

A NEW APPROACH FOR INTEGRATING TRANSACTION DATA IN THE CELLULAR SERVICES PRICE INDEX (CSPI)

Statistics Canada

May 15, 2024

Delivering insight through data for a better Canada



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Agenda

1. Current methodology for the Cellular services price index
2. New transaction data
3. Methodology for transaction data and hybrid indexes
4. Results
5. Next steps and ongoing challenges.



Current methodology – Cellular services price index

- The Cellular services price index is a closely watched index in the Canadian CPI.
- Sample includes retail brands from national wireless service providers (WSPs) and regional providers.
- Prices of plans are manually collected monthly from company websites in all provinces.
- The index methodology is based on the consumer profile approach.

iC iPhone in Canada

[Feds Tout Cellphone and Internet Prices Keep Falling in Canada • iPhone in Canada Blog](#)

Summary of International Price Comparisons
2023 Average Monthly Price in PPP-adjusted USD

Country	USA	Canada	UK	Japan	India	Australia
Advanced Services						
Level 1 (1GB and 100 min)	\$15.28	17%	19%	19%	\$10.45	\$14.61
Level 2 (1 GB)	\$25.98	17%	17%	17%	\$12.18	\$18.42
Level 3 (2GB and 100 min)	\$22.22	18%	18%	18%	\$13.31	\$16.78
Level 4 (5GB and 100 min)	\$45.46	18%	18%	18%	\$25.39	\$31.86
Level 5 (10GB and 100 min)	\$26.22	17%	17%	17%	\$13.31	\$16.78
Level 6 (15GB and 100 min)	\$45.46	18%	18%	18%	\$25.39	\$31.86
Level 7 (20GB and 100 min)	\$45.46	18%	18%	18%	\$25.39	\$31.86
Level 8 (30GB and 100 min)	\$64.70	18%	18%	18%	\$38.14	\$47.67
Level 9 (50GB and 100 min)	\$83.94	18%	18%	18%	\$50.38	\$62.91
Level 10 (100GB and 100 min)	\$103.18	18%	18%	18%	\$62.62	\$78.15
Basic Services						
Level 1 (1GB and 100 min)	\$16.88	17%	17%	17%	\$10.45	\$14.61
Level 2 (1GB and 100 min)	\$16.88	17%	17%	17%	\$10.45	\$14.61
Level 3 (2GB and 100 min)	\$16.88	17%	17%	17%	\$10.45	\$14.61
Level 4 (5GB and 100 min)	\$16.88	17%	17%	17%	\$10.45	\$14.61
Level 5 (10GB and 100 min)	\$16.88	17%	17%	17%	\$10.45	\$14.61
Level 6 (15GB and 100 min)	\$16.88	17%	17%	17%	\$10.45	\$14.61
Level 7 (20GB and 100 min)	\$16.88	17%	17%	17%	\$10.45	\$14.61
Level 8 (30GB and 100 min)	\$16.88	17%	17%	17%	\$10.45	\$14.61
Level 9 (50GB and 100 min)	\$16.88	17%	17%	17%	\$10.45	\$14.61
Level 10 (100GB and 100 min)	\$16.88	17%	17%	17%	\$10.45	\$14.61

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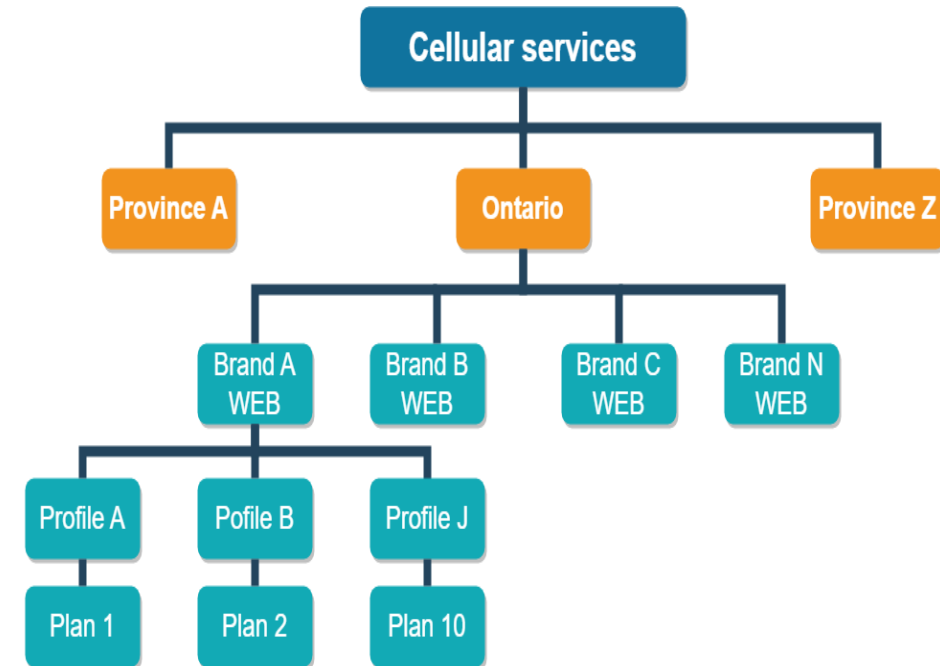
Global News

Looking for cheaper wireless plans? Prices are dropping sharply, data shows

Jul 19, 2023 • Sammy Hudes

Current methodology – Cellular services price index

- Pure price change is estimated by tracking prices of the same plans every month.
 - Quality adjustment is applied when a sampled plan is modified or replaced.
- A retail brand price relative is computed using an unweighted geometric mean of all the consumer profile price relatives.
 - Each profile contains only one representative plan.
- A provincial price relative is computed using a weighted geometric mean of all retail brand price relatives.



Current measurement challenges and opportunities from new transaction data

Theme	Current challenges	Hybrid cellular services price index, incorporating new transaction data
1. Coverage	Sample of plans is limited to those advertised on company websites.	Transaction data includes all advertised and the most popular legacy plans in the market.
2. Quality adjustment	Small sample precludes the use of hedonic methods for QA.	Larger sample size allows for robust implementation of hedonic QA methods.
3. Weighting	Lack of subscriber count data at plan level is a major data gap.	Subscriber counts data for all plans will be used to weight plans appropriately.
4. Communication	Perception of a disconnect between the CSPI and trends in consumer bills.	The agency will continue to emphasize that the CSPI measures pure price change.



New transaction data

- Statistics Canada has been receiving monthly files from some WSPs since September 2021. Coverage is about 70% of the subscriber base.
 - In scope:
 - All in-market postpaid and prepaid plans in each province/territory,
 - Top 100 legacy postpaid plans in each province/territory,
 - Top 10 legacy prepaid plans in each province/territory.
 - Out of scope:
 - Exclusive Partner Program (EPP) plans and business plans.



New transaction data – plan features

Feature name	Description
Ranking number	a plan's rank based on its subscriber count in a province or territory
Geography	the province or territory where a plan is offered
Plan ID	an internal WSP-generated alphanumeric code used to identify plans
Plan Name	the name of the plan—will sometimes include a description of the plan's characteristics (like number of minutes, etc.)
Retail Brand	the name of the retail brand offering the cellular service plan
Plan Type	indicator for prepaid or postpaid plans
Plan Availability	indicator for in-market or legacy plans
Monthly Recurring Charge (MRC)	monthly price of a plan, before tax and other fees
Voice	voice allowance, in number of minutes per month
Short Message Service (SMS)	SMS allowance, in number of texts per month
Data	data allowance, expressed in Gigabytes (GB) per month
Subscriber count	count of subscribers on the plan



Mitigating plan level churn

Unique plan identifiers

- Unique plan IDs are used to track the same plans over time and to help mitigate the effects of plan level churn.
 - These IDs are created by the index processing system using the **Plan ID, Geography, Brand and Type** features.

Treatment of missing plans:

Plan	Previous month (T_0)	Current month (T_1)	Action
Legacy plan A	In sample	Missing	Carry forward plan A's feature information to T_1
Legacy plan B	Missing	In sample	Carry backward plan B's feature information to T_0
In-market Plan C	In sample	Missing	Carry forward plan C's feature information to T_1

Characteristics of service packages

- WSPs often launch promotional plans with the same features as existing plans, but at different prices.
- Each month, plans having identical features are assigned to a “service package”.

Features are used to define a service package:

Feature name	Description	Provided by WSP?
Geography	the province or territory where a plan is offered	Yes
Retail Brand	the name of the retail brand offering the cellular service plan	Yes
Plan Type	indicator for prepaid or postpaid plans	Yes
Data	data allowance, expressed in Gigabytes (GB) per month	Yes
isMinUnlimited	binary variable that indicates if the service package includes unlimited calling minutes	No--derived from Voice feature
isSMSUnlimited	binary variable that indicates if the service package includes unlimited SMS (text) messages	No--derived from SMS feature
isDataUnlimited	binary variable that indicates if the service package includes unlimited data	No--derived from Plan Name feature
isDataShareable	binary variable that indicates if the service package includes data that can be shared among the members in a family plan.	No--derived from Plan Name feature
includesCANUS	binary variable that indicates if the service package includes Canada-US calling	No--derived from Plan Name feature
Is5G	binary variable that indicates if the service package uses the 5G network	No--derived from Plan Name feature

Tracking service packages

- The price of a service package is the weighted arithmetic mean of all its plans' MRCs.
- Subscriber counts are used as weights.
- Service packages are classified into two types:
 1. **Continuing:** Service packages which are in sample in T_0 and T_1
 - No action is taken
 2. **Entering:** Service packages which are in sample in T_1 but not in T_0
 - T_0 price needs to be imputed

Actions for different types of service packages:

Service package (type)	Previous month (T_0)	Current month (T_1)	Action
Service package C (Continuing)	In sample	In sample	No action
Service package D (Entering)	Missing	In sample	Impute T_0 price for Service package D

Quality adjustment of service packages

- Hedonic-based quality adjustment of entering service packages is used to ensure that a constant quality price change is measured.
 - Continuing service packages are of constant quality.
- Hedonic models for each province/territory are used to predict T_0 prices of new service packages entering the market in T_1 .
 - The models are trained using T_0 price data of in-market service packages only.

Regression equation:

$$\ln(MRC_i) = f(X_i) + \epsilon_i$$

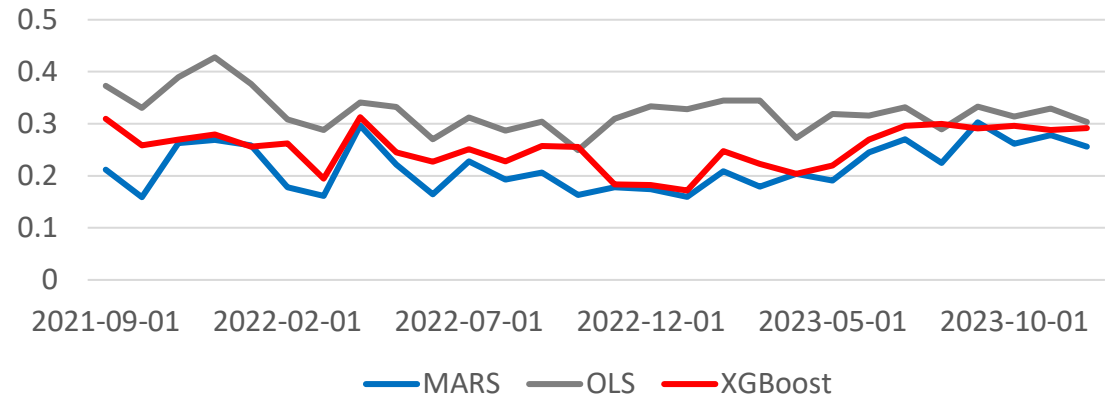
where X_i consists of the following explanatory features for service package i :

Retail brand, Plan type, Data, *isMinUnlimited*, *isSMSUnlimited*, *isDataUnlimited*, *IsDataSharable*, *IncludesCANUS*, and *is5G*.

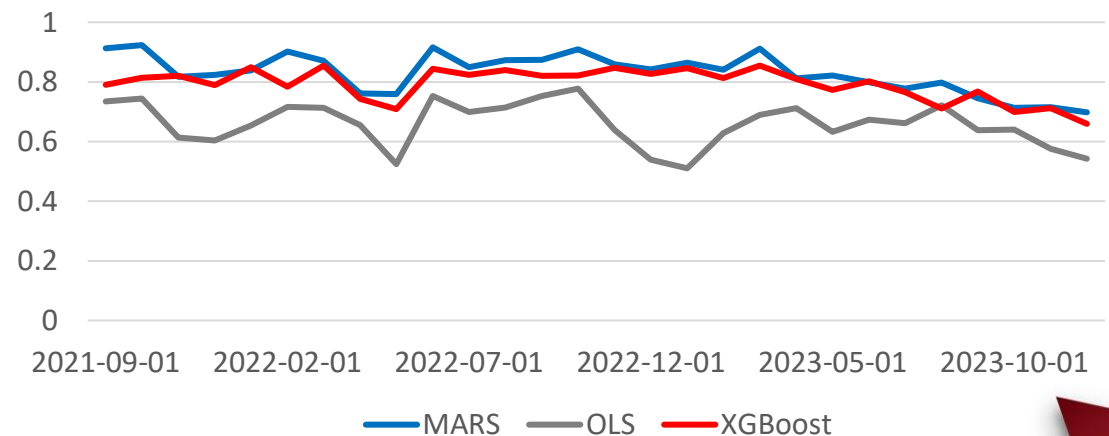
Quality adjustment of service packages

- Various estimation methods for the hedonic models were considered including:
 - Ordinary least squares estimation (OLS),
 - Multivariate adaptive regression splines (MARS),
 - eXtreme Gradient Boosting estimation (XGBoost),
 - Linear model with hedonic time dummy (TD), OLS.
- Metrics derived from cross validation were used to assess the performance of OLS, MARS, and XGBoost.
- The MARS algorithm will be used to predict T_0 prices of new service packages (in T_1).

Root mean squared error

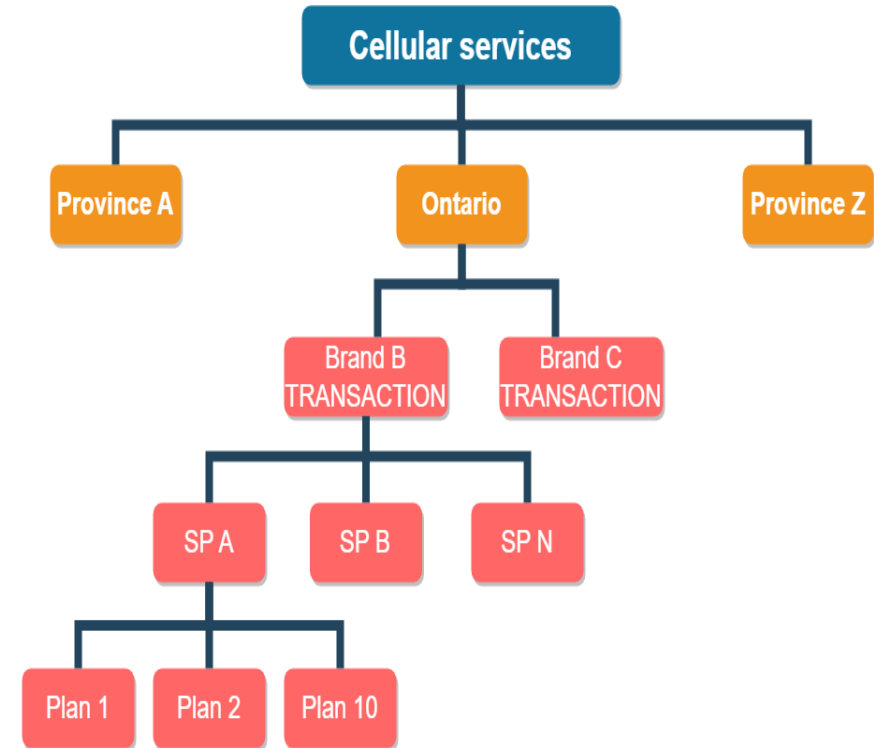


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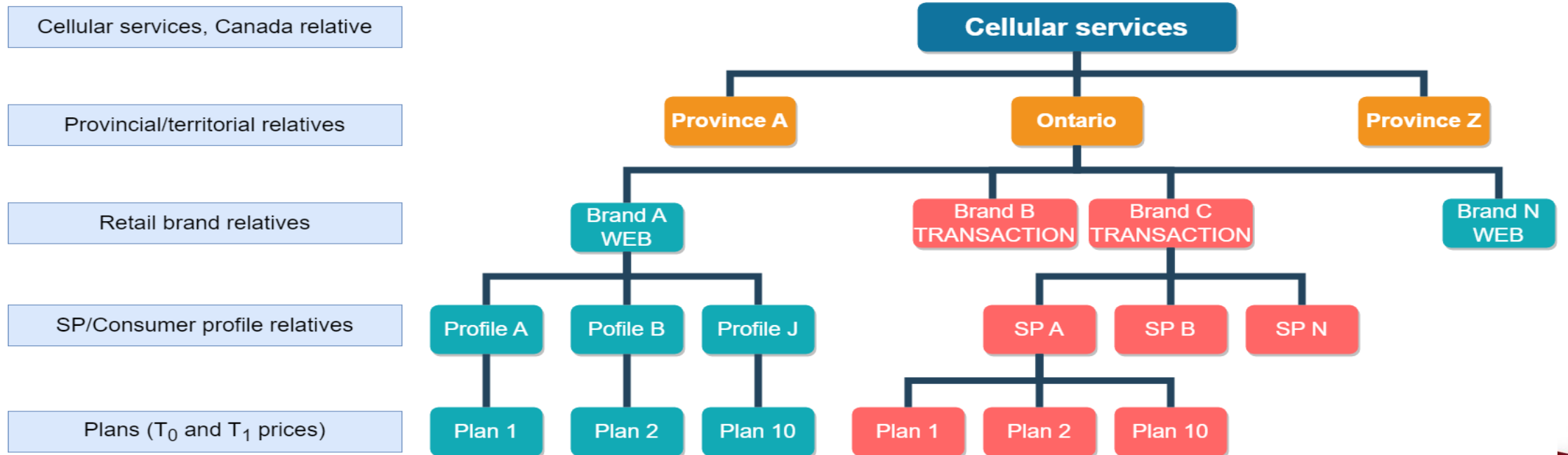
Aggregation – service packages

- A service package's price relative is calculated as the ratio of its T_1 and T_0 prices.
- Each service package's price relative is weighted by its average revenue share over T_0 and T_1 .
- The Törnqvist index formula is used to aggregate service package price relatives to the retail brand level in each province and territory.



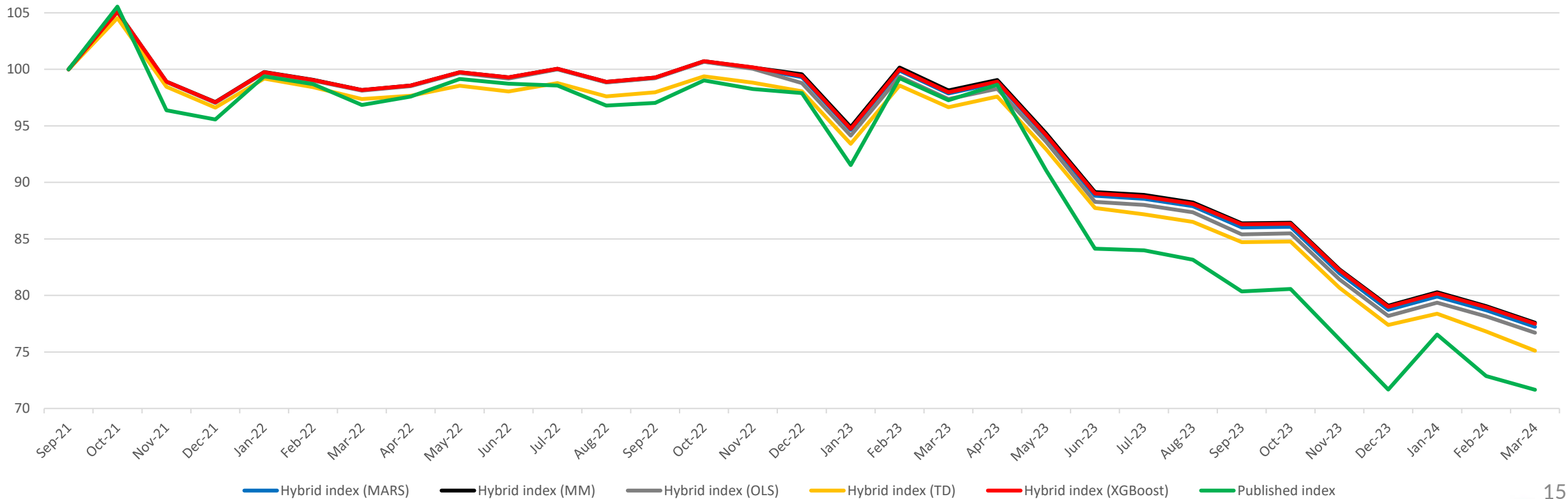
Aggregation – hybrid indexes

- The transaction data price relatives are combined with the web collected data price relatives from the other retail brands in the same province or territory using a weighted geometric mean to produce a “hybrid” provincial or territorial price relative.
- The Canada level price relative is obtained by computing the weighted arithmetic mean of all provincial and territorial relatives.



Impact of transaction data on the Cellular services price index

Cellular services price index values by quality adjustment method, Canada



Next steps

- Implementation of this new methodology in production in the near future.
- Statistics Canada will continue partnering with WSPs to acquire and integrate additional transaction data.
- Ongoing research work to maintain the quality of the CSPI as new cellular services offerings or technologies are introduced in the market.



Ongoing challenges

1. Consumer experience of flat or rising bills may not line up with recent declines in the CSPI,
 - Subscribers on legacy plans face fixed bills,
2. Some critics prefer the Average Revenue Per User (ARPU) as a better measure of cellular services price change.
 - ARPU includes other fees (e.g., international roaming charges, activation fees),
3. As WSPs offer more plans with large data allowances (e.g., 100GB per month), the need to quality adjust for "excess data" has been questioned.

Global News

[Are cellphone bills falling in Canada? Critics question Ottawa's claims](#)

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Feb 19, 2024



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