The Ottawa Group on Price Indices

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18th Meeting of the Ottawa Group on Price Indices

Hosted by Statistics Canada and Bank of Canada
Ottawa, 13-15 May 2024

Report from the meeting

Introduction

Statistics Canada and the Bank of Canada hosted the 18th Meeting of the Ottawa Group on Price Indices from 13 to 15 May 2024. This meeting also marked 30 years since the Ottawa Group was formed in 1994. The celebration of this important milestone of the Ottawa Group included a special panel discussion on the state of research and practice of CPI methodology and challenges ahead.

The meeting attendance was hybrid. Presenters and speakers attended the meeting in-person (except for one presenter). Participants who could not travel to Ottawa had the possibility to observe the meeting virtually and ask questions in the meeting chat.

More than 60 participants from over 20 national statistical offices, 6 academic institutions, 6 central banks and 5 international organizations attended the meeting in-person. Additionally, more than 135 individuals have enrolled for virtual participation, representing a multitude of nations and a variety of institution types.

The eighteenth meeting: Summary

The invitation and call for papers for the meeting outlined nine topics for discussion. These topics formed the basis of the meeting's agenda, which was structured into nine sessions. The sessions, along with their respective chairpersons, are listed below.

Session number	Session title	Chairperson and his affiliation
1	Alternate data sources and index number formulas I	Jan de Haan (International Price Statistics Expert)
2	Alternate data sources and index number formulas II	Leigh Merrington (Australian Bureau of Statistics)
3	Alternate data sources, quality adjustment methods and index number	Patrick Kelly (Statistics South Africa)
4	Index number theory and practice	Erwin Diewert (University of British Columbia)
5	Challenging areas of price measurement and update by UN scanner data task team	Randi Johannessen (Statistics Norway)
6	Price statistics that meet multiple user needs	Federico Polidoro (World Bank)
7	Analytical or complementary measures of inflation	Corinne Becker (Switzerland Federal Statistical Office)
8	Alternate data sources and index number formulas III	Xin Ha (Statistics Canada)
9	Treatment of housing in the CPI	Rob Cage (Bureau of Labor Statistics)
Special session	Panel discussion on the state of research and practice of CPI methodology and challenges ahead	David Fenwick (International Price Statistics Expert) Panel members: • Erwin Diewert (University of British Columbia) • Jan de Haan (International Price Statistics Expert) • Randi Johannessen (Statistics Norway)

Twenty-eight papers were presented for discussion in the plenary sessions and 11 papers were presented in a poster session. The poster session offered the opportunity to learn about the findings from all papers not selected for the plenary sessions due to the time constraints, given the very high number of excellent submissions. The UN Task Team on scanner data presented an update on the work undertaken over the past few years and conducted a workshop providing a hands-on exploration of optimal methodologies for National Statistical Offices (NSOs) grappling with compiling consumer price indices using alternative data.

Papers were very well received by participants and useful discussions were held on various topics relating to the concepts, methods, and compilation procedures for consumer price indices. The group debated many issues at the forefront of current thinking on the development and improvement of price index methodologies. The key points emerging from each session are given in the Chairperson's summary notes in Annex A.

Evaluation forms indicated very positive feedback from participants on all aspects and some suggestions for further improvement have been made. The venue, particularly having all in one place at the Bank of Canada's Conference Centre, was praised. The participants also appreciated the offer of a good hotel near the meeting venue. A summary of the participants' feedback is given in Annex B.

The success of the meeting reflected the following contributions:

- the Steering Committee (OGSC) members for their assistance in planning this meeting;
- the authors for presenting findings from their research, for the quality of their papers as well as for their valuable contributions to discussions;
- session chairs for leading the discussions and preparing summaries of each session;
- all participants for the fruitful discussions and feedback; and
- staff at Bank of Canada and Statistics Canada for their help in organizing the meeting and for the support they provided to participants.

The next meeting

The next Ottawa Group meeting will be hosted by Statistics Poland in the city of Warsaw in May 2026. Possible topics for discussion at the next meeting include:

- new data sources to compile price indices (scanner / web-scraped data; index formulae; product churn and shrinkflation; quality adjustment);
- compiling property price indices (residential and commercial);
- challenging areas of price measurement (e.g. services);
- conceptual frameworks (index number formulae; multi-purpose price statistics); and
- treatment of special cases (strongly seasonal products; zero prices).

The final list of topics for the next meeting will be distributed with the invitation and call for papers.

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Annex A: Chairperson's summary notes

Session 1: Alternate data sources and index number formulas I

Chairperson: **Jan de Haan**

- Kevin Fox, Peter Levell, Martin O'Connell and Erwin Diewert. *Inflation measurement with high frequency data.*
- Jacek Białek. *Evolution of the GEKS index.*

Summary of session 1

Two papers were presented at the first session, which was chaired by Jan de Haan. Both papers focus on the use of multilateral price index methods to calculate CPI sub-components from scanner data in a timely fashion.

Paper 1: Inflation measurement with high frequency data

By Kevin Fox | University of New South Wales, **Peter Levell** | Institute for Fiscal Studies, **Martin O'Connell |** University of Wisconsin-Madiso **and Erwin Diewert** | University of British Columbia

The first paper, "Inflation measurement with high frequency data" by Kevin Fox (University of New South Wales, Australia), Peter Levell (Institute for Fiscal Studies, UK), and Martin O'Connell (University of Wisconsin-Madison, US), was presented by Erwin Diewert (University of British Columbia, Canada). The paper provides a systematic comparison of the leading bilateral and multilateral price index methods using a scanner dataset on 178 product categories over 8 years. The multilateral CCDI (GEKS-Törnqvist) index, with a 25-month rolling window and a mean splice for linking, was found to be the preferred approach. Product churn seems a key determinant of chain drift bias. Future work could include an assessment of the impact of disappearing products and the use of imputation methods for temporarily missing products. During the discussion it was argued that choosing the full window multilateral index (based on 8 years of data) as the benchmark might be problematic because of the severe lack of matching.

Paper 2: Evolution of the GEKS index

By Jacek Białek | Statistics Poland and University of Lodz

The second paper, "Evolution of the GEKS index" by Jacek Bialek (Statistics Poland and University of Lodz), discusses modifications and generalizations of the multilateral GEKS index, including GEKS-Törnqvist, GEKS-Walsh, GEKS-Laspeyres, GEKS-Geometric Laspeyres, and GEKS-Loyd-Moulton (a CES, Constant Elasticity of Substitution, variant). The paper presents the basic axiomatic properties of the various indexes provides an empirical comparison using scanner data on two product categories, coffee and milk. From a theoretical (axiomatic) perspective, the GEKS-LM (CES) class of indexes seems "best" because the indexes satisfy the identity test. This approach requires the estimation of the elasticity of substitution, e.g., using a panel regression model, which was suggested as potential future work.

Session 2: Alternate data sources and index number formulas II

Chairperson: **Leigh Merrington** | Australian Bureau of Statistics

- Gregory Kurtzon. *Combining Hedonic with Multilateral Indexes for Turnover and Chain Drift in Transactions Data Consumer Price Indexes.*
- Ludwig von Auer and Sebastian Weinand. *Multilateral Approaches in Inflation Measurement: Why Does the TPD Method Fail Us and Can We Do Something About It?*
- Adam Tardos. *The choice between bilateral and multilateral index for scanner data: Case study on Austrian grocery scanner data 2022-2023.*

Summary of session 2

This was the second of three sessions on the topic of 'Alternate data sources and index number formulas. In this session, three papers were presented which each dealt with the challenges of how to use scanner data to measure the CPI. The session provided a nice mix of theory and practice and finished with how scanner data has been implemented in the CPI at Statistics Austria.

Combining Hedonic with Multilateral Indexes for Turnover and Chain Drift in Transactions Data Consumer Price Indexes

By Gregory Kurtzon | Bureau of Labor Statistics (USA)

This paper combined hedonics and rolling window multilateral indexes in transactions data to address the problems of product turnover and chain drift. Hedonic indexes were used on grocery and drug store data from 2001-2011 with dummy variables for all variable values plus interactions and bootstrap the indexes to check for overfitting. The research found that using a hedonic index should be done for bias reduction of omitting new and exiting goods, avoiding unit values and provides evidence that hedonics can also reduce chain drift, though probably not eliminate it. The paper presented some unique solutions to the issues of product churn and chain drift, however there were questions on how practical the solutions were for National Statistical Offices.

Multilateral approaches in inflation measurement: Why does the TPD method fail us and can we do something about it?

By Ludwig von Auer | University Trier **and Sebastian Weinand** | Eurostat

This paper explains why heterogeneous price level elasticities of product prices invalidate any statistical inference based upon the TPD regression approach and why these heterogeneous elasticities in conjunction with systematic data gaps lead to biased TPD estimates of the price levels. The paper introduced the NLTPD regression, a non-linear generalisation of the TPD regression. This novel method estimates the heterogeneous price level elasticities, it avoids the issues of the TPD regression and the bias inherent in the GEKS approach and the GK approach. The audience was taken through a simple graphical example showing how heterogeneous elasticities and missing prices impact the TPD method. Comments from the audience complemented the presentation on how clearly the problem was explained how the solution addressed the problem.

The Choice between Bilateral and Multilateral Index for Scanner Data: Case Study on Austrian Grocery Scanner Data 2022-2023

By Adam Tardos | Statistics Austria

This paper explained Statistics Austria's approach to introducing scanner data in their CPI. In 2020 a bilateral method was used, which was recently changed to the multilateral GEKS method. The paper analyses the advantages and pitfalls of the two main approaches for the compilation of CPIs and compares the performance of these methods, particularly with regard to the problem of chain drift. Furthermore, the paper discusses the issue of communicating the choice between bilateral and multilateral index methods to users and the pragmatic approaches taken in when introducing a multilateral method for the Austrian CPI/HICP. The paper is a helpful guide for other countries grappling with how to introduce scanner data into their CPI. The paper provides some important practical solutions to similar challenges being faced by many National Statistical Offices.

Session 3: Alternate data sources, quality adjustment methods and index number formulas

Chairperson: **Patrick Kelly** | Statistics South Africa

- Erwin Diewert and Chihiro Shimizu. *Product Churn and Quality Adjustment: Using Scanner data of Laptop in Japan.*
- Tom Arend, Jarmila Botev, Emmanuelle Guidetti, Annabelle Mourougane and Minsu Park. *Seasonal adjustment of CPIs during the COVID-19 pandemic and beyond: main insights from NSO experience.*
- Botir Radjabov, Lucien May, Yu-Lin Huang and Claude Lamboray. *A practical implementation of Machine Learning Methods for Price Imputation.*
- Mario Spina and Liam Greenhough. *Outlier detection for grocery scanner data in Consumer Price Statistics.*

Summary of session 3

Paper 1: Product Churn and Quality Adjustment: Using Scanner data of Laptop in Japan

By Chihiro Shimizu | Hitotsubashi University (Japan) **and Erwin Diewert** | The University of British Columbia

The paper explores the optimal method of quality adjustment for high tech products (specifically laptop computers) which experience rapid turnover. The authors used a scanner data set covering a two year period (2020-2021). Several methods of quality adjustment are computed and tested including Time *Product* Dummy Hedonic regression and Time Dummy *Characteristics* Hedonic regression, weighted regressions and the expanding window. They conclude that the Weighted Time Dummy Characteristics Price Index and the expanded window perform better than the alternative modes and a simple average price, traditional matched model and unit value indices. Chain drift is a problem for most bilateral methods. The Expanding Window methodology best deals with this.

The paper also considers the relationship of quality adjustment models to consumer utility or preference functions. The conclusions are considerate of practical constraints of a statistics agency such as not revising a CPI.

Paper 2: Seasonal adjustment of CPIs during the COVID-19 pandemic and beyond: main insights from NSO experience

By Tom Arend, Jarmila Botev, Emmanuelle Guidetti, Annabelle Mourougane, and Minsu Park | OECD

An increasing number of NSOs employ seasonal adjustment techniques in their CPI to smooth specific seasonal peaks and troughs. The paper reviews which OECD countries do use seasonal adjustment and the specific methods employed. Results from different methods such as X-13 and Tramo-seats are compared. There is little difference in the results obtained from the two methods. Similarly, there is little difference in headline inflation using the direct (seasonally adjusting the headline index) and indirect (seasonally adjusting the components). Although seasonality is weak at a headline level, it is more evident for specific components such as clothing and footwear. Recent economic shocks as a consequence of events such as COVID-19 and the Russian war in Ukraine do not have a noticeable impact on seasonal patterns. Machine learning may provide new methods for seasonal adjustment.

Seasonal adjustment may lead to revisions in the index which may be confusing for users. The authors review communication messages employed by countries and offer further advice on this.

Paper 3: A practical implementation of Machine Learning Methods for Price Imputation

By Lucien May, Botir Radjabov, Yu-Lin Huang, and Claude Lamboray | STATEC (Luxembourg)

Price imputation is commonly employed to obtain a previous period price for a product that has just entered the market in a traditional matched model price index. Hedonic regression models are often used to impute the price using relevant product characteristics.

The authors investigate the application of machine learning methods for price imputation when using scanner data. They demonstrate that machine learning models are more flexible and offer superior performance in terms of predictive accuracy compared to standard linear regression. The study finds the Random Forest method particularly advantageous. The models are developed and tested on web scraped data on televisions and a public dataset of laptops (the same data set as used by Shimizu and Diewert). The conclusions highlight the importance of expenditure weights, and the choice of machine learning method. Open issues requiring further investigation include optimizing resampling strategies, encoding time effectively in models, and understanding the impact of individual price imputations on aggregate price indices.

Paper 4: Outlier detection for grocery scanner data in Consumer Price Statistics

By Mario Spina and Liam Greenhough | Office for National Statistics (UK)

The ONS intends to introduce scanner data for grocery items to compute components of the CPI. The paper compares different methods for identifying outliers including price relative fences, and price-quantity filtering. Junk filtering is applied initially to remove observations that are missing certain data fields. The authors conclude that a combination of price relative fences and price-quantity - price and price-quantity - filters is more effective than each individually in identifying and removing dump prices (end of season discounts) from grocery data. The method is straightforward, scalable, and minimally disruptive, as it removes only a small percentage of observations, thereby maintaining the integrity of the grocery index. Overall, the approach ensures a more accurate reflection of grocery prices by mitigating the downward bias caused by seasonal dump prices.

Session 4: Index number theory and practice

Chairperson: **Erwin Diewert** | The University of British Columbia

- Jan de Haan and Frances Krsinich. *Product Churn and the GEKS-Törnqvist Price Index: The "Feenstra Adjustment".*
- Olivia Ståhl. *Higher-Level Aggregation with Long-Term Links - An Application to the Swedish CPI.*
- Yuri Dikhanov. *A new elementary index – the equal share counterpart of the Walsh index.*

Summary of session 4

Paper 1: Product Churn and the GEKS-Törnqvist Index: The "Feenstra Adjustment"

By Jan de Haan | International price statistics expert **and Frances Krsinich** | Statistics New Zealand

In 1994, Robert Feenstra proposed an ingenious method for measuring the effects on consumer utility of new and disappearing products that was based on consumers having CES (Constant Elasticity of Substitution) utility functions. Feenstra showed that if one had an empirical estimate of the elasticity of substitution in hand, then a simple index number calculation could give the true cost of living index number between two periods. Thus his method could be applied to scanner data. The authors of the present paper sum up the core of their paper as follows:

"We address a couple of issues with Feenstra's proposal. While the CES index and therefore, under CES assumptions, the Sato-Vartia price index are transitive, disturbances may lead to non-transitivity when applied to real-world data. Even without disturbances, Feenstra's adjustment produces an index that is not necessarily transitive. Also, statistical agencies prefer the superlative Törnqvist price index to the Sato-Vartia. To resolve these issues, we derive an expression for the adjusted CES index in terms of the Törnqvist price index and then apply the GEKS procedure to impose transitivity."

The authors also derive many different ways that could be used to estimate the elasticity of substitution.

However, in the empirical part of their paper, the authors cast doubt on the usefulness of the Feenstra methodology when dealing with scanner data. They found that their empirical estimates of the elasticity of substitution were not very "reliable"; i.e., they obtained wildly fluctuating estimates for this parameter and at times, they obtained negative estimates for the elasticity of substitution (a negative estimate is not consistent with the Feenstra methodology). Thus the overall conclusion of the authors was as follows:

"Even if we do not worry too much about conceptual issues and the identifier issue, the estimation of the elasticity of substitution is really problematic. Different estimation methods led to quite different and often totally implausible results."

Reference

Feenstra, R.C. (1994), "New Product Varieties and the Measurement of International Prices", *The American Economic Review* 84, 157-177.

Paper 2: Higher Level Aggregation with Long-Term Links: An Application to the Swedish CPI

By Olivia Stahl | Statistics Sweden

This is an important paper that raises several issues that require further discussion and research.

The most important point which emerges from her paper is this: as more up to date information on household expenditures becomes available, it is possible to revise the month to month CPI links for past months and thus lead to a more accurate estimate of actual inflation for the present period relative to some past starting point for the CPI series. This updating procedure would not revise past published values of the index and so it would be consistent with the "no revisions" methodology that is applied to most CPIs. However, as Stahl points out, this updating of past links procedure means that the current CPI value would measure the *combined effect* of revisions *and* of month to month inflation. Thus the updated CPI would be useful for indexation purposes and as a deflator for consumption in the national accounts but it may not be suitable for measuring "pure price change" between the current month and the previous month. But for European Union countries, the Harmonized Index of Consumer Prices (HICP) would serve the purpose of measuring pure price change and the country's domestic CPI could utilize the updating methodology suggested by Stahl. It should be mentioned that Stahl's suggested updating procedures are consistent with the Ever Expanding Window methodology that is advocated in Diewert and Shimizu (2024) and in Diewert's (2024) Appendix.

Stahl shows that the HICP longer term trend consists of chained December to December links of Lowe type indexes. Thus there is the possibility of upward substitution bias in the HICP. She compared HICP inflation for Sweden with various variants of the updating methodology and indeed found if the Swedish CPI used the HICP methodology, it likely would have led to a 3% upward bias for the year 2023 relative to 2005.

There are some problematic aspects to the Swedish CPI methodology, which combines *annual* Walsh indexes with *month to month* price indexes. It is not straightforward to link an annual index to a monthly index, at least in theory. This aspect of the Swedish linking methodology needs to be more closely examined. This methodological review should also look at the problems associated with the use of annual weights with monthly prices. For strongly seasonal commodities, the following quotation states the problem:

"There is a conceptual problem with using annual basket indexes along with carry forward prices in the strongly seasonal commodities context. The problem is that these indexes have no theoretical justification. To see the problem clearly, think of an extreme case of strong seasonality for an elementary category where each commodity is available in only one month of the year. It is simply impossible to construct a meaningful price (or quantity) index for this category of goods or services. There is no basis for comparing the prices or quantities of one month or quarter with the corresponding prices or quantities of a different month or quarter of the same year since the product categories do not overlap." Diewert, Finkel, Sayag and White (2022; 68)."

References

Diewert, W.E. and C. Shimizu (2024), "Scanner Data, Product Churn and Quality Adjustment", 18th Ottawa Group Meeting, Ottawa, May 13. Website: https://stats.unece.org/ottawagroup/meeting/18

Diewert, W.E., Y. Finkel, D. Sayag and G. White (2022), "Seasonal Products", Chapter 9, *Consumer Price Index Theory*, Washington D.C., International Monetary Fund. Website:

https://www.imf.org/en/Data/Statistics/cpi-manual,

Diewert, W.E. (2024), "The Ottawa Group After 30 Years", 18th Ottawa Group Meeting, Ottawa, May 13.

Website: https://stats.unece.org/ottawagroup/meeting/18

Paper 3: A New Elementary Index: The Equal Share Counterpart of the Walsh Index

By Yuri Dikhanov | World Bank

This paper introduces a new elementary bilateral index number formula and compares it to other well-known elementary indexes.

Dikhanov starts off his analysis by considering three superlative bilateral price indexes: the Fisher, Törnqvist and Walsh indexes. These three indexes can be written in terms of expenditure shares s_n^0 and s_n^1 for periods 0 and 1 and relative prices p_n^1/p_n^0 for products n = 1,…,N as follows:

(1) $P_F = [\sum_{n=1}^N s_n^0(p_n^1/p_n^0)]^{1/2}/[\sum_{n=1}^N s_n^1(p_n^1/p_n^0)^{-1}]^{(1/2)}$;

(2) $\ln P_T = \sum_{n=1}^N (½)(s_n^0 + s_n^1)\ln(p_n^1/p_n^0)]$;

(3) $P_W = [\sum_{n=1}^N (p_n^1/p_n^0)^{1/2}(s_n^0 s_n^1)^{1/2}]/[\sum_{n=1}^N (p_n^0/p_n^1)^{1/2}(s_n^0 s_n^1)^{1/2}]$.

Now suppose that we have information on prices but no information on expenditures and we assume that each expenditure share is equal to 1/N. Then the above 3 bilateral indexes simplify into the following elementary indexes where p^0 and p^1 are the price vectors for periods 0 and 1:

(4) $P_{CSWD}(p^0,p^1) = [\sum_{n=1}^N (p_n^1/p_n^0)]^{1/2}/[\sum_{n=1}^N (p_n^1/p_n^0)^{-1}]^{(1/2)}$;

(5) $P_J(p^0,p^1) = [\prod_{n=1}^N (p_n^1/p_n^0)]^{1/N}$;

(6) $P_D(p^0,p^1) = [\sum_{n=1}^N (p_n^1/p_n^0)^{1/2}]/[\sum_{n=1}^N (p_n^0/p_n^1)^{1/2}]$.

$P_{CSWD}(p^0,p^1)$ is the Carruthers, Sellwood, Ward (1980) and Dalén (1992) elementary index which corresponds to the Fisher index when all expenditure shares are equal to one. (Dalén established this result). The Törnqvist index collapses down to the Jevons index $P_J(p^0,p^1)$ when expenditures shares are equal to one and the Walsh index collapses into the Dikhanov elementary index $P_D(p^0,p^1)$ defined by (6) when expenditure shares are equal to one. (This is a new result). Diewert (1978) showed that the Fisher, Törnqvist and Walsh indexes approximate each other to the accuracy of a second order Taylor series approximation around an equal price and quantity point where $p^0 = p^1$ and $q^0 = q^1$ and this property means that the three elementary indexes defined by (4)-(6) will approximate each other to the second order around an equal price point. Dikhanov's paper goes on to develop third order Taylor series approximations to these three indexes and he shows that when price changes are "reasonably realistic", the Dikhanov index will lie between the Jevons and CSWD indexes. He also indicates that the Dikhanov index satisfies the same tests as the CSWD elementary index.

Dikhanov also defines a new family of elementary indexes which contain the 3 elementary indexes defined by (4)-(6) as special cases.

Dikhanov's empirical simulations show that the differences between the 3 indexes defined by (4)-(6) are tiny using his simulated data. This raises the following question: what is the advantage in using his new indexes when they do not seem to be very different from the Jevons index, which satisfies more tests than competing elementary indexes?

References

Carruthers, A.G., D.J. Sellwood and P.W. Ward (1994), "Recent Developments in the Retail Prices Index", website: https://stats.unece.org/ottawagroup/meeting/1 Also published in *The Statistician* 29:1 (1980), 1-32.

Dalén, J. (1992), "Computing Elementary Aggregates in the Swedish Consumer Price Index," *Journal of Official Statistics* 8, 129-147.

Diewert, W.E. (1978), "Superlative Index Numbers and Consistency in Aggregation", *Econometrica* 46, 883-900.

Session 5: Challenging areas of price measurement and update by UN scanner data task team

Chairperson: **Randi Johannessen** | Statistics Norway

- Tanya Flower, Serge Goussev and Federico Polidoro. *Special update by the UN Task Team on Scanner Data 2024.*
- Pavel Belchev. *A framework for the games of chance index calculation in the HICP.*
- Bernhard Goldhammer. *A measure for the similarity of time series.*

Summary of session 5

This session on challenging areas of price measurement covers challenges and possible methods for measuring games of chance in the Harmonized Index of Consumer Prices, and a new method for measuring for similarities in time series. In addition, there was an update from the UN Task Team on Scanner Data 2024. The update conducted by ONS, StatCan and World Bank informed about the objectives of the Task Team and state of play.

The second presentation conducted by Eurostat analyse the two most promising methods of measuring games of chance in the HICP; the New Zealand method and the Minimum Bet method.

The third presentation conducted by the ECB, analyses traditional and introducing a new methods of measuring similarities especially for price indices.

Paper 1: UN Task Team on Scanner Data 2024 Update

By Tanya Flower | Office for National Statistics (UK), **Serge Goussev** | Statistics Canada **and Federico Polidoro** | World Bank

The update was presented by Tanya Flower (ONS), Serge Goussev (StatCan) and Federico Polidoro (World Bank). Within the UN Big Data platform, the Task Team on scanner data is created as a separate team, since scanner data is one of the Big Data sources which is used more and more in national statistical

systems for the calculation of price indices. The objective of the Task Team is guidance on using alternative data sources for consumer price indices (CPI) by drafting a methodological guidance (e-handbook), summarising best practice and guidance for using new data sources in CPI's and make code available to NSOs to test out different methods. The e-handbook is now available for the public. On other objective is to develop new guidance material and code for the process of classifying scanner data for consumer prices. The Task Team has finalised written guidance on classification methods and key considerations on applying them and will publish these as part of the handbook. The third objective is to develop a new training package using the guidance material to promote the use of scanner data and methods. The first course "Alternative Data Sources to compile CPI: an overview" has been finalised and will be launching shortly on the UN Global Platform. A second course "Alternative Data Sources acquisition" is near completion and will be made available by end of June2024, while a course on bilateral and multilateral price indices will be available in July. Additional courses are under development, including support on all new data sources, not just scanner data.

Paper 2: A framework for the games of chance index calculation in the HICP

By Pavel Belchev | Eurostat

The paper was presents by Pavel Pavel Belchev, Eurostat. Games of chance are still not included in the Harmonised Index of Consumer Prices (HICP) due to the lack of methodological consensus. Using the prices directly is not an option since only lottery tickets have fixed prices that can be followed. In other games, the player decides how much to bet. Even in lotteries the cost of a ticket is not the price that the player pays as the price does not account for the expected winnings. The real price of a bet is the expected loss which is the difference between the bet amount and the bet's expected winnings, thus the service charge. However, since bets are not fixed, using the service charge is not a good method. When measuring the price of games of chance, the service charge should include a monetary inflation. Two approaches are the most used ones in those countries thar have included games of chance: the New Zealand method and the Minimum Bet method:

- New Zealand method [price = (bet – expected winning (bet)) * inflation factor]
- Minimum Bet method [price = minimum bet – expected winning (minimum bet)]

If the minimum bet never changes, the Minimum Bet method is equivalent to using only the service charges. If the minimum bet changes exactly as the CPI, the Minimum Bet methos and the New Zealand method are identical.

The New Zealand method is the preferred approach for the HICP as the service factor should continuously be adjusted with inflation to keep the amount of the bet equally representative over time. Also due to the HICP regulations that clarify that for services where the price is determined as a proportion of the transaction price, the observed price to be used is the multiplication of the proportion of the price of a representative unit transaction. Although the New Zealand method outperforms the Minimum Bet methods, the latter is still valid for the case of pool betting games like lotteries since the winnings in a lottery depend on the number of tickets sold, and it is reasonable to expect that their price will follow inflation patterns in the long run. Eurostat still in the process of finalizing aggregation examples and formal guidelines to summarise treatment recommendations.

The paper also analyses data sources, stratification, and the product definition of the different types of games of chance, like lotteries, betting and gambling.

Paper 3: A measure for the similarity of time series

By Bernhard Goldhammer | European Central Bank

The presentation was conducted by Betrand Goldhammer, ECB. With the advent of multilateral methods being used in computing price indices from scanner data, the question of choosing the "correct" index formula, window length and splicing method has gained unprecedent importance. This means that different time series are generated and compared against each other judging the similarity of time series in general. Mean and variance are the most common metrics being used when comparing time series. One could argue that two time series are similar when their mean and variance are similar. The aim of this paper is to develop a new measure of time series for price indices by looking at the following axioms: Continuity, Identity, Positivity, Symmetry, Proportionality

The paper focus on three measures of the family of average quadratic distances: that by their very nature already satisfy Continuity:

- Average quadratic distance of indices (S_1)
- Average quadratic distance of annual change rates (S_2)
- Average quadratic distance of monthly change rates (S_3)

S_3 satisfies all axioms, while S_1 fails most of them. S_2 fails only the focus on change rates. S_3 seems to be superior and is used in the remainder of the paper by applying it to some problems of time series comparison from the literature, focusing on price indices. Since S_3 has desirable properties, it might contribute to the discussion about economic indices and help to identify the most suitable index formula and splicing method for the use of scanner data. However, being a first proposal, it leaves room for future research.

Session 6: Price statistics that meet multiple user needs

Chairperson: **Federico Polidoro** | World Bank

- Corinne Becker. *Is it still possible to publish a single consumer price index that satisfies all needs?*
- Naohito Abe and Noriko Inakura. *Reevaluating Household Real Consumption through Attribute-Specific Price Indices and Actual Consumption.*
- Thomas A. Knetsch, Dilyana Popova and Patrick Schwind. *HICP and national CPI in Germany – as similar as possible, as different as needed.*

Summary of session 6

Three papers were presented in the session: the first by Corinne Becker ("Is it still possible to publish a single consumer price index that satisfies all needs?"), the second by Naohito Abe and Noriko Inakura ("Reevaluating Household Real Consumption through Attribute-Specific Price Indices and Actual Consumption"), the third by Thomas A. Knetsch, Dilyana Popova, Patrick Schwind ("HICP and national CPI in Germany – as similar as possible, as different as needed). The three papers illustrated different perspectives, looking at indicators or case studies related to the topics of the session and raised a lively discussion. In general, the underlying general topic that went through the issue of the coverage of CPI in terms of households' consumption concepts, looking at the dissemination issues (specifically the paper by Corinne Becker and that by Thomas A. Knetsch et al.) and at the weights to use to compile CPI (all the

papers). The recent sharp increase of inflation in the world represents the background for the discussion that was proposed and that took place during the session.

Paper 1: Is it still possible to publish a single consumer price index that satisfies all needs?

By Corinne Becker | Office federal de la statistique, Switzerland

The presentation, given by Corinne Becker, started form a sequence of questions about the scope and the understanding of CPI in the public debate. She went through the potential answers to all these questions, looking specifically to the socio-economic and income-based indices produced by the federal statistical office of Switzerland, highlighting that the differences of inflation measures amongst different groups of households are very limited. The final parts of the presentation focused on the one side on a possible cost of living index that fills the gap, in terms of weights, between total households' consumption expenditure and total households' income and on the other side on the personal inflation calculator that was setup.

In the debate, the thought expressed in the presentation about the need to meet the user needs and reply to questions in the public debate, through more than one CPI, was accompanied by the concern regarding the interpretation of the different indices proposed. The return of inflation has highlighted the limits of the CPI (as general macroeconomic measure) to represent the impact of price increases on different sectors of population. Sub-indices are necessary to better measure this impact, but they are not enough. How to consider households' expenditures that are not strictly related to consumption domain but that can affect their purchasing power? Also, the multiplication of dissemination tools looks to be not sufficient, but a wider re-thinking of the measures could be more helpful. Is it possible? Or would it create more confusion with the consequent risks that this confusion can bring? These questions together with others were at the center of the debate in the session and, of course, had just some partial answers and in a way, they introduced the following presentations. Anyway, the content of the paper and the quality of the presentation received a general appreciation.

Paper 2: Reevaluating Household Real Consumption through Attribute-Specific Price Indices and Actual Consumption

By Naohito Abe | Hitotsubashi University, Japan, **Noriko Inakura** | Shikoku University, Japan

The presentation, given by Noriko Inakura, started from highlighting an issue of coverage of CPI if its use to evaluate the household welfare (CPI scope is the household expenditure consumption based on a purchase and not the actual consumption). From this perspective, the study illustrated by Noriko, proposes an extension of the traditional methods to measure real household consumption (that in general are obtained by using CPI). The innovations proposed are two. The first is considering heterogeneity in household characteristics in the compilation of price indices, looking at age differences in the compilation of a Törnqvist index. This approach allows consider the effects of targeted policies like those regarding the introduction of free childcare occurred in 2019 and highlights the underestimation of real expenditures coming from deflating nominal expenditures by common CPI. The second is dealing with the issue of gap between expenditure amounts and actual consumption by including real consumption of medical services through the integration of the data on national healthcare expenses in its calculations. Also in this case Noriko highlighted how the conventional methods underestimates the real consumption of young households from 2005 to 2021. In conclusion, it was proposed to consider actual consumption expenditure in the price index compilation if the aim is to assess the economic households' welfare and effects of the policies.

Some questions and comments followed the presentation. Again, the debate focused on how to face the issue of the coverage of CPI in terms of consumption. The need of more than one consumer price index (or better more than one price index) to cover different aims and to improve the measures of impact of price evolution on real households 'consumption was discussed. The availability of information to complement out of pocket expenditure data emerged as an issue as their merging with the other data traditionally used to estimate the weights. It was general the appreciation of the further perspective that the study presented by Noriko and Nahoito gave to the analysis of households' economic welfare and well-being from the point of view of the use of consumer prices evolution measures. This is a point strictly to the issue of producing multiple price indices for multiple aims and to the handling of their dissemination.

Paper 3: HICP and national CPI in Germany – as similar as possible, as different as needed
By Thomas A. Knetsch, Dilyana Popova, Patrick Schwind | Deutsche Bundesbank

The presentation given by Thomas A. Knetsch, started from similarities and differences of HICP and national CPI in Germany. The differences highlighted are related to aims, scope (and indeed weights that mainly explain the differences between the two indices in 2022), revision, and index formula, whereas the index concept and the data sources and methods are common to the two indices. Then Thomas went on illustrating how the impact of weights on these differences is expected to diminish for the replacement, in the last base year changeover, of HBS by National Accounts as major source for deriving five-year fixed CPI weights, increasing the conformity with the annual updating procedure for HICP weights. Afterwards, the Thomas's analysis moves to the role of considering OOH in the HICP compilation, given the recent requests of the ECB on that. The evidence discussed highlighted that the adoption of the net acquisition approach, that is the approach requested by ECB and the desirable one for HICP, re-proposes significant differences between HICP and CPI given that the national approach to the use of OOH is based on the rental equivalence one. The conclusions of the presentations were that measuring OOH in HICP and CPI by using different approaches are justified, but considering the differences that were brought by that, good communication is strongly necessary.

Also, in the case of the paper by Thomas, Diylana and Patrick, the questions and the comments were several. The topic of how to consider OOH in the CPI compilation re-emerged, allowing go back to the recent debate developed within the frame of United Nations Statistical Division. Questions were mainly focused on the weights systems, asking for some clarifications concerning the differences between HICP and national CPI considering the role of OOH. Beyond the weights, the issue of how to measure the evolution of imputed rentals in the monthly compilation of CPI was raised. General appreciation was expressed for the presentation and the focus on a twofold point (from the point of view of weights and from the point of monthly measures) that is represented by OOH. Again, the communication problems related to different measures of inflation and different methods to consider the same component (OOH in this case) were discussed.

After the last presentation, the chair thanked the authors of the papers and the speakers for the valuable contribution given and the participants for having animated a lively debate.

Session 7: Analytical or complementary measures of inflation

Chairperson: **Corinne Becker** | Office Fédéral de la Statistique, Switzerland

- Leigh Merrington. *Beyond the CPI: Producing analytical measures of inflation using outputs from the CPI.*
- Alan Bentley, Karsten Chipeniuk and Frances Krsinich. *Online price data, high frequency inflation measures, and formulation of monetary policy in New Zealand.*
- Luigi Palumbo and Tiziana Laureti. *Finding the Goldilocks data collection frequency for the Consumer Price Index.*

Summary of session 7

In this session, three papers explored the possibility of compiling analytical price indices, either directly using the CPI or using external sources (webscraping), and of establishing a cost-benefit analysis between the cost of collection and the quality of the results.

Paper 1: Beyond the CPI: Producing analytical measures of inflation using outputs from the CPI

By Leigh Merrington | Australian Bureau of Statistics

Analytical price indices, derived directly from the consumer price index, give users a better understanding of where inflation comes from and highlight underlying inflation. The Australian Bureau of Statistics has compared several methods for defining underlying inflation (trimmed mean, weighted median and CPI ex. food and energy) and has broken down inflation according to the characteristics of the products (tradables versus non-tradables, discretionary versus non-discretionary). It also analyses price indices for different socio-economic groups (employee, age pension, other government recipients and self-funded retiree). A survey of national statistical offices reveals that many countries publish analytical price indices; this is an excellent way of communicating and explaining where inflation comes from to a wide audience. Useful and widely covered by the media, these analytical and complementary price indices deserve to be framed by international standards and guidelines.

Paper 2: Online price data, high frequency inflation measures, and formulation of monetary policy in New Zealand

By Alan Bentley | Statistics New Zealand**, Karsten Chipeniuk** | Reserve Bank of New Zealand **and Frances Krsinich** | Statistics New Zealand

Statistics New Zealand and the Reserve Bank of New Zealand have worked together on this study on the use of web-scraped data, in reaction to the turbulent period of the health crisis but also in order to test whether the frequency of the CPI should and could be increased (from quarterly to monthly). They investigate the scope for timely and accurate nowcasting and forecasting. Millions of observations have been collected over a 10-year period. Using a machine learning algorithm, this data was first aggregated before being used in the model to forecast inflation and compare the results with the official CPI. The model translates some periods correctly but others less well. This has probably to do with the training data, which does not cover all inflationary scenarios and the fact that web-scraped data does not cover all the products of the CPI basket, and. Further work is therefore required, as other techniques could be used.

Paper 3: Finding the Goldilocks data collection frequency for the Consumer Price Index

By Luigi Palumbo | Banca d'Italia, **Tiziana Laureti** | Università degli Studi della Tuscia

How often prices need to be collected to ensure the quality of results while minimising survey costs? A framework is proposed to find the right balance. Based on electricity and gas prices collected daily on the internet for a period of 6 months (contracts on the open market), daily price changes were calculated using a weighted Time-Product Dummy method and compared with the official index. The combination of two factors (relationship between frequency and uncertainty and relationship between uncertainty and cost) was minimized and distribution analysed. The frequency with which prices are collected is a very important qualitative factor for the CPI. The new data sources offer great opportunities in terms of frequency, but also raise major technical challenges. This type of study has its merits and can help to strike the right balance.

Session 8: Alternate data sources and index number formulas III

Chairperson: **Xin Ha** | Statistics Canada

- William Spackman, Serge Goussev, Mackenzie Wall, Greg DeVilliers, David Chiumera. *Machine Learning is (not!) all you need: Impact of classification-induced error on price indices using scanner data.*
- Joseph Waihenya, Maria Rosario Reyes and Clément Yélou. *A new approach for integrating transaction data in the cellular services price index (CSPI).*
- Alessandro Brunetti, Tiziana Laureti and Federico Polidoro. *Estimating shrinkflation in the traditional data collection and by using scanner data.*

Summary of session 8

This was the third and final session of three on the use of alternate data sources and index number formulas used to calculate the CPI. The presentations highlighted the many opportunities of alternative data sources such as scanner data, but also the challenges faced when using these data sources in a production process. The presentations proposed solutions in resolving these challenges, which generated a lot of discussion and should provide helpful experience to statistical agencies undertaking similar research.

Paper 1: Machine Learning Is (Not!) All You Need: Impact of Classification-Induced Error on Price Indices Using Scanner Data

By William Spackman, Serge Goussev, Mackenzie Wall, Greg DeVilliers, and David Chiumera | Statistics Canada

William and Serge presented this paper which describes the impact of misclassification on the calculation of price indices using scanner data and proposed mitigation techniques to reduce the bias in the price index that can arise from these errors.

In the empirical study of the paper, 4 product categories were looked at using a public scanner dataset. Monte Carlo simulations were used to generate different levels of misclassifications to arrive at a distribution of price indices calculated which were compared to the true price index calculated using the public scanner data with no misclassification errors. Results found that depending on the level of misclassification, it can lead to bias in the calculation of the price index.

For mitigation techniques, the paper looked at reviewing top n% of product sales for different levels of n. For example, looking at the top 80% of product sales only required reviewing 16% of the products. By reviewing different levels of n, the national statistical organization can determine the optimal cutoff level to use that has the most impact on reducing the bias in the price index.

Questions and comments received from the audience include:

1. The impact of misclassification is not as big of a problem depending on the product category.
2. It would be beneficial to see the impact on the top level of the price index rather than just looking at certain product categories.

Paper 2: Statistics Canada's Methodology for Integrating Transaction Data in the Cellular Services Price Index

By Joseph Waihenya, Maria Rosario Reyes, Clement Yélou | Statistics Canada

Joseph and Maria presented this paper which describes Statistics Canada new proposed methodology to calculate their cellular services price index. The new proposed methodology is composed of two components. Web-scrapped data and transaction data from a wireless service provider. For the web-scrapped data, different customer's profiles are used to collect the data from the web. For the transaction data, the top 100 post-paid plans and top 10 pre-paid plans are provided each month which represent 70% of total revenues approximately.

In the transactions data set, to predict prices of a new cellular plan in the previous period which appears in the current period for the first time, a hedonic regression is estimated using multivariate adaptive regression splines. In the web-scrapped data, quality adjustments are done using GB allowance.

Questions and comments from the audience includes:

1. How to adjust for "excess" data that are not used? If data is not used, then value is 0.
2. Not possible to impute previous period prices for new characteristics that appear in the current period for the first time.

Paper 3: Estimating Shrinkflation in the Traditional Data Collection and By Using Scanner Data

By Alessandro Brunetti, Tiziana Laureti, Federico Polidoro | Statistics Italy and World Bank

Federico presented this paper which delves into looking at shrinkflation when the data is collected in a traditional way compared to data that is derived from scanner data. The analysis was focused on certain COICOP classes where specific goods could be affected by shrinkflation.

In the paper, the empirical study found that in the traditional method of data collection, the impact of shrinkflation on the estimate of general inflation to be limited but could be significant in certain product classes such as sugars, jams, honey, chocolate, and sweets.

When analyzing the impact of shrinkflation using scanner data, product category dishwashing liquid was investigated. The methodology used was to create unit prices among homogeneous group of products to calculate a bilateral price index, but this method does not deal with product composition changes

from period to period. Results showed significant differences between the unit price approach versus the published index in this product category. However, impact on aggregate inflation numbers not analyzed but the authors think the impact will be limited. Regardless, impact for certain product categories can be meaningful and proposed to think about using dynamic sampling approach for these food categories such as processed food. Finally, there needs to be more in-depth analysis on shrinkflation during periods of sharp increases in inflation such as during the Covid.

Questions and comments from the audience include:

1. Using Producer Price Indices as early indication of shrinkflation.
2. Switch to scanner data better at picking up quantity decreases but not quantity increases. More analysis in this area needed.

Session 9: Treatment of housing in the CPI

Chairperson: **Rob Cage** | Bureau of Labor Statistics (USA)

- Ken Van Loon. *Exploring different index methods for short-term rentals*.
- Ning Huang and Yang Wang. *Measuring Rental Price Changes for Prospective Tenants Using Rental Listings Microdata.*
- Ben Hillman and Tony Liu. *Modelled rental prices and their effect on price indices.*
- Corinne Becker and Muriel Mundwiler. *Using electronic data for the rent index: child's play?*

Summary of session 9

The penultimate session of the conference was dedicated to housing inflation measurement. Taking a break from the ongoing debate over the best way to treat owner occupied housing (OOH) in official CPIs, this session offered insightful perspectives on innovative ways to incorporate non-traditionally collected data into the estimation of rent change for rental occupied housing. Four papers were presented. The first two papers focused on inflation measurement of sub-sectors of the overall rental market: short term rentals and indexes for the prospective tenant cohort. The final two papers highlighted efficiencies and quality improvements that could be achieved via automating source data processes.

Paper 1: Evaluating different index methods for short-term rentals

By Ken Van Loon | Statistics Belgium

Using web-scraped data from a market leading international booking website platform, this paper demonstrated the plausibility of compiling an index for short-term rentals, covering the requisite steps of data collection, weight estimation, and final index methodology. Price and characteristic data were scraped over a three-year study period (2020 to 22023) for the three largest short-term rental markets in Belgium (Brussels, Antwerp, and Ghent). Indices of price change were compiled and contrasted using four different methods: matched-model indices (time product dummy (TPD) and GEKS-Jevons), hedonic indices (a multilateral time dummy hedonic (TBH) and a bilateral chained TDH, an index that combines matching and hedonics (an imputation Jevons GEKS) and a stratification approach. The author concludes based on the empirical evidence presented that an imputations Jevons GEKS is the recommended index methodology for these data.

Paper 2: Measuring rental price changes for prospective tenants using rental listings microdata

By Huang Ning and Yang Wang | Statistics Canada

Yang Wang presented rich empirical results from this paper detailing the construction of rental price indexes for new tenants. Using a large set of microdata obtained from an online rental listing website, the authors developed rent indexes for prospective tenants for selected provinces and metropolitan areas (Calgary, Montreal, Toronto, and Vancouver) in Canada. Instead of the use of actual transaction prices normally targeted in CPIs (i.e., rental amounts negotiated in lease agreements), the prospective tenant indexes represent price change of advertised asking rents or offer prices. As a targeted measure of the rent inflation consumers face, these statistics provide additional insight for policymakers on inflation trends and components. The authors experiment with various outlier treatment techniques and index estimation methods to yield constant quality asking price rent indices. Index techniques explored included a pooled time dummy, a rolling window time dummy, and various other hedonic models. The authors conclude new tenants experienced larger rent growth compared to existing tenants during the paper's study period, 2019 to 2023.

Paper 3: Modelled rental prices and their effect on price indices

By Tony Liu and Ben Hillman | U.K. Office of National Statistics

Using monthly rental price and property characteristic data obtained from an administrative data source, the authors calculate indices and price relatives from real data and compare them to price relatives and indices derived from imputed data generated by a double imputation hedonic index approach. The authors divide the source data into matched pools (properties with a price quote at the beginning and end of various 15-month time periods) and unmatched pools (properties that do not stay in the monthly dataset throughout the 15-month window periods). The paper's core methodology then follows a 'train and test split' machine learning technique on both unmatched and matched rental properties. Tony Liu presented the empirical results, which suggested some evidence of missing variable correlation with matched and unmatched status, causing the unmatched pool to display higher inflation rates. The authors conclude the hedonic methods explored give low biases for Jevons elementary aggregates despite a low accuracy at predicting individual property rents.

Paper 4: Using electronic data for the rental price index: child's play?

By Corinne Becker and Muriel Mundwiler | Office Federal de la Statistique, Switzerland

As the last presentation of the session, Muriel Mundwiler detailed the experience of Switzerland's Office of Federal de la Statistiue in incorporating source data innovation into the Swiss rental price index. Having obtained access to a rich source of rental lease data housed by a large real estate management company, this paper summarizes the steps taken to develop a process to automatically incorporate the electronic ingested data into the Swiss CPI, as an alternative to traditional survey collection obtained via a paper or online questionnaire. A major advantage of the automatic approach is reduced respondent and interviewer burden. The author's found that for one company, the automated approach eliminated a burden of approximately 39 hours to manually respond to roughly 400 questionnaires. Time savings for statistical office staff were estimated at 62 hours per quarter. Despite the obvious advantages in

efficiency of data collection operations, the authors caution scrutiny of the source data is required to eliminate potential sources of nonsampling error.

Special session: panel discussion on the state of research and practice of CPI methodology and challenges ahead

Chairperson: **David Fenwick** | International price statistics expert

Panel members:

- **Erwin Diewert** | The University of British Columbia
- **Jan de Haan** | International price statistics expert
- **Randi Johannessen** | Statistics Norway

Summary of the special session

i. Delegates recognised the significant role that the Ottawa Group had made in the last 30 years in the development of consumer price indices and pointed to the major contributions members had made to the drafting of the international manuals on CPIs. It was noted that the volume on CPI Theory, that complements the IMF's practical guide to Producing Consumer Price Indices (2020) and which was written by Erwin Diewert, is due to be published electronically very soon. An email will be sent to the IMF contact list, which includes members of the Ottawa Group.

ii. The current state of CPI research and practice and the road to where things stand now, was well illustrated by the paper presented by Diewert. This paper provided an extensive review of CPI methods.

iii. Diewert reviewed existing index number theory around the time of the first Ottawa Group meeting in 1994 and, in particular, he reviewed the contents of the Turvey CPI Manual which came out in 1989. He then went on to describe some important papers that appeared in the first Ottawa Group meeting:

- The paper by Bohdan Schultz demonstrated empirically the upward bias of the Carli formula which was widely used by National Statistical Office's (NSOs) at the time.
- The paper by Jörgen Dalén who, along with Carruthers, Sellwood and Ward, developed formulae for measuring the differences between various elementary index number formulae. More importantly, Dalén developed the test approach to elementary indexes and found that the Jevons index had the best axiomatic properties.
- The paper by Alain Saglio introduced the Ottawa Group to the use of scanner data at the first stage (or elementary index stage) of aggregation. The use of scanner data meant that superlative indexes could be used at the first stage of aggregation instead of using Carli, Dutot or Jevons indexes.
- The paper by Erwin Diewert further developed the test approach to elementary indexes. The Jevons index again emerged as the "best" elementary index that depended only on prices. He also noted that once price and quantity data were available at the elementary index level, then the prices and quantities that should enter a bilateral index number formula should be a narrowly defined unit value price and the corresponding quantity should be the total quantity purchased (or sold) during the period. However, he noted that the scope of a unit value would depend on the particular circumstances that the NSO faced.

- The possible use of scanner data at the elementary level of aggregation meant that the Turvey Manual needed to be updated. Thus, in 1998 work started on the production of the *Consumer Price Index Manual: Theory and Practice* which appeared in 2004. Peter Hill was the editor. An important recommendation from both this Manual and the Turvey Manual was that more than one index was needed for the treatment of Owner-Occupied Housing in order to serve different index purposes. Another main recommendation in this Manual was for the use of chained superlative indexes at all levels of aggregation if price and quantity information were available.

iv. In 2008, Jan de Haan showed empirically that chained superlative indexes at the elementary index level could lead to downward chain drift if the products in scope went on sale at heavily discounted prices. In response to this paper, Ivancic, Fox and Diewert (2009) suggested adapting multilateral index number theory to the time series context. They suggested adapting the use of two multilateral methods to the time series context: the GEKS and Time Product Dummy multilateral indexes. They found little empirical difference in their final indexes using these two multilateral methods. They noted that Bert Balk had already suggested the use of multilateral methods in the time series context to deal with the problems associated with seasonal products. Ivancic Fox and Diewert suggested a Rolling Window approach to the problem of linking the old window of periods used in their Rolling Window multilateral method with a new window of periods that included the addition of a new period and the dropping of the first period in the previous window of observations. The Rolling Window multilateral indexes are free from chain drift within each window and it was thought that with a long enough window length, the chain drift in the long run series would be small. Of course, the problem with a very long window is that if the products in scope are subject to rapid product churn (rapid introduction of new products and rapid product disappearance), then the number of product matches between the first period and last period of the window become small and hence the resulting bilateral index (which is a building block for many multilateral indexes) becomes unreliable.

v. The issue of how to link the results of the new window with the "permanent" index arises. Ivancic, Fox and Diewert (2009) suggested what has come to be called the "movement splice": the Rolling Window price ratio between the final period and the penultimate period index price levels in the current window is linked to the level of the permanent index in the penultimate period. Frances Krisinich (2016) suggested linking the price ratio between the final period and first period price levels in the current window to the permanent index level that corresponds to the first period of the current window, which she called the "window splice". De Haan (2015; 27) suggested that perhaps the linking period should be in the middle of the new window, which the Australian Bureau of Statistics (2016) termed the "half splice". Finally, Ivancic, Diewert and Fox (2011) suggested that the geometric average of all possible links of the ratios of the index values in the last period in the current window to the prior level in the current window to the corresponding levels in the permanent index could be used as the linking factor. Diewert and Fox (2021) called this "the mean splice" and it seems to be the safest strategy from a statistical point of view. Another strategy would be to use an *ever expanding* window that simply adds the data of a new period to the current window without dropping the data of any of the prior periods. This strategy is pursued in Appendix A of Diewert's paper.

vi. The above material shows that implementing a multilateral index is not simple. The NSO has to decide on (a) a choice of multilateral index formula; (b) the length of the rolling window and (c) the method for linking the results of the rolling window to the permanent index. Each choice is not straightforward.

vii. The above discovery of a potentially large chain drift problem in elementary superlative indexes led to the need to revise the 2004 CPI Manual. Thus in 2015, work began on an updated Manual which appeared in 2020: *Consumer Price Index Manual: Concepts and Methods 2020*. The editor of this new manual was Brian Graf and the lead institution was the IMF. The purpose of the 2020 Manual was explained as follows:
"The Manual is intended for the benefit of agencies that compile CPIs, as well as users of CPI data. It explains in some detail the methods that are recommended for use to calculate a CPI. A separate companion publication, *Consumer Price Index Theory*, explains the underlying economic and statistical theory on which the methods are based."

viii. The companion *CPI Theory* volume has not been finalized due to the rapid pace of new CPI theoretical research, which has led to revisions which incorporate the new research. Draft chapters of the *CPI Theory Manual* are available on the IMF CPI website.

ix. There are 14 chapters and 7 Appendices in the 2020 Manual. Most of the chapters follow up on similar chapters in the 2004 Manual but Chapter 10 on Scanner Data is a valuable entirely new chapter. This chapter, written by Jan de Haan, also covers the use of multilateral indexes. The 2020 Manual also has the following very useful Appendices:

- The Harmonised Index of Consumer Prices (European Union);
- Classification of Individual Consumption According to Purpose (COICOP 1999);
- Classification of Individual Consumption According to Purpose (COICOP 2018);
- Resolution Concerning Consumer Price Indices Adopted by the Seventeenth International Conference of Labour Statisticians;
- Spatial Comparisons of Consumer Prices, Purchasing Power Parities and International Comparisons;
- Some Basic Index Number Formulas; and
- The Consumer Price Index Research Agenda.

x. In section 7 of his paper, Diewert listed many topics that required further research including the topics that were listed in the 2020 Manual in Appendix 7: The Consumer Price Index Research Agenda. Diewert also reviewed some of his predictions made in 2001 on future developments on price index research.

xi. Diewert also had an Appendix to his paper which explained the *consumer demand approach* to the construction of multiperiod (multilateral) indexes. To explain why this approach is important, it is necessary to return to the discussion of the chain drift problem. The Ottawa Group paper by Fox, Levell and O'Connell (2024) showed that the Predicted Share multilateral index did not eliminate chain drift in their UK data set, even though it satisfies Walsh's (1901) Multiperiod Identity Test. It turns out that the multilateral method needs to satisfy the stronger Circularity or Transitivity Test to ensure that the multilateral index is free from chain drift. The Fox, Levell and O'Connell paper also demonstrated that chained Törnqvist indexes exhibited substantial downward chain drift. However, there is a problem with the measurement of downward chain drift: we need to evaluate chain drift of a given multilateral index relative to a target index which is free from chain drift but what is the appropriate target index? Fox, Levell and O'Connell chose the GEKS-Törnqvist or CCDI index defined over the entire sample period as the target index. This index satisfies the circularity test and is free from chain drift. But it may suffer from a lack of matching bias; i.e., the bilateral Törnqvist indexes used in the construction of these multilateral indexes use matched product prices and, as the length of the sample

increases, the number of matched products falls due to product churn. Hence there is a need for a target index that satisfies the circularity test and does not suffer from a lack of matching bias when there is product churn. The consumer demand estimation approach to index number theory is a multilateral method which meets these requirements.

xii. The economic approach to index number theory targets the estimation of price levels rather than quantity levels but in the end, it does not matter which type of index level that we target. The period t price level P^t using the economic approach is $c(p^t)$ where p^t is the price vector of product prices the consumer faces in period t and $P^t = c(p^t)$ is the minimum cost of achieving one unit of utility in period t. The period t quantity level Q^t using the economic approach is $f(q^t)$ where q^t is the aggregate consumption vector and $Q^t = f(q^t)$ where f is consumer's utility function. The period t price and quantity level satisfy $P^tQ^t = c(p^t)f(q^t) = \Sigma_{n=1}^N p_{tn}q_{tn} = p^t \cdot q^t$ using Diewert's notation.

xiii. When there is product churn, the key idea in Diewert's Appendix is to estimate the consumer's utility function f(q) rather than the unit cost function c(p). It turns out that the cost or expenditure approach to the estimation of consumer preferences is not workable when there are missing products in some periods. But the estimation of direct utility functions (as in forming Geary-Khamis indexes) is perfectly workable. When a product is not available during a period, the quantity consumed is 0 and this can be observed. The corresponding reservation price cannot be observed. It is this fact that makes the direct estimation of utility functions possible and the estimation of consumer expenditure functions difficult if not impossible. Diewert goes on to suggest a simplified version of the Diewert and Feenstra (2017) (2022) approach to the estimation of preferences (and reservation prices). This simplified approach is similar to the calculation of Geary Khamis price indexes or to running a Time Product Dummy regression. However, the approach has not been tested but it seems promising.

xiv. Finally, in the Appendix, Diewert showed that while it is possible to adjust the price of a new product for quality change if consumers have linear utility functions, it is not possible to do this for more general utility functions. However, it is possible to quality adjust with nonlinear utility functions provided that the new product is available on the marketplace for at least two periods. This observation provides support for the use of window linking for Rolling Window multilateral methods or to use expanding window linking. It also provides some support for allowing indexes to be revised.

xv. Delegates offered a number of comments. David Fenwick, who chaired the session, noted how the exploitation of new data sources had provided new opportunities for applying new methods to index production. These methods had been very effectively exploited in the computation of house price indices and rent indices but were yet to be fully utilised more broadly in the consumer price indices regularly published by statistics offices. In this regard, the Diewert paper raised important issues that warranted further research. He also suggested that the computation of quality-adjusted price indices for services continues to be a challenge and that a service improvement for some might be a service deterioration for others. This was the case with shopping over the internet where elderly people faced the challenge of not having the skills to go online and having fewer local shops. Additionally, the interface between households as customers and households as producers was becoming less clear cut with more individuals and households earning income from their underused assets. This was facilitated by the internet. Airbnb and Uber were examples of this. Fast moving changes in retailing and the availability of more data will heavily influence the direction of future research. Fenwick concluded that the case was strengthened for a family of indices, reflecting different population groups and the differing needs relating to different uses of a CPI. He also speculated whether some

time in the future there might be a universally and internationally recognised family of harmonised indices of consumer prices.

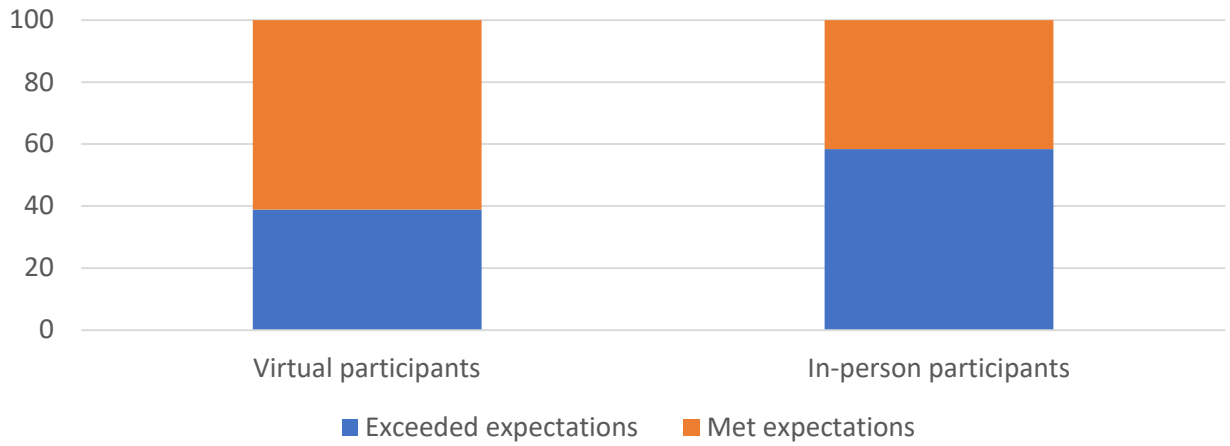
Annex B: Summary of the participants' feedback

This Annex summarizes the evaluation forms reported by attendees of the 18th Ottawa Group Meeting. Among the 42 individuals who participated in the evaluation, 24 attended the meeting in person, while 18 joined remotely.

The responses indicated very positive feedback from participants on all aspects, and some suggestions for further improvement have been made.

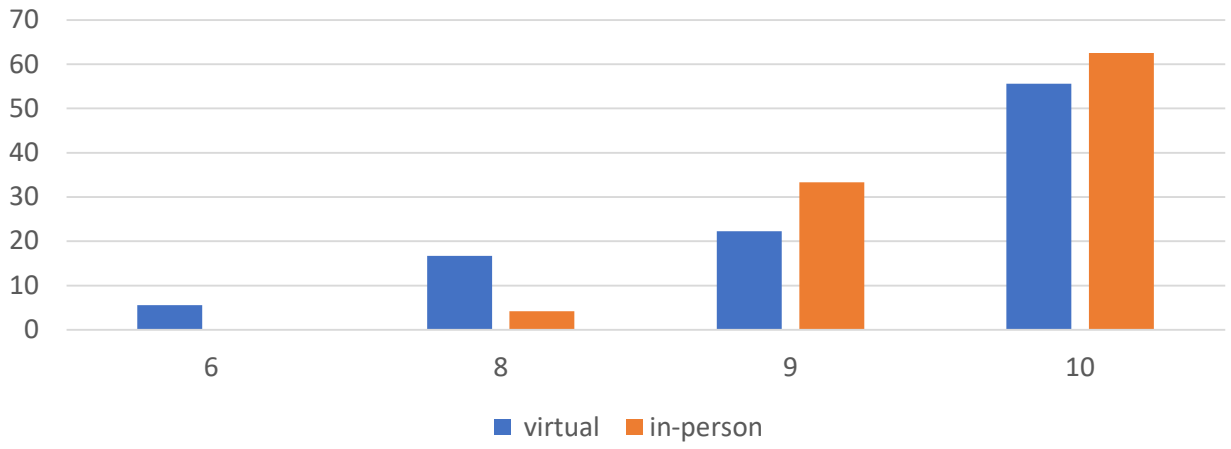
In terms of overall satisfaction, a higher percentage of in-person participants (58%) reported that the event exceeded their expectations compared to virtual participants (39%). The remaining attendees indicated that the event met their expectations. It was encouraging to see that, concerning the question about accessibility needs, all evaluation participants indicated either that it was not applicable (43%) or that their needs were satisfactorily addressed (57%); refer to Figure 1.

Figure 1: A larger proportion of in-person participants reported that the meeting exceeded their expectations compared to virtual participants



Due to the very positive feedback on the conference experience, most attendees indicated that they would strongly recommend the event. Among them, a higher percentage of in-person participants (96%) expressed this sentiment compared to virtual attendees (78%); see Figure 2.

Figure 2: A higher proportion of in-person participants would highly recommend this event compared to virtual participants

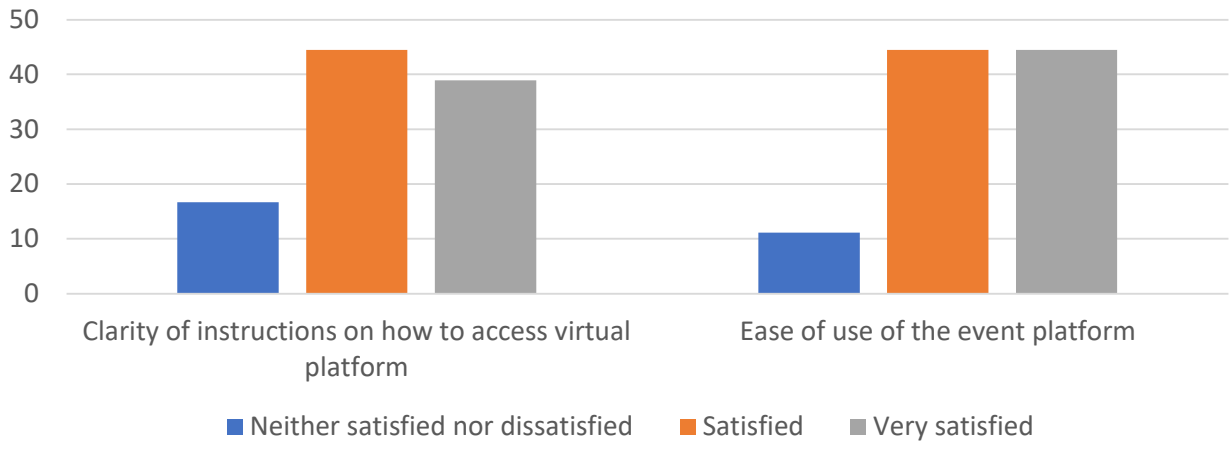


Regrettably, none of the attendees who were present in-person provided responses to the two questions concerning access to and usability of the meeting platform, which was unexpected. This omission is probably caused by the reference to "virtual aspects of the event" in those inquiries. The two questions are:

- How satisfied were you with the virtual aspects of the event? Clarity of instructions on how to access virtual platform.
- How satisfied were you with the virtual aspects of the event? Ease of use of the event platform.

Among virtual attendees, the vast majority expressed satisfaction or high satisfaction with both the clarity of instructions for accessing the virtual platform (83%) and the ease of use of the event platform (89%); refer to Figure 3.

Figure 3: Most virtual participants reported being satisfied or very satisfied with both the instructions for accessing the event platform and its usability



Additionally, meeting participants reported being satisfied or very satisfied with various aspects of the event, including the registration process, event format, quality of topics, food, conference center facilities, visuals, audio and the chat Q&A functionality; see Figures 4, 5 and 6.

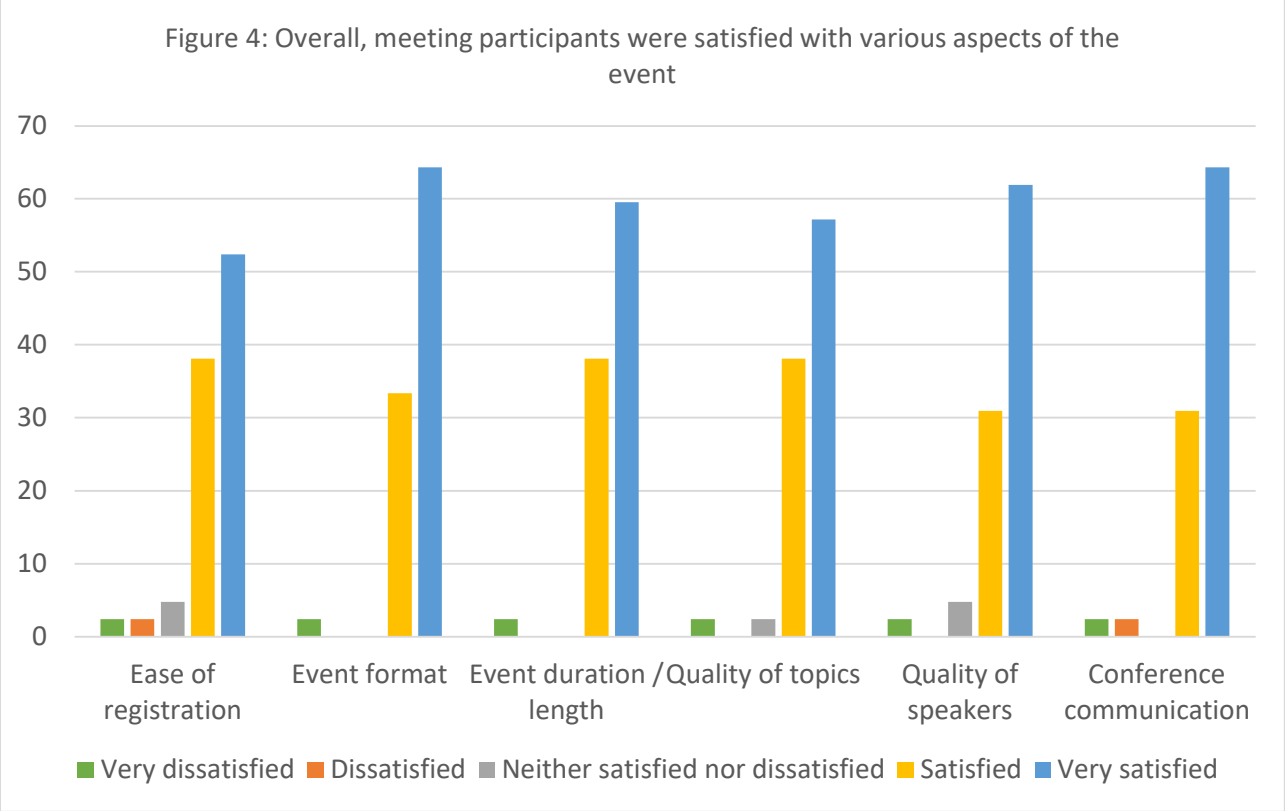


Figure 5: Most participants were very satisfied with the in-person aspects of the meeting

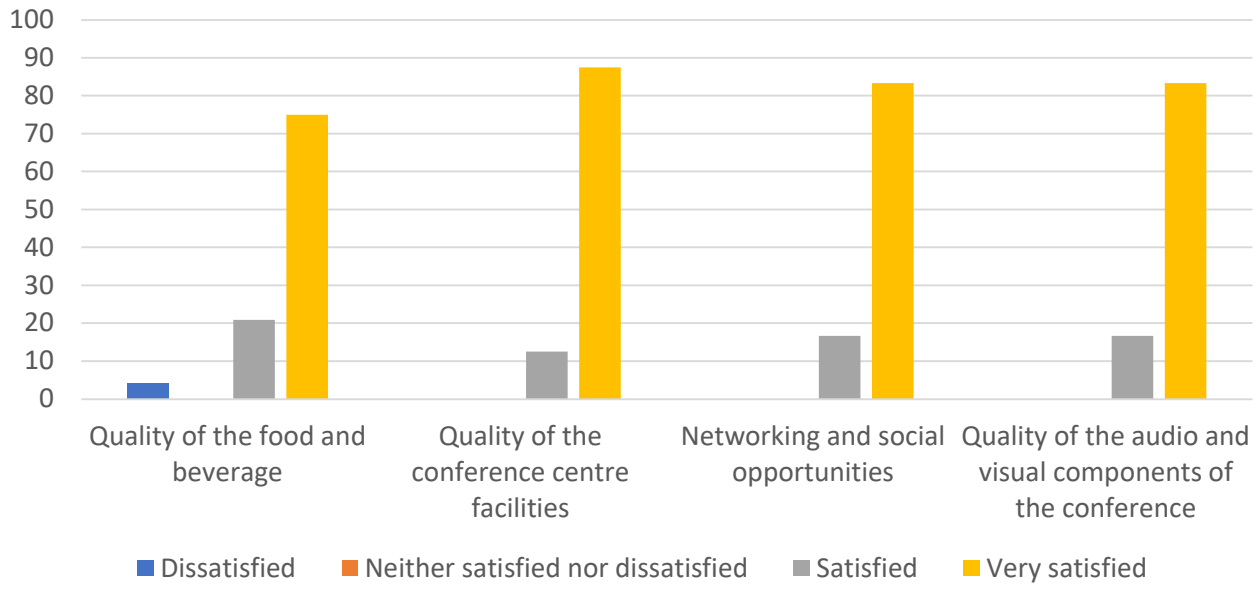


Figure 6: Most participants were either satisfied or very satisfied with the virtual aspects of the meeting