-net, per-minute call prices were correlated with the level of the MTR. Fixed-to-mobile off-net call prices tended to be lower when the underlying MTR was lower.
- b. The ratio of off-net fixed-to-mobile to on-net fixed-to-fixed pricing was higher in countries with higher MTRs. This result is consistent with the expectation that allocative efficiency is negatively affected, and inter-modal (fixed-mobile) competition hindered, by higher MTRs.

8.2.3. Price and usage benefits from reduced MICC and FICC

As in the case of the domestic MTR and FTR and retail call prices, reductions in MICC and FICC should also, in principle, lead to reductions in international retail call prices. However, the link between international interconnection rate reductions and retail international call prices is less direct compared to retail domestic call prices. Reducing the MICC and FICC rates that held in March 2017 to the recommended costing benchmarks should lead to greater competition for international traffic carriage in and out of Trinidad and Tobago. This, in turn, could put downward pressure on inter-carrier settlement rates and, ultimately, retail international call prices, which would benefit consumers and, potentially, operators as a result of increased international call volumes.

The Authority conducted an estimation of the proposed impact of lowered interconnection rates on local retail prices and this is presented in Appendix 1V.

8.3. Risk Assessment

The Authority also considered the risks related to not implementing the recommended costing benchmarks in terms of the costs and benefits.

Several potential negative impacts could be expected if the recommended costing benchmarks are not implemented. Leaving interconnection rates at levels that held in March 2017 would allow operators to continue charging above-cost rates for interconnection services. This implies that those operators with net in-payments would be allowed to continue profiting from excessive rates. On the other hand, those with net out-payments would continue incurring excessive interconnection costs. The combined effect would allow interconnection pricing inefficiencies to remain in place, which would affect retail prices and/or bar market entry/expansion and, as a result, impact consumer usage of retail call services.

With respect to the impact on the consumer, above-cost call-termination service pricing very likely results in higher-than-otherwise retail call prices, since retail prices reflect operators' underlying costs, which include call termination costs. As a consequence, consumers are potentially harmed by excessive retail prices, which have the compounded effect of suppressing consumer demand in terms of usage as well as subscriptions. More specifically, allowing above-cost call-termination rates to remain in place also distorts competition in the retail market by serving to promote higher-than-otherwise retail off-net calling prices.

There is a very high risk that not reducing the relevant interconnection rates that held in March 2017 to the recommended costing benchmarks will endorse existing network interconnection pricing inefficiencies, harm consumers through higher-than-necessary retail prices, and distort market competition.

There is, therefore, sound basis³⁸ for the Authority's position that, in order to mitigate these risks, reducing the relevant interconnection rates that held in March 2017 to the recommended costing benchmarks will result in lower retail call prices over the course of the glide-path time period.

9. Conclusion

The objective of this Revised Report is to present the methodology, data, rationale and results for the Authority's recommended costing benchmarks for the domestic MTR and FTR and the MICC and FICC, in fulfilment of regulation 15(2) of the Interconnection Regulations.

The results of the benchmarking analysis summarised herein indicate that the domestic MTR and FTR and the MICC and FICC that have held since March 2017 are high, and the implementation of the Authority's recommended costing benchmarks would bring about a reduction in those charges to more reasonable and appropriate cost-based levels.

The Authority is convinced that reducing the relevant interconnection rates that held in March 2017 to the recommended costing benchmarks will result in lower retail call prices and yield significant consumer benefits in Trinidad and Tobago.

³⁸ As described above, lower interconnection rates are correlated with lower retail prices in the Caribbean region. Similarly, efforts by regulators in Europe to ensure interconnection rates are consistently reduced over time as corresponding costs decline also support the view that lower interconnection rates would lead to lower retail prices. The findings of Ofcom referenced in section 8 clearly reflect this view.

It is also important to reiterate that lowering call termination rates over time, to ensure they reflect costs as closely as possible, is an interconnection policy objective pursued by virtually all NRAs, including the Authority. Evidence from the Caribbean region and elsewhere (e.g., Europe) testifies to this fact. Consequently, the Authority is in step with international regulatory practice with respect to its recommended costing benchmarks.

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Appendix I: European Benchmarking Data

This appendix includes data and analysis on interconnection rates in Europe. As indicated in section 6 of the Revised Report, this is a complementary analysis that is used as a “reasonableness” check to the Caribbean benchmarking, and as not a substitute for the primary Caribbean benchmarking.

The Body of European Regulators of Electronic Communications (BEREC) provides regular survey reports on interconnection rates in Europe, including on the 28 member states of the European Union (EU) along with eight other European countries, for a total of 36 countries³⁹. The countries included in this analysis are generally not directly comparable to Caribbean jurisdictions, including Trinidad and Tobago. There are, however, nine less populous countries with populations of under 2 million included in the BEREC surveys that can be considered more comparable to Trinidad and Tobago. The rates observed in this sub-sample of smaller scale European countries are examined in what follows for cross-check purposes.

i. Mobile Termination Rates (MTRs)

BEREC collects information on the MTRs for every major mobile network operator in each of the 36 countries. For each country, an average MTR is calculated using market shares as weights. BEREC also provides a summary of the methodologies used by the NRAs to set MTRs in each country. In this respect, a bottom-up, long-run, incremental cost (BU-LRIC) approach is used by the majority of the NRAs (21 of the 36), roughly half of which are pure BU-LRIC approaches. Benchmarking is the next most often used approach (7 of 36), while the remaining approaches vary from country to country and, in some cases, are unreported. MTRs in Europe have been steadily declining for years. As shown in Figure A1, between 2008 and 2016, the simple-average European MTR has dropped to USD\$0.018.

³⁹ BEREC, *Termination rates at European level*, January 2016, BoR (16) 90, issued May 2016, and related reports, are available at: http://berec.europa.eu/eng/document_register/subject_matter/berec/reports/6086-termination-rates-at-european-level-january-2016.

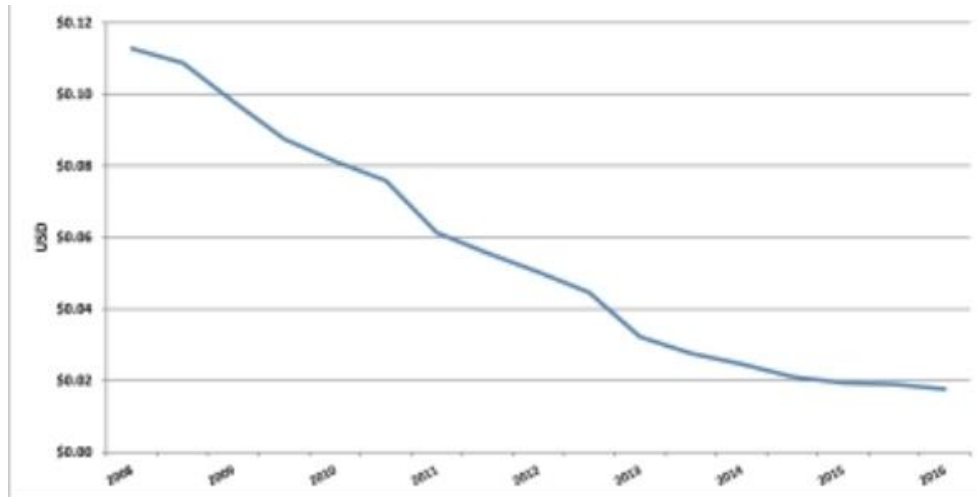


Figure A1. Average European MTR - historical trend and projection (simple average, USD per minute)

Figure A2 provides a snapshot of the country-specific European MTRs reported for January 2016, ranked from lowest to highest. The figure also includes simple averages for the entire group of European countries as well as the 28 EU member states — USD\$0.018 and USD\$0.013, respectively. The figure also highlights the set of smaller European countries included in BEREC’s survey. To a considerable extent, the MTRs for this sub-group of countries are equally distributed on either side of the European-wide average rates. Of note is that Malta (MT) has the lowest MTR of the group, at USD\$0.005. Otherwise, the simple average of the smaller European countries is USD\$0.021 for January 2016, which is very close to but slightly higher than the EU group averages (in red).

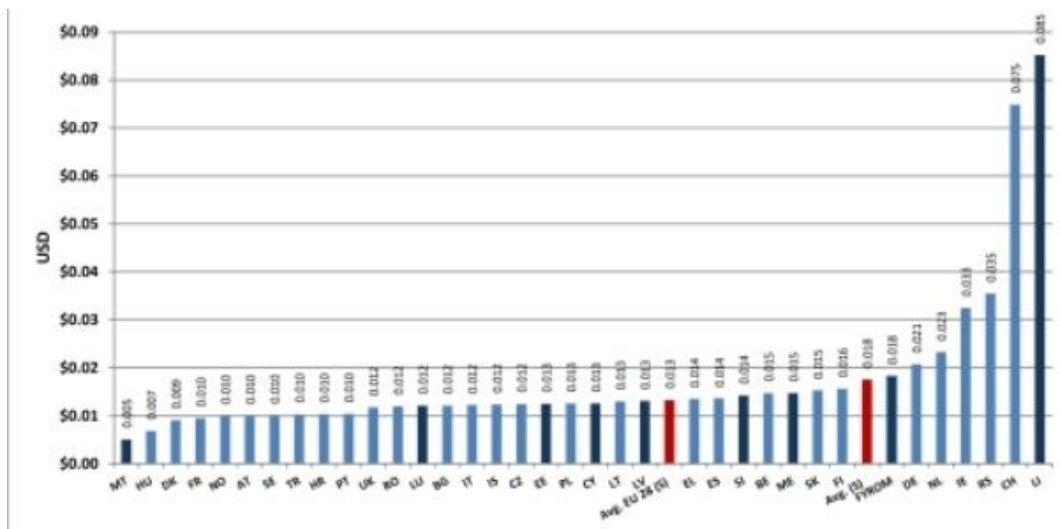
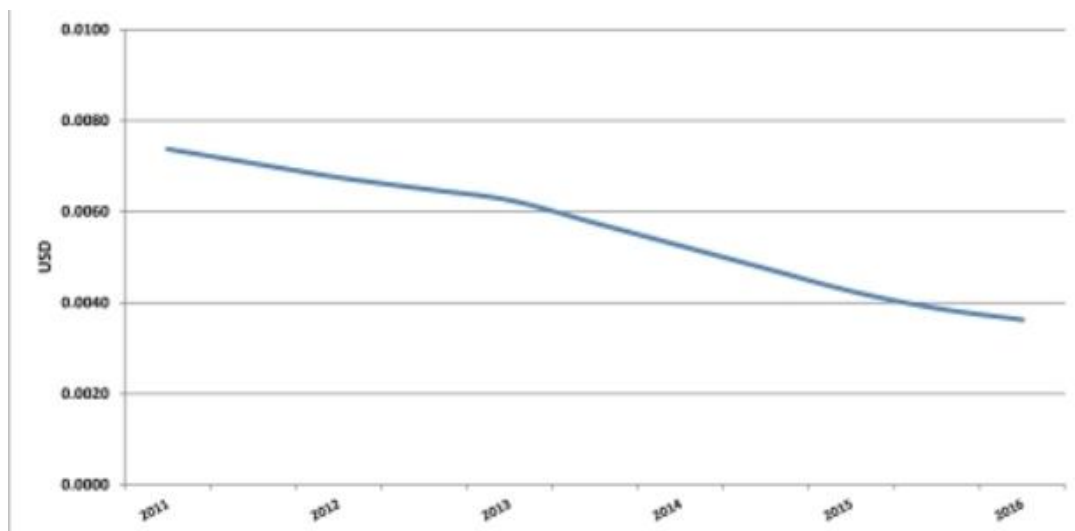


Figure A2. Average European country-specific MTRs as of January 2016 (USD per minute). Countries with population < 2m highlighted in dark blue

ii. **Fixed Termination Rates (FTRs)**

BEREC notes that fixed network interconnection services in Europe are typically provided at different levels or “layers” of the operators’ networks. The three main interconnection layers defined are: layer 1, or local level service provision; layer 2, or regional level service provision (single transit); and layer 3, which is national level service provision (or double transit). For the benchmarking purpose at hand, European layer 1 FTRs are comparable to FTRs in effect in the Caribbean region, since they reflect the cost of local call termination on fixed networks.

In terms of alternative methodologies used by NRAs to set FTRs, the most common approach is pure BU-LRIC (which is used in 18 of the 36 countries). The next most popular approaches, in order of use, are: fully distributed costing or fully allocated costs (FDC/FAC), LRAIC+, and benchmarking. As shown in Figure A3, FTRs in Europe had also been declining over time and had dropped to USD\$0.0036 by January 2016.



**Figure A3. Average European FTR - historical trend and projection
(simple average, USD per minute)**

Figure A4 depicts the country-specific European FTRs for January 2016. The figure also includes simple FTR averages for the entire group of European countries as well as the 28 EU member states (USD\$0.0036 and USD\$0.0033, respectively), and highlights (in dark blue) the set of smaller European countries included in the survey. For the most part, they are equally distributed on either side of the European-wide averages. Of note is that Malta (MT) has the second lowest FTR of the group, at USD\$0.0005. Otherwise, the simple average of the full sub-group of smaller European countries is USD\$0.0028, which is below the group averages (in red).

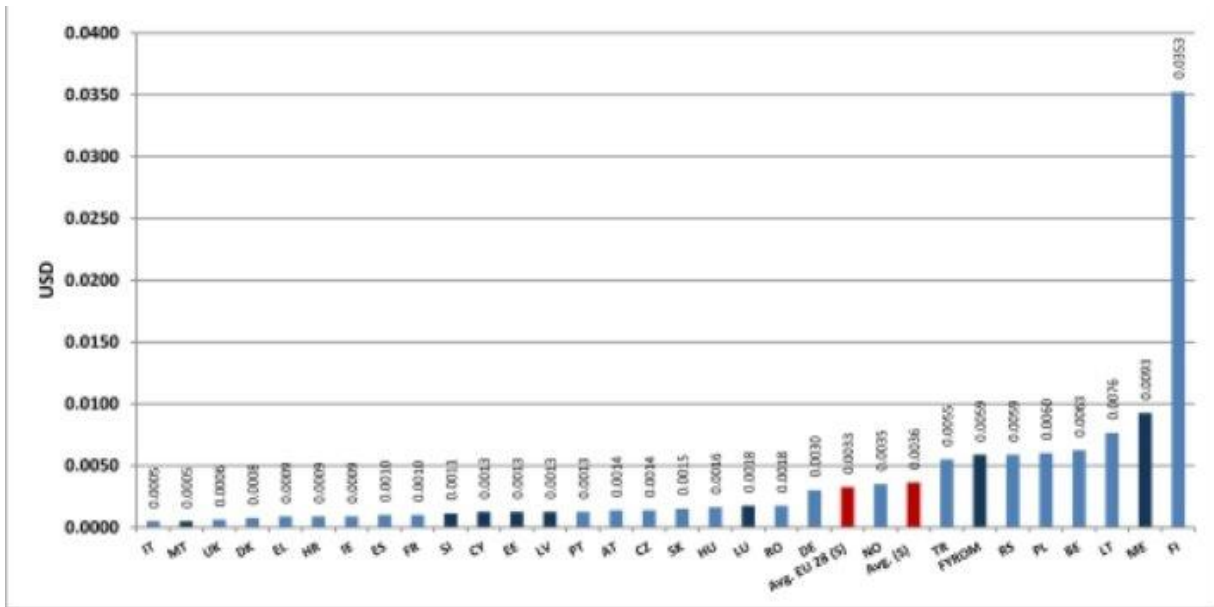


Figure A4. Average European country-specific FTRs as of January 2016 (USD per minute). Countries with population < 2m highlighted in dark blue

Appendix II: Domestic MTR and FTR Sensitivities

This appendix presents the summary results and the corresponding figures for the six sensitivity analyses discussed in section 6.3 of this Revised Report. Note that, in each case, sensitivity results are compared to the Authority’s recommended costing benchmarks for the MTR and FTR, which are referred to in the discussion below as the “base case”. More detailed discussion and analysis for each of these sensitivities is included in the DoRs (see Appendix IV). As summarised below, after conducting these sensitivity analyses, the Authority considers that they support the appropriateness of its recommended costing benchmarks.

a) Sensitivity #1: Exchange Rate Sensitivity

As noted in section 5, most exchange rates are reported in local currency units (LCUs). For benchmarking purposes, these were converted into USD, using official exchange rates. To separate changes in exchange rates from changes in LCU interconnection rates, a single average long-term (nine years) exchange rate was used. The 2017 Report included an exchange rate sensitivity for only the MTR, using average 2016 exchange rates (instead of the average long-term exchange rate)⁴⁰. This same sensitivity analysis was subsequently conducted for the FTR and is now included in the Revised Report. The Authority reiterates its conclusion in the 2017 Report that a different exchange rate formulation would not have changed the MTR recommended costing benchmark (see Figure B1). That is, this sensitivity analysis showed that the MTR recommended costing benchmark is robust to a different foreign exchange formulation.

⁴⁰ For the affected jurisdictions, the benchmarked LCU-USD exchange rates used were as follows: 1.25 for FWI, 0.0100 for Jamaica and 0.1550 for Trinidad and Tobago. Comparatively, the sensitivity exchange rates are 1.100, 0.008 and 0.1500, respectively.

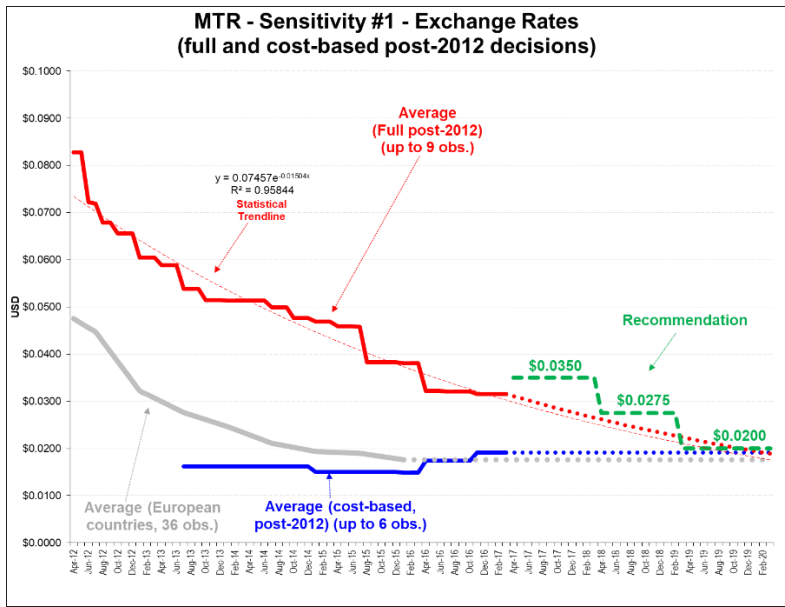


Figure B1. MTR Sensitivity #1

Having included the FTR in this sensitivity analysis (see Figure B2), the Authority now also concludes that a different exchange rate formulation would not have changed the FTR recommended costing benchmark. That is, this sensitivity analysis showed that the FTR recommended costing benchmark is robust to a different foreign exchange formulation.

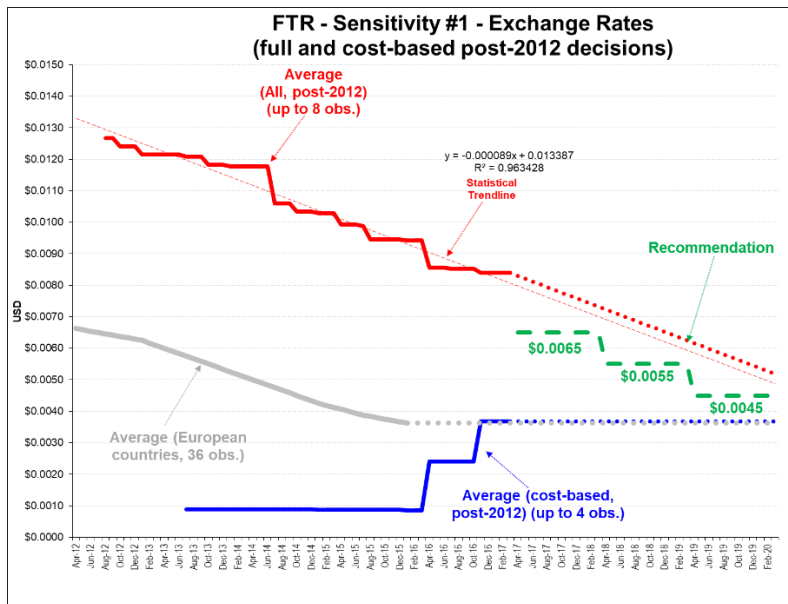


Figure B2. FTR Sensitivity #1

b) Sensitivity #2: Benchmark Sample Inclusion Sensitivity

The 2017 Report included an MTR sensitivity analysis using the full benchmarking sample, and thereby including jurisdictions with rates set by decisions made prior to 2012. The sensitivity analyses contained in this Revised Report include the same sensitivity analysis for the MTR and now adds the equivalent sensitivity analysis for the FTR.

These two sensitivity analyses, presented in Figures B3 and B4, demonstrated that reliance on the full MTR and FTR benchmarking samples produced implausible benchmarking costing results because the results were largely driven by out-of-date interconnection rates. Furthermore, the results of these sensitivity analyses were completely inconsistent with interconnection rate trends in the Caribbean as well as Europe (see Appendix I).

The Authority disagrees with the suggestion received in parties' comments on the 2017 Report that the full rather than post-2012 and cost-based benchmarking sub-samples should be used to developed recommended costing benchmarks. The Authority continues to be of the view that reliance on the full benchmark sample did not provide a valid basis for developing the recommended costing benchmarks for either the MTR or the FTR.

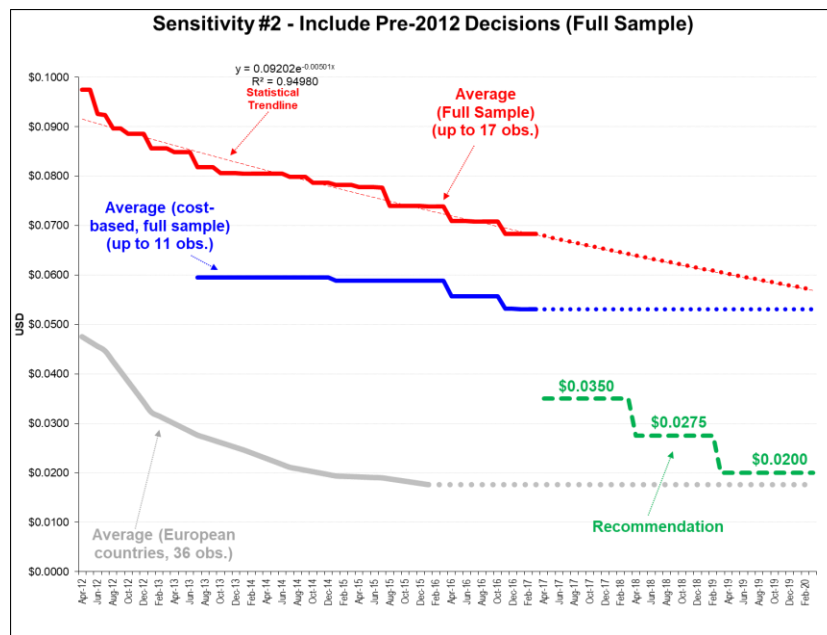


Figure B3. MTR Sensitivity #2

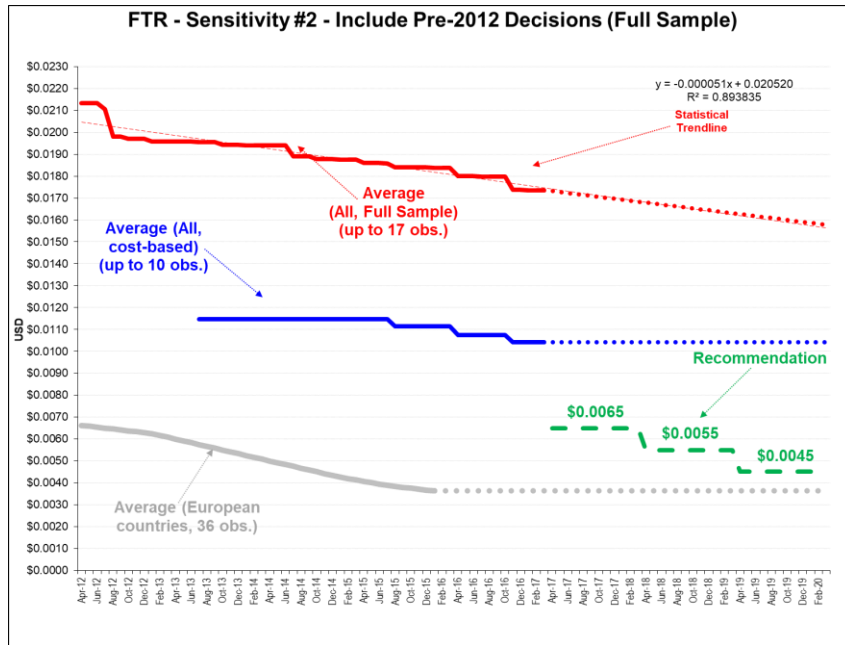


Figure B4. FTR Sensitivity #2

c) Sensitivity #3: Exclusion of Outlier Observations Sensitivity

In the comments received on the 2017 Report, one party suggested that outlier observations should be excluded from the benchmarking samples. As indicated in the DoRs, the Authority disagrees with this suggestion.

Two sensitivity analyses have been carried out to assess the impact of excluding the “maxima” and “minima” (i.e., outlier) observations from the MTR and FTR post-2012 and cost-based sub-samples. The respective maxima and minima benchmark sample jurisdictions are identified in Table B1.

Table B1. Outliers for MTR and FTR cost-based and post-2012 sub-samples

Sub-sample	MTR		FTR	
	Maxima	Minima	Maxima	Minima
Post-2012	TCI	FWI Group 2 (St. Barts/St. Martin)	TCI	FWI Group 2 (St. Barts/St. Martin)
Cost-Based	The Cayman Islands	FWI Group 2 (St. Barts/St. Martin)	The Bahamas	FWI Group 2 (St. Barts/St. Martin)

These maxima and minima benchmark sample jurisdictions have been excluded from corresponding benchmark sub-samples in the sensitivity analyses shown in Figures B5 and B6.

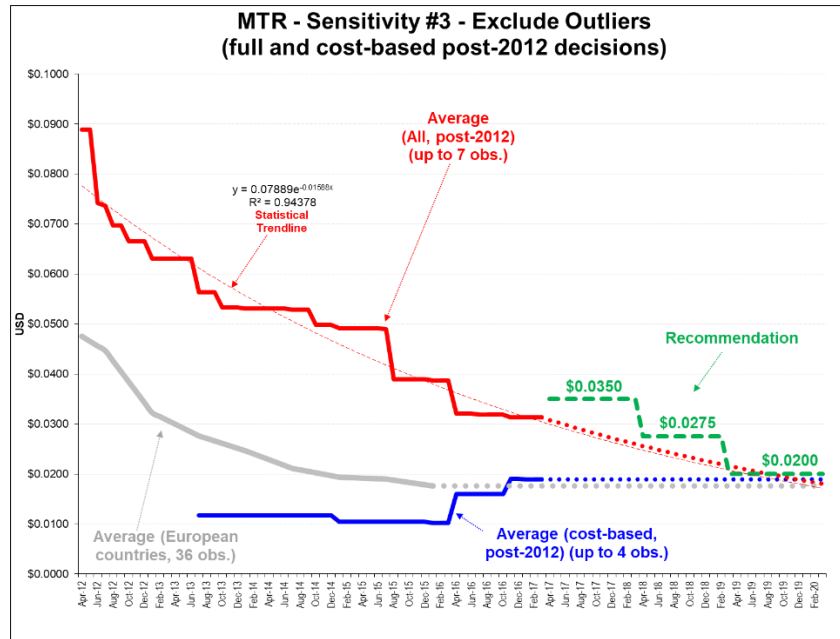


Figure B5. MTR Sensitivity #3

Summary Findings for MTR Sensitivity #3

MTR post-2012 sub-sample: Relative to the base case, sensitivity #3 does not materially change the results of the historical benchmarking, including the March 2017 end point, nor the best-fit statistical trend line, nor the corresponding projection, including the March 2020 end point.

MTR cost-based sub-sample: Relative to the base case, sensitivity #3 does not materially change the results of the historical benchmarking, including the March 2017 end point, nor the corresponding projection, including the March 2020 end point.

Conclusion: Based on these findings, even if the Authority were to agree to exclude the noted maxima and minima countries from the sub-samples (which it does not), the suggested exclusion of these jurisdictions would not change the MTR recommended costing benchmark. Therefore, this sensitivity analysis shows that the MTR recommended costing benchmark is robust to the inclusion or exclusion of the noted MTR maxima and minima jurisdictions shown in Table B1.

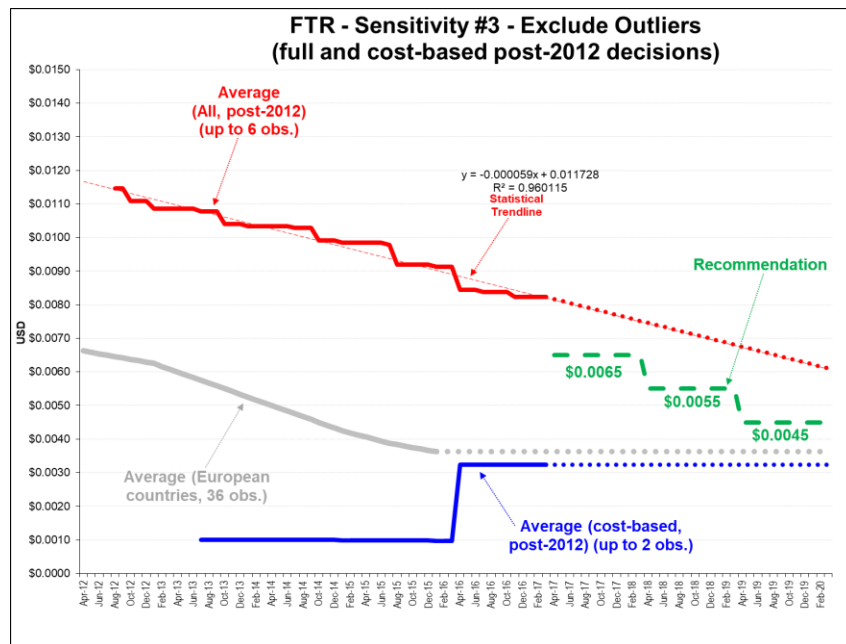


Figure B6. FTR Sensitivity #3

Summary Findings for FTR Sensitivity #3

FTR post-2012 sub-sample: Relative to the base case, sensitivity #3 does not materially change the results of the historical benchmarking, including the March 2017 end point, nor the best-fit statistical trend line, nor the corresponding projection, including the March 2020 end point.

FTR cost-based sub-sample: Relative to the base case, sensitivity #3 does not materially change the results of the historical benchmarking, including the March 2017 end point, nor the corresponding projection, including the March 2020 end point.

Conclusion: Based on these findings, even if the Authority were to agree to exclude the maxima and minima countries from the sub-samples (which it does not), the suggested exclusion of these jurisdictions would not have changed the FTR recommended costing benchmark. Therefore, this sensitivity analysis shows that the FTR recommended costing benchmark is robust to the inclusion or exclusion of the noted FTR maxima and minima jurisdictions shown in Table B1.

d) Sensitivity #4: Treatment of FWI Jurisdictional Observations Sensitivity

In comments received on the 2017 Report, one party suggested that rather than treating FWI as two benchmarking jurisdictional observations, it should be treated as four⁴¹. As indicated and explained in the DoRs, the Authority disagrees with this suggestion.

Nevertheless, in response to this suggestion, sensitivity analyses were carried out to assess the impact of treating FWI as four rather than two jurisdictional observations. These sensitivity analyses are shown in Figures B7 and B8.

⁴¹ As indicated in section 3.3, in the benchmarking sample, FWI is treated as two jurisdictional observations: FWI Group 1 consists of Guadeloupe and Martinique and FWI Group 2 consists of St. Barts and St. Martin.

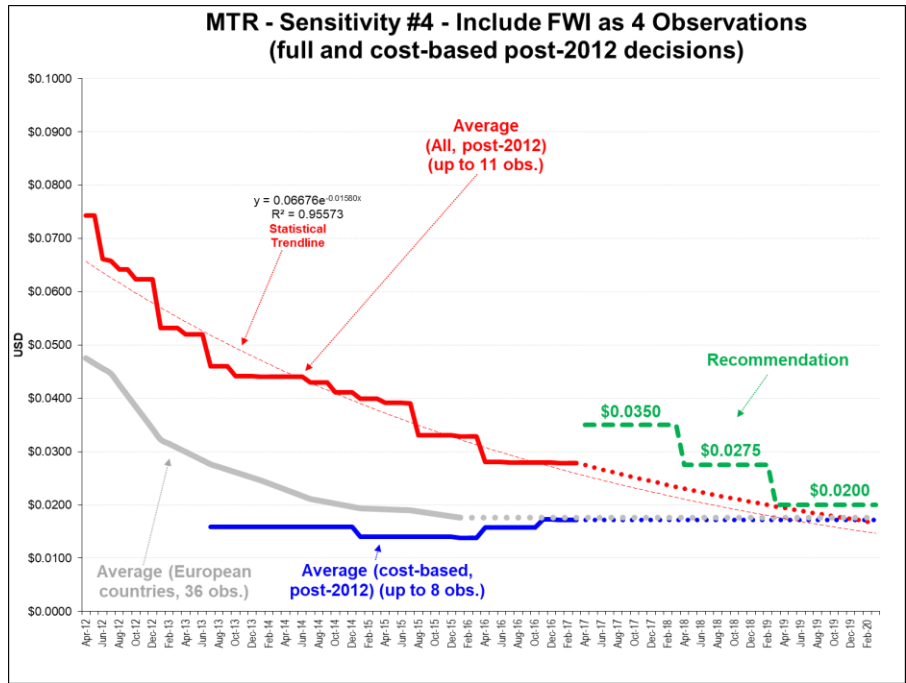


Figure B7. MTR Sensitivity #4

Summary Findings for MTR Sensitivity #4

MTR post-2012 sub-sample: Relative to the base case, sensitivity #4 decreases the results of the historical benchmarking, including the March 2017 end point. It also lowers the best-fit statistical trend line and the corresponding projection, thus decreasing minimally the March 2020 end point.

MTR cost-based sub-sample: Relative to the base case, sensitivity #4 decreases somewhat the results of the historical benchmarking, including the March 2017 end point. It also lowers somewhat the corresponding projection, including the March 2020 end point.

Conclusion: Based on the findings, even if the Authority were to agree to include the FWI as four rather than two jurisdictional observations (which it does not), the suggested treatment of FWI would not have changed the MTR recommended costing benchmark. Therefore, this sensitivity analysis shows that the MTR recommended costing benchmark is robust to the treatment of FWI as four instead of two jurisdictional observations.

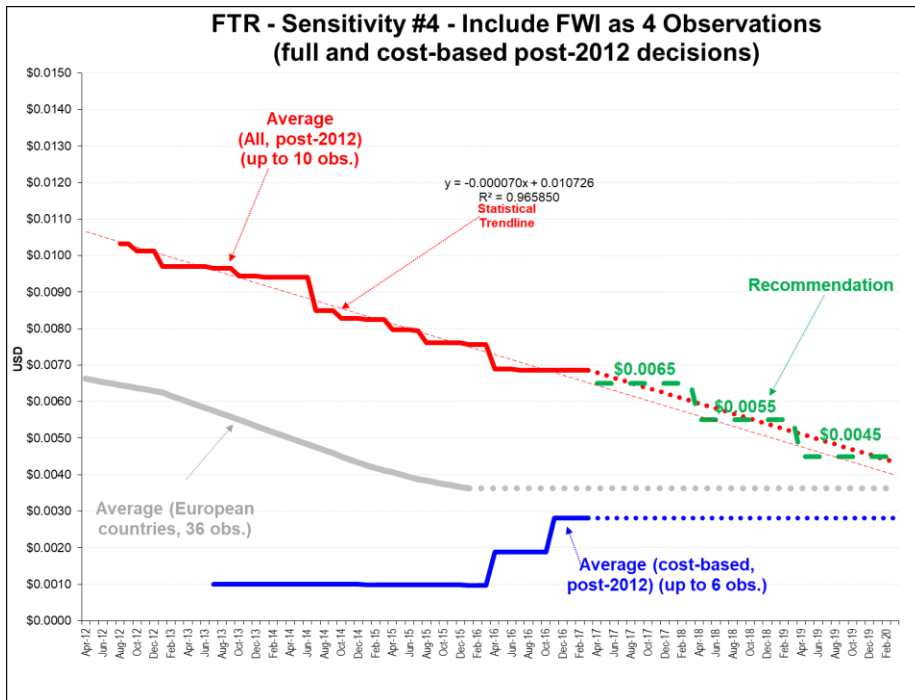


Figure B8. FTR Sensitivity #4

Summary Findings for FTR Sensitivity #4

FTR post-2012 sub-sample: Relative to the base case, sensitivity #4 decreases the results of the historical benchmarking, including the March 2017 end point. It also lowers somewhat the best-fit statistical trend line and the corresponding projection, thus decreasing somewhat the March 2020 end point.

FTR cost-based sub-sample: Relative to the base case, sensitivity #4 decreases the results of the historical benchmarking, including the March 2017 end point. It also lowers somewhat the corresponding projection, including the March 2020 end point.

Conclusion: Based on the findings, even if the Authority were to agree to include the FWI as four rather than two jurisdictional observations (which it does not), the suggested treatment of FWI would not change the FTR recommended costing benchmark. Therefore, this sensitivity analysis shows that the FTR recommended costing benchmark is robust to the treatment of FWI as four, not two, jurisdictional observations.

e) Sensitivity #5: Exclusion of Hybrid RPP/PPP Jurisdictions Sensitivity

In comments received on the 2017 Report, one party suggested that hybrid RPP/PPP jurisdictions should be excluded from the benchmarking sample. As stated in the DoRs, the Authority continues to be of the view that the two hybrid RPP/PPP jurisdictions in question should remain in the benchmarking sample.

That said, in response to this suggestion, sensitivity analyses were carried out to assess the impact of excluding hybrid RPP/PPP jurisdictions from the benchmarking sample, i.e., The Bahamas and Barbados. These sensitivity analyses are shown in Figures B9 and B10.

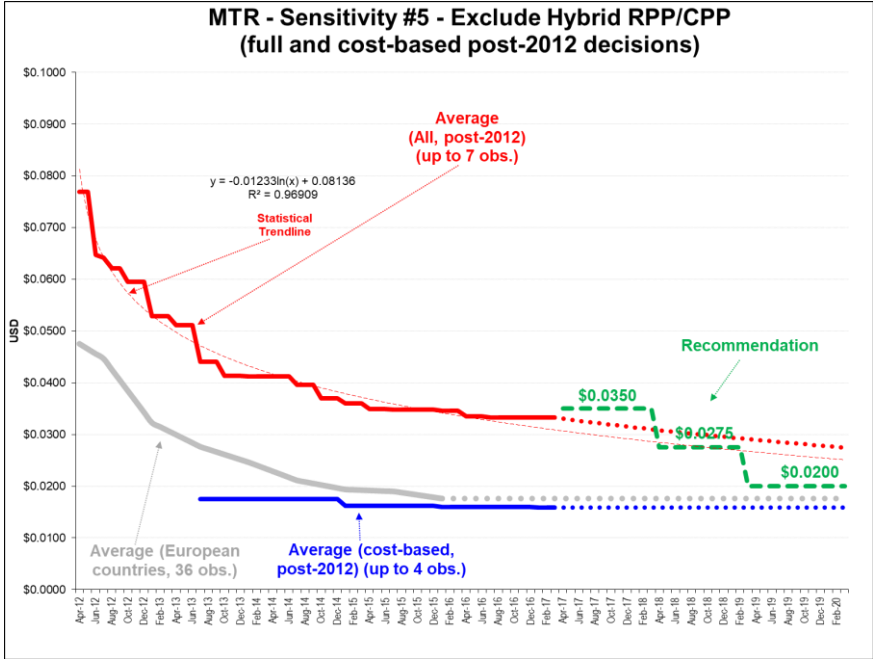


Figure B9. MTR Sensitivity #5

Summary Findings for MTR Sensitivity #5

MTR post-2012 sub-sample: Relative to the base case, sensitivity #5 does not materially change the results of the historical benchmarking, including the March 2017 end point. However, the form of the best-fit statistical trend line does change (from exponential in the base case to logarithmic form) and, hence, the March 2020 end point for the corresponding projection is somewhat higher than the base case.

MTR cost-based sub-sample: Relative to the base case, sensitivity #5 does not materially change the results of the historical benchmarking, including the March 2017 end point, nor the corresponding projection, including the March 2020 end point.

Conclusion: Based on the findings, even if the Authority were to agree to exclude hybrid RPP/CPP jurisdictions from the MTR benchmarking sample (which it does not), their exclusion would not change the MTR recommended costing benchmark. The revised historical and projected post-2012 and cost-based sub-sample trend lines under this alternative scenario are fully consistent with, and support, the MTR recommended costing benchmark. In other words, this sensitivity analysis showed that the MTR recommended costing benchmark is robust to the inclusion/exclusion of the two noted hybrid RPP/CPP jurisdictions.

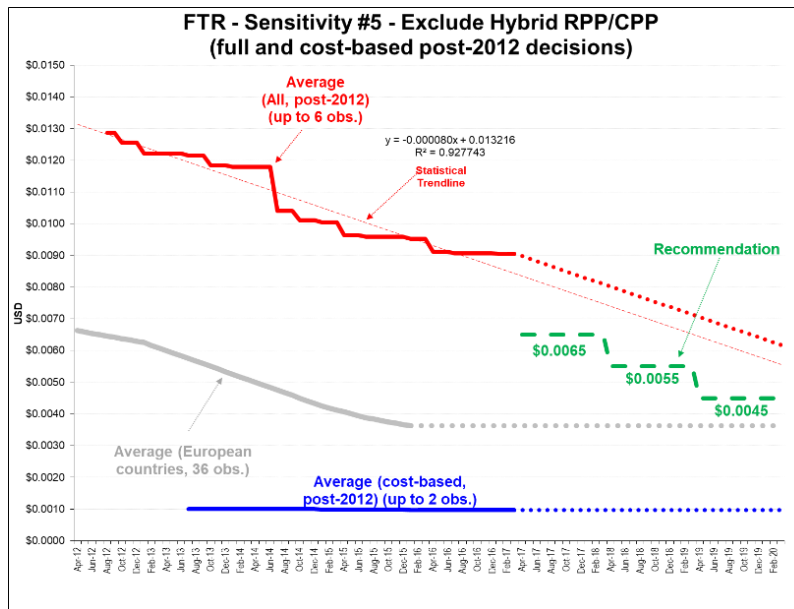


Figure B10. FTR Sensitivity #5

Summary Findings for FTR Sensitivity #5

FTR post-2012 sub-sample: Relative to the base case, sensitivity #5 does not materially change the results of the historical benchmarking, including the March 2017 end point. However, the results of the best-fit statistical trend line do change slightly and, hence, the March 2020 end point for the corresponding projection is somewhat higher than the base case.

FTR cost-based sub-sample: Relative to the base case, sensitivity #5 reduces, in a significant manner, the results of the historical benchmarking, including the March 2017 end point. Hence, the March 2020 end point for the corresponding projection is significantly lower than the base case.

Conclusion: Based on the findings, even if the Authority were to agree to exclude hybrid RPP/ CPP jurisdictions from the FTR benchmarking sample (which it does not), their exclusion would not change the FTR recommended costing benchmark. The revised historical and projected post-2012 and cost-based sub-sample trend lines under this alternative scenario are fully consistent with, and support, the FTR recommended costing benchmark. In other words, this sensitivity analysis showed that the FTR recommended costing benchmark is robust to the inclusion/exclusion of the two noted hybrid RPP/ CPP jurisdictions.

f) Sensitivity #6: First Quarter 2017 Interconnection Rate Projections Sensitivity

In comments received on the 2017 Report, a party suggested that any first quarter 2017 rate projections be excluded from the benchmarking sample. As explained in the DoRs and in section 4.1 of the Revised Report, the Authority disagrees with this suggestion.

However, in response to this suggestion, sensitivity analyses were carried out to assess the impact of excluding the first quarter 2017 rate projections included in the 2017 Report. These sensitivity analyses are shown in Figures B11 and B12.

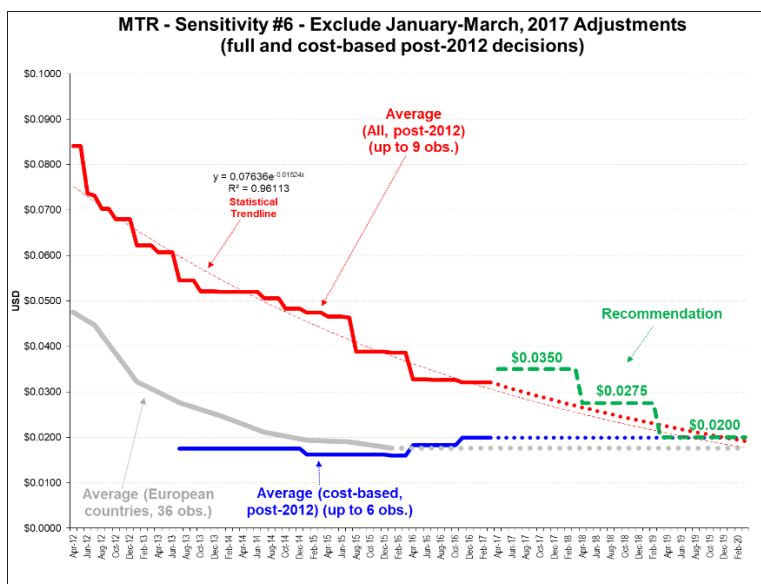


Figure B11. MTR Sensitivity #6

Summary Findings for MTR Sensitivity #6

MTR post-2012 sub-sample: Relative to the base case, sensitivity #6 does not materially change the results of the historical benchmarking, including the March 2017 end point, nor the best-fit statistical trend line, nor the corresponding projection, including the March 2020 end point.

MTR cost-based sub-sample: Relative to the base case, sensitivity #6 does not materially change the results of the historical benchmarking, including the March 2017 end point, nor the corresponding projection, including the March 2020 end point.

Conclusion: Based on the findings, even if the Authority were to agree to exclude any first quarter 2017 MTR projections for the MTR benchmarking sample (which it does not), their exclusion would not change the MTR recommended costing benchmark. Therefore, this sensitivity analysis showed that the MTR recommended costing benchmark is robust to the inclusion/exclusion of first quarter 2017 MTR projections.

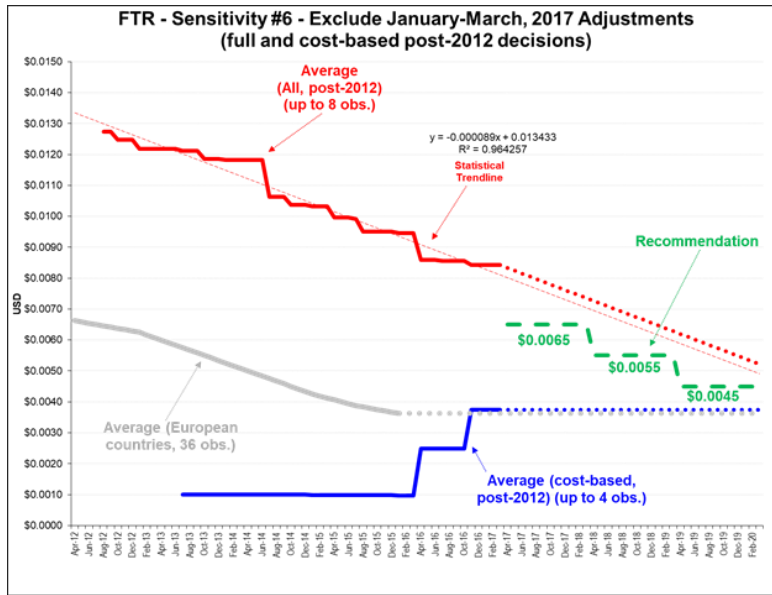


Figure B12. FTR Sensitivity #6

Summary Findings FTR Sensitivity #6

FTR post-2012 sub-sample: Relative to the base case, sensitivity #6 does not materially change the results of the historical benchmarking, including the March 2017 end point, nor the best-fit statistical trend line, nor the corresponding projection, including the March 2020 end point.

FTR cost-based sub-sample: Relative to the base case, sensitivity #6 does not materially change the results of the historical benchmarking, including the March 2017 end point, nor the corresponding projection, including the March 2020 end point.

Conclusion: Based on the findings, even if the Authority were to agree to exclude first quarter 2017 FTR projections from the FTR benchmarking sample (which it does not), their exclusion would not change the FTR recommended costing benchmark. Therefore, this sensitivity analysis showed that the FTR recommended costing benchmark is robust to the inclusion/exclusion of first quarter 2017 FTR projections.

Appendix III: Empirical Evidence of Consumer Benefits

This appendix provides a summary of the 2010 analysis of retail mobile prices and MTRs in the Caribbean region discussed in section 8 of the Revised Report.

Figures C1 to C3 show the relationship between postpaid retail mobile-to-mobile calling prices and MTRs for the 14 Caribbean jurisdictions surveyed. Figure C1 shows that postpaid off-net calling prices tended to be lower when the underlying MTR was lower. While the statistical relationship was not strong, the results clearly did not support the contention that mobile prices increase as MTRs decrease. Figure C2 suggests that the level of MTRs did not tend to influence on-net retail prices for postpaid calling. Figure C3 shows that the ratio of off-net to on-net postpaid calling pricing was higher for higher MTRs. This is consistent with the expectation that allocative efficiency and competition are promoted by lowering MTRs.

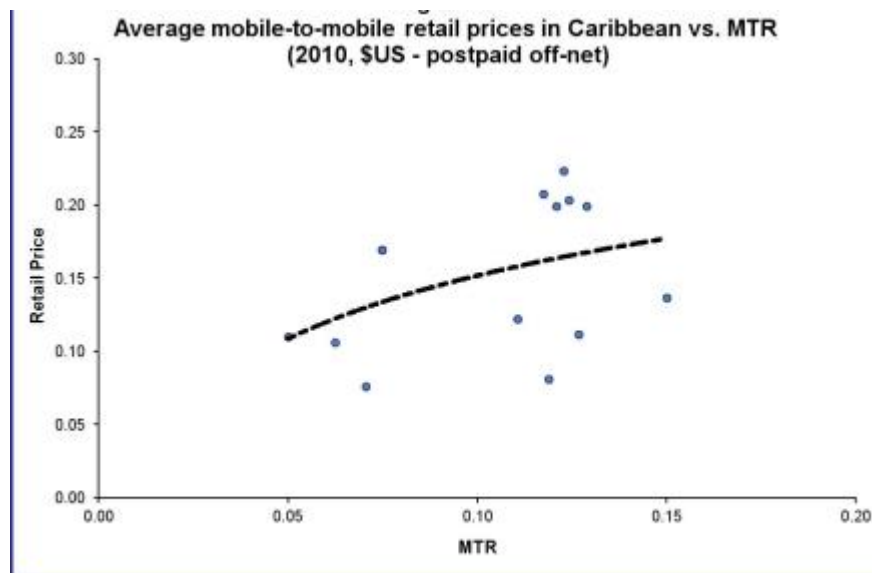


Figure C1. Average mobile-to-mobile retail prices in the Caribbean vs. MTRs (postpaid off-net)

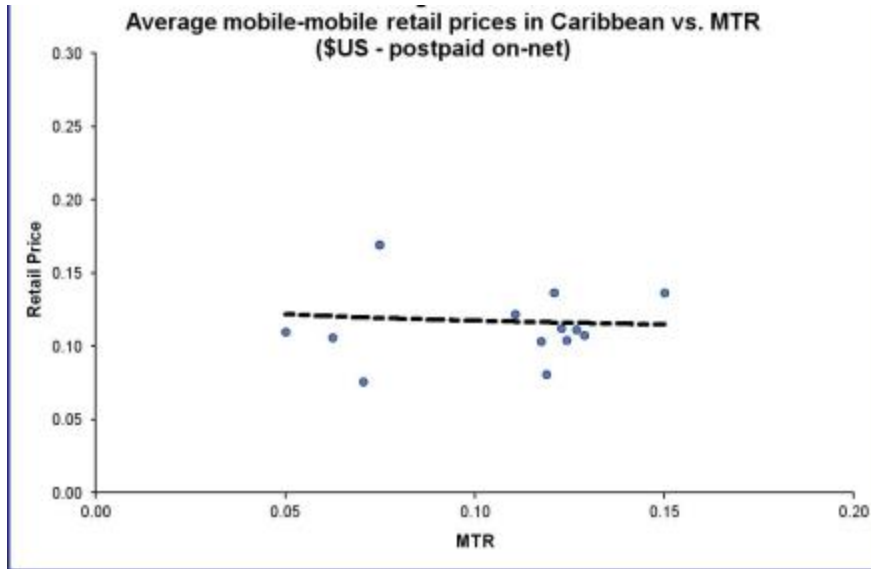


Figure C2. Average mobile-to-mobile retail prices in the Caribbean vs. MTRs (postpaid on-net)

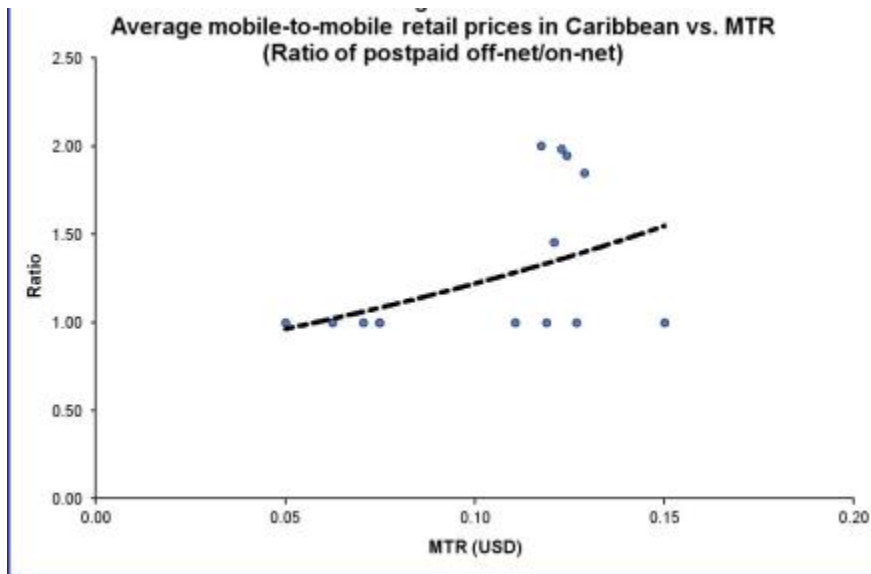


Figure C3. Average mobile-to-mobile retail prices in the Caribbean vs. MTRs (ratio of postpaid off-net/on-net)

Figures C4 and C5 show the relationship between retail fixed-to-fixed and mobile calling prices and MTRs for the 14 Caribbean jurisdictions surveyed. Figure C4 shows that fixed-to-mobile off-net call prices were correlated with the level of the MTR. Off-net call prices tended to be lower when the underlying MTR was lower. Figure D5 shows that the ratio of off-net fixed-to-mobile to fixed-to-fixed pricing was higher in countries with higher MTRs. This is consistent with the expectation that allocative efficiency and competition are promoted by lowering MTRs.

Appendix IV: An Evaluation of the Impact of a Change in Interconnection Rates on Local Retail Prices

1. Case Studies

Interconnection continues to be an essential component of the modern, competitive telecommunications sector. The International Telecommunication Union's (ITU) Regulation Handbook refers to interconnection as "...an essential element of local, long distance and international fixed voice calls, mobile voice and data services, satellite services, Internet access, e-mail and message services, broadband data transmission, and a wide range of multi-media services..." (IBRD, The World Bank, InfoDev, and ITU 2011)⁴². Thus, the interactions between upstream (wholesale) and downstream (retail) markets are of keen interest to the Telecommunications Authority of Trinidad and Tobago (the Authority). Wholesale arrangements between operators, in terms of interconnection charges, are more than likely to have some impact on the prices of services in the retail markets. This is due to the fact that, among themselves, operators in the wholesale markets incur (and benefit from) origination and termination charges to facilitate communication services in the retail markets, where applicable.

The Authority reviewed relevant country cases to identify instances where reductions in the rates of interconnection telecommunications services may be transferred to consumers in the form of lower retail service rates, and to determine the extent to which this may be realised in the domestic context.

The literature showed that there exists some correlation between the rates/prices at retail and wholesale market levels. To illustrate this, the Indian and Jamaican regulatory bodies' assessments of the relationship between prices in the wholesale and retail markets are outlined in a and b below.

a. The Case of India

The Telecom Regulatory Authority of India (TRAI) addressed the issue of interconnection charges via consultation. TRAI used the telecommunications interconnection usage charges regulations to reduce termination charges. This resulted in a quarterly decrease of per-minute retail prices⁴³ for outgoing calls on the respective GSM networks.

⁴² The Telecommunications Regulatory Handbook, page 119. http://www.infodev.org/infodev-files/resource/InfodevDocuments_1057.pdf

⁴³ The Lithuanian Communications Regulatory Authority (CRA) similarly indicated that high termination rates at the wholesale/upstream level of the market led to higher retail prices and lower usage. https://www.itu.int/ITU-D/treg/Documentation/Bahrain/Session%204%20Vaiva_NGN%20interconnection%20pricing%20strategies.pdf

Neither service providers nor consumers were adversely impacted by the implementation of this measure, as it “...resulted in lower retail tariffs without, in any way, jeopardizing the overall revenue of the TSPs” (Telecom Regulatory Authority of India 2016)⁴⁴. Table C1, taken from TRAI’s consultation document, shows the impact of a rate reduction in the wholesale market on retail prices from June 2015.

Table D 1. Retail tariff change over the period 2013 - 2015

S. No.	Quarter Ending	Retail tariff for voice call per minute*
1	June, 2013	₹ 0.50
2	September, 2013	₹ 0.51
3	December, 2013	₹ 0.51
4	March, 2014	₹ 0.50
5	June, 2014	₹ 0.51
6	September, 2014	₹ 0.50
7	December, 2014	₹ 0.51
8	March 2015	₹ 0.50
9	June 2015	₹ 0.49
10	September, 2015	₹ 0.48
11	December, 2015	₹ 0.47

Source: The Telecom Regulatory Authority of India (2016)

b. The Case of Jamaica

The Office of Utilities Regulation (OUR)⁴⁵ in Jamaica, in a document titled *Mobile Termination Rate: Determination Notice*, states that “...the termination rate sets a floor on the possible retail price of a cross network call...” (Office of Utilities Regulation 2012)⁴⁶.

The document also notes that, “in the absence of effective competition at the retail level, a reduction in the termination rate may not automatically be passed to consumers in the form of lower retail rates...” (Office of Utilities Regulation 2012). This highlights the importance of competition in retail markets as an avenue through which welfare gains will be passed from the service provider to consumers, in the form of lower retail rates, as a result of reduced interconnection charges in the upstream/wholesale markets.

⁴⁴ Telecom Regulatory Authority of India. August 5, 2016. https://main.trai.gov.in/sites/default/files/Consultation_Paper_05_August_2016.pdf

⁴⁵ Office of Utilities Regulation. “Mobile Termination Rate: Determination Notice.” 2012. https://www.our.org.jm/ourweb/sites/default/files/documents/sector_documents/mobile_termination_rate_-_determination_notice_-_june_2012.pdf

⁴⁶ According to OUR, “...the originating network would need to set the off-net retail rate at a minimum of the termination rate so as to not incur a loss on the call”.

Thus, it can be deduced that interconnection charges do have an impact on retail prices and there exists a strong positive correlation between the two. A reduction in interconnection charges should lead to lower prices in the retail market, which may likely lead to greater usage (uptake) of call services.

2. Estimation of the Impact of a Decrease in the Domestic Interconnection Rate on Consumers in Trinidad and Tobago

An estimation of the change in consumer demand for retail fixed voice services, due to a decrease in the retail tariff brought about by a reduction in the interconnection rate in Trinidad and Tobago, (using a major operator as the case study), was analysed using regression analysis.

Figure C1 gives the estimation of the demand response for fixed voice services due to lower interconnection rates, where the full extent of the decrease in said rates is passed on to the consumer through lower retail prices. In the regression equation, the relationship between demand for fixed voice calls and the average spend by subscribers on fixed voice services (average revenue derived on each minute of talk by the operator), is assessed.

```
regress logtcalls logarmin
```

Source	SS	df	MS	Number of obs = 46		
Model	.523854363	1	.523854363	F(1, 44) =	31.90	
Residual	.722558057	44	.016421774	Prob > F =	0.0000	
Total	1.24641242	45	.027698054	R-squared =	0.4203	
				Adj R-squared =	0.4071	
				Root MSE =	.12815	

logtcalls	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
logarmin	-2.170803	.3843484	-5.65	0.000	-2.945406	-1.396199
_cons	16.95231	.0219733	771.50	0.000	16.90803	16.99659

Figure D1. Fixed voice call elasticity results (Sept 14 - Jun 18)

The data outputs in the figure show that changes in demand for the provider's given fixed call service (represented by the variable labelled logtcalls) is responsive, by a coefficient of -2.17 times, to changes in the price for fixed talk (represented by the variable labelled logarmin⁴⁷). This coefficient of -2.17 indicates that, for every unit increase in the price of fixed talk, demand for fixed calls is projected to decrease by a multiple of -2.17, ceteris paribus. In other words, demand for calls originating on the service provider's fixed voice network may be considered elastic or sensitive to changes in price.

⁴⁷ The t value of -5.65 exceeding the test value of 2.021 indicates that the variable logarmin is significant in explaining changed in logtcalls (i.e., demand for fixed talk from the relevant operator).

Furthermore, this elastic coefficient may be indicative of the availability of substitutes in the market or the prevalence of effective competition. Therefore, if the retail per-minute price for talk originating on the operator's fixed voice network were to decrease, the operator can expect an increase in demand for its service, by the proportionately greater amount of 2.17 times its original volume. Given the economic axiom that where consumers are price elastic, operators are able to increase total revenue by reducing tariffs (Khan Academy 2017)⁴⁸, this demand coefficient provides an incentive to operators to lower retail rates. This estimation is, thus, consistent with the observation noted by OUR, where reduced interconnection rates are more likely to be passed on to consumers in competitive environments.

Estimates of the potential change in consumer demand using the PED coefficient output in Figure C1, and the established formula for price elasticity of demand, are articulated below:

The economic formula for price elasticity of demand is used to estimate the potential change in consumer demand for fixed calls using the PED coefficient and is shown below:

$$PED = \% \Delta Qd / \% \Delta P$$

where, PED represents the price elasticity of demand. By transforming this equation for Qd, we get the following:

$$\% \Delta Qd = PED * \% \Delta P$$

- where $\% \Delta Qd$ refers to the percentage change in quantity demanded for fixed calls made on service provider "x" network;
- PED refers to the price elasticity of demand for calls originating on service provider "x" fixed network; and
- $\% \Delta P$ refers to the percentage change in price (per minute of fixed voice talk) on the service provider's fixed network.

Inputting the estimated values for PED and percentage change in prices led to an approximation of the impact to the service provider's fixed voice consumers, where the full price of the reduction in interconnection rate is passed on to the consumer, in the form of lower retail prices.

The following provides the calculation of the percentage change in the weighted average interconnection charge of calls originating on a fixed network:

⁴⁸ <https://www.khanacademy.org/economics-finance-domain/microeconomics/elasticity-tutorial/price-elasticity-tutorial/a/elasticity-and-pricing-cnx>

$$\% \Delta P = \frac{\text{reduction in price due to fall in interconnection rate}}{\text{existing blended retail charge}^{49}}$$

$$\% \Delta P = \frac{-0.056^{50}}{0.46} = -0.122$$

Based on the operator reviewed, the change or impact on the quantity demanded for fixed talk due to the decrease in fixed and mobile interconnection rates, is given below:

$$\% \Delta Qd = -2.17 * -0.122 = 0.27$$

Thus, the results indicate that demand is estimated to increase by 27%, or 21 minutes⁵¹, per subscriber, or 5 MM minutes monthly. This translates to a positive change in revenue of approximately 1 MM (million) TTD⁵² monthly, for a 12.2% fall in the price of the service provider's fixed voice service, brought about by a transfer of the reduction in the rate charged for interconnection service (of 0.056).

3. Conclusion

It has been observed that there exists a positive correlation between interconnection charges and retail rates, particularly in competitive markets. A decrease in the interconnection charges in the wholesale market would lead to lowered retail rates and an increase in the uptake of fixed voice services, *ceteris paribus*⁵³.

It is important to note that the observed trends are also expected to be applicable to the mobile market, given the market's projected higher level of competition, as evidenced by the lower levels of concentration, increased frequency of promotions and price changes. Therefore, a similar trickle-down

⁴⁹ Calculated as fixed retail rate (0.38) * % of fixed to fixed consumers + fixed to mobile rate (0.80) * % of fixed to mobile consumers

⁵⁰ Calculated as the difference between the proposed interconnection rate and the existing rate (i.e., 0.0315 – 0.05 and 0.14 – 0.27 times the FtF and FtM call weights (66.3% and 33.7%, respectively)

⁵¹ Minutes are calculated as the difference between new and old minutes consumed (99.4 – 78.6) due to the fall in price. The number of subscribers and call length are held conservatively as constant on the principle of prudence.

⁵² Change in total revenue is calculated as the difference between (P2* Qd 2) –(P1*Qd1) or (0.40 * 25MM) – (0.45*20MM).

⁵³ It is pertinent to note that the presence of competition potentially allows the consumer to be the recipient of welfare gains. In the absence of competition, lowered interconnection charges may not be passed on to consumers in the form of reduced retail prices.

effect of interconnection cost-saving transfer can be expected for the domestic mobile market until determined otherwise.

Appendix V: Decisions on Recommendations (DoRs)