

# **Guide on producing CPI under lockdown**

*DRAFT*



# Preface

The lockdown that followed the outbreak of the Covid-19 pandemic in 2020 posed unprecedented challenges for the production of the consumer price index (CPI) in many countries. While different sectors of the economy and retails were closed and regular price collection could not be conducted because of restrictions on movements of persons, Statistical Offices had to be innovative and explore new data sources and new ways of collecting prices. Despite efforts to ensure price collection the lockdown in many instances caused a significant drop in the number of collected prices, in some cases prices for goods or services could not be collected at all when markets were closed. Statistical offices therefore also had to implement methods to adjust for the missing price observations to ensure the compilation of a reliable CPI. The lockdown also created challenges for the dissemination and communication of the CPI and users requested additional information about the lockdown's impact on the CPI.

This Guide is based on countries' experiences with producing the CPI during the pandemic. On this background, the Guide provides recommendations and good practices for CPI data collection, calculation methods and communication that countries may refer to in periods of lockdown or similar exceptional circumstances as they find it useful.



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# Chapter 1 Introduction

## 1.1 Background

1.1 The outbreak of the Covid-19 pandemic in early 2020 and the measures implemented in countries to reduce its spread raised unprecedented challenges for national statistical offices around the world. In many countries different sectors of the economy were closed and there were restrictions on the movement of people and social distancing. Staff in statistical offices were not able or allowed to work or were asked to work remotely. This made it difficult to maintain data collection and the regular compilation and publication of official statistics. In many cases the usual statistical operations could not be carried out and the lack of data raised methodological and conceptual questions in the calculation of the statistics.

1.2 In most countries the consumer price index (CPI) is compiled and published monthly adhering to a tight production schedule to allow time for collection and validation of data and index compilation and ensuring publication on the pre-announced release date. The production of the CPI was therefore directly and quickly impacted by the lockdown, which underlined the importance of being flexible and innovative in responding to challenges to normal statistical operations.

1.3 The regular price collection was impacted because of temporary closure of outlets and difficulties with collecting prices from outlets that remained open. Prices are usually collected by price collectors visiting the outlets, or by respondents reporting the prices on questionnaires sent to the statistical office. However, in many instances price collectors were not allowed to work or not allowed to enter outlets, and statistical offices had to ensure that collection activities did not contravene emergency rules or recommendations issued by authorities and did not place staff at risk. Outlets that reported prices on questionnaires in some cases were not able to submit prices for the full set of sampled products or were delayed in providing response.

1.4 The closing of outlets and problems with collecting prices from outlets that remained open led to very significant drops in the number of collected prices. The lockdown demonstrated the vulnerability of depending on a single data source or a single data collection mode. To collect as many prices as possible statistical offices had to consider alternative data sources and different modes of price collection and how to integrate price data from different sources in the CPI compilation.

1.5 Missing prices is a regular feature in the CPI compilation that is dealt with according to established procedures. However, the magnitude of missing observations because of the pandemic created problems that could not be dealt with by usual procedures and methods. In some cases, it was not possible to collect prices at all because markets were closed. In many countries this happened for international and domestic airline travels, retail trade, personal services such as hairdressers etc., childcare and sports and cultural events. Statistical offices therefore needed to consider how to manage missing observations efficiently and apply suitable methods to adjust for the missing observations and ensuring the quality and reliability of the CPI.

1.6 The lockdown also created challenges for the dissemination and communication of the CPI. The CPI is used as the general measure of inflation and plays a key role in economic and monetary policy. It is also widely used for indexation of wages, pensions and social transfers and for indexation of contracts. Thus, the CPI is used by a large and diverse group of users for different purposes and attracts great interest by households and the public in general. The pandemic underlined users' need for timely and relevant statistics and the challenges for statistical offices to meet the needs of different user groups.

1.7 The lockdown also raised questions about its effect on the CPI and the relevance and the quality of the index. Statistical offices therefore also had to communicate carefully and provide enough documentation and explanations to allow correct interpretation and use of the CPI and maintain the public trust in the index. Proactive communication with users is crucial for maintaining trust in official statistics during a crisis, and to manage and raise awareness of trade-offs among the quality criteria for statistics, e.g. timeliness, relevance and accuracy.

## 1.2 Purpose of the Guide

1.8 The purpose of this Guide is to provide recommendations and examples of good practices for producing the CPI under lockdown and other exceptional circumstances. Through this, the Guide aims to help maintain the quality and international comparability of CPIs under periods of lockdown.

1.9 Lockdown, in this guide, is understood as a situation where it is not possible to collect enough prices for the sample of goods and services to rely on the regular production procedures for the CPI. A lockdown may cover the whole of a country or only certain areas and it may affect different markets of goods and services in different ways. A lockdown may be caused by a pandemic, such as with the Covid-19, or, e.g., epidemics, natural disasters, conflicts, or unrests.

1.10 Because of the drop in the number of price observations associated with a lockdown, suitable methods to ensure the quality of the CPI must be applied. This includes the utilization of alternative data sources and modes of price collection and implementation of methods to adjust for missing observations or changes in data sources or mode of price collection.

1.11 Countries may refer to the Guide for establishing contingency plans that can be implemented in cases of lockdown and in developing multi-source and multi-mode data collection approaches and more resilient production systems for the CPI. Suitable procedures should be established in terms of contingency plans. Ideally, contingency plans in terms of back-up data collection alternatives and imputation methods should be integrated in the production procedures to be ready for implementation when required.

1.12 The recommendations and examples of the Guide are based on countries' experience with producing the CPI under the Covid-19 pandemic in 2020-2021. The *Consumer Price Index Manual: Concepts and Methods, 2020* (hereafter referred to as the *CPI Manual*).<sup>1</sup> provides the international statistical standard for compiling the CPI. It provides recommendations for sampling and data collection, data processing and calculation methods for the CPI under normal conditions. The Manual does not give guidance on the production of the CPI under lockdown. The Intersecretariat Working Group on Price Statistics (IWGPS) therefore in May 2020 issued Business Continuity Guidance for producing the CPI under lockdown, which gives recommendations on data collection, index compilation and imputations and communication under lockdown. The recommendations of the Guide are in line with the *CPI Manual* and the IWGPS Business Continuity Guidance for CPI. The Guide compliments these by presenting additional and more detailed guidance and examples of good practices for producing the CPI under lockdown.

## 1.3 Overview of chapters

1.13 *Chapter 2 Data collection* provides practical advices on the conducting of field price collection under lockdown and communication with price collectors and outlets. It presents alternative data sources and alternative data collection methods, such as websites, newspapers advertisements, telephone, e-mail, in person price collection, scanner data, big data and their advantages and disadvantages. Use of multiple data sources and multiple data collection methods is recommended while NSOs must be aware of

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<sup>1</sup> See [www.imf.org/cpi](http://www.imf.org/cpi).



associated problems with sample representativity, weighting and quality differences. The chapter provides more concrete guidance on the treatment of extra charges and delivery charges that may be introduced during the lockdown. The chapter advises on recommencement of regular price collection following the lifting of lockdown and provides long-term guidance on how to make price collection more resilient and moving towards a multi-source/multi-method environment.

1.14 *Chapter 3 Imputation and index calculation* presents the most used imputation methods. It makes a distinction between products that are still available on the market and unavailable products and recommends imputation practices in these two cases. The chapter gives guidance on the treatment of products with pronounced seasonal price variation, adjustments that may be necessary when changing the mode of data collection, imputation periods and data validation.

1.15 *Chapter 4 Expenditure weights*, firstly, discusses the possible impact on the weights of a lockdown. Secondly, it discusses how to derive weights for future CPIs based on consumption data from a lockdown period and present examples of different approaches.

1.16 *Chapter 5 Communication* stresses the importance of being transparent by publishing suitable documentation and explanations to facilitate correct interpretation and use of the CPI. The chapter gives recommendations for communicating with users and stakeholders under lockdown. It provides examples of additional information about the quality and reliability of the CPI that may be compiled to inform users, including measures of the impact of the lockdown such as imputation ratios. It also provides examples of experimental or analytical CPIs that may be compiled to supplement the headline CPI.

## 1.4 More information

1.17 Many statistical offices have posted documentation on CPI methods and practices under the pandemic on their websites. Some of these are referred to in the chapters. International organisations including Eurostat, ILO, IMF, OECD and UNECE, in spring 2020 established websites for sharing experiences in producing the CPI during the lockdown. These websites (see Box 1) include many papers and presentations from national statistical offices, international organisations and researches.

### Box 1 Websites with material on producing CPI during lockdown

The following websites contain selected papers and presentations on producing the CPI under lockdown by countries, international organisations and researchers

**Eurostat:** <https://ec.europa.eu/eurostat/data/metadata/covid-19-support-for-statisticians>

**IMF:** <https://www.imf.org/en/Publications/SPROLLs/covid19-special-notes#stats>

**ILO:** <https://ilostat ilo.org/topics/covid-19/>

**OECD:** <https://community.oecd.org/community/official-stats-workspace-covid19>

**UNECE:** <https://statswiki.unece.org/x/roKSE>

**UNECE/Ottawa Group Webinar on Producing CPI under Lockdown:**

<https://unece.org/statistics/events/webinars-producing-cpi-under-lockdown>

**UNECA Regional Seminar on data collection for the CPI in combat with Covid-19:**

<https://ecastats.unece.org/acsweb/FocusAreas/ESNA/CPI2020.aspx>

**Websites of national statistical offices:**

Many countries have published additional material and analysis on the website of the statistical office.

## 1.5 Acknowledgments

1.18 To facilitate continuing sharing of experiences among CPI compilers and more detailed discussions, UNECE in cooperation with the Ottawa Group on Price Indices organized a webinar on the production of CPI under lockdown which took place in terms of four online sessions on 21 and 28 October and 4 and 11 November 2020. The webinar discussed theoretical issues and challenges and best practices in data collection, imputation methods and communication with users under lockdown. The webinar, which attracted global interest, was based on presentations by experts from countries, international organisations and researchers.

1.19 In October 2020, the Bureau of the Conference of European Statisticians requested the UNECE Steering Group on Consumer Price Indices to summarise recommendations and good practices for producing CPI under lockdown in a reference document that countries may refer to in similar situations in the future. As a follow-up to the decision of the Bureau, a group of experts established under the Steering Group was formed to summarise recommendations and good practices based on country experiences and in line with the *CPI Manual* and the Business continuity Guide of the IWGPS.

1.20 The Guide was drafted by Giorgi Tetrauli (National Statistics Office of Georgia), Federico Polidoro (National Institute of Statistics of Italy), Chris Jenkins (Office for National Statistics, United Kingdom), Rob Cage (Bureau of Labor Statistics, United States), Claude Lamboray (Eurostat) and Carsten Boldsen (UNECE).

# Chapter 2 Data Collection

## 2.1 Introduction

2.1 Lockdown measures will present the NSO with numerous challenges for the CPI price collection, depending on the severity of the restrictions in place. In the most serious circumstances, routine price collection could fail due to:

- Price collectors being unable to leave their place of residence to physically collect prices
- Lockdown restrictions limiting access to physical outlets by price collectors, or dramatically reducing the time price collectors are welcome within an outlet
- Sectors of the economy in complete shut-down due to lockdown restrictions, meaning there are no prices to collect either physically or via alternative means.

2.2 This chapter attempts to present emerging best practices for price collection under lockdown, drawing on the experiences from the 2020 Covid-19 pandemic. This content should act as a set of guiding principles rather than established rules. Each country will be impacted differently by a lockdown situation and therefore the NSO should be flexible to adapt as required to ensure the CPI can be produced to an appropriate standard.

2.3 Section 2.2 discusses the organization of the price collection under lockdown. Section 2.3 discusses the communication with outlets and respondents. Alternative price collection methods are presented in section 2.4. Section 2.5 stresses the need to compare like-with-like during the lockdown and be aware of possible quality changes and additional costs passed on to consumers because of the lockdown. Section 2.6 highlights issues to consider when changing the mode of price collection. Section 2.7 looks at the impacts of possible long-term growth in households' online purchases. Section 2.8 provides guidance for returning to the regular price collection when the lockdown is lifted. Section 2.9 gives long-term guidance to make price collection more resilient. Finally, section 2.10 presents key points from the chapter.

## 2.2 Organization of price collection

2.4 Price collection for the consumer price index typically relies on two basic price collection approaches: a field price collection from physical outlets and a central collection where prices are collected centrally, such as by the National Statistical Office (NSO) via web, electronic means, by telephone or by obtaining other data sources (such as scanner data, administrative data etc.). Price collection for the CPI is covered in detail in chapter 5 of the *CPI Manual*.

2.5 The NSO is central to the organization and control of both field and central price collection for CPI. For the field price collection, the NSO should be in regular contact with the field force and be ready to provide updated guidance and advice to account for any issues (lockdown or otherwise) that may occur.

2.6 In the anticipation of future lockdown restrictions, the NSO should develop contingency plans that set out the processes to follow in the event of any such shocks or pandemics occurring again. Contingency plans should be regularly reviewed and updated to adapt price collection to reflect the restrictions in place. The contingency plans should be flexible, well communicated with both the price collection team and users of CPI and ultimately be designed to ensure the integrity of the CPI is maintained in periods of crisis. Chapter 5 of the *CPI manual* provides useful advice on contingency planning.

2.7 In the event of a lockdown, the NSO should quickly determine the potential impact of such an event on CPI collection. There are likely to be two main impacts for consideration – areas of the basket where prices remain available (as in available for consumption), but lockdown restrictions make it difficult to physically collect the prices and areas of the basket which are unavailable as lockdown restrictions mean that sectors of the economy are no longer open to consumers. The focus of the NSO should be to attempt to collect as many actual prices as possible for CPI, via alternative collection modes as needed, but maintaining the safety of price collectors and adhering to government restrictions. The extent to which this price collection is successful will vary and chapter 3 of this guide will consider the implications for imputation of both limited price collection and for those price collections which cannot take place.

2.8 The NSO should have a clear understanding and definition of what constitutes an available or unavailable item during a lockdown period, for the benefit of price collection. During a lockdown scenario (or a similar shock event) an item should be defined as *available* if it is possible for a consumer to purchase it from either outlets that remain open, or via alternative means, such as online, telephone etc. An item should be defined as *unavailable* if it is no longer possible for a consumer to purchase it from either outlets or via alternative means, such as online, telephone etc. For both the items deemed as *available*, but for which a price cannot be collected, or *unavailable*, then an appropriate method of imputation should be used (as detailed in chapter 3 of this guide).

2.9 For the still available items (whose prices can still be collected even if through different modes), the NSO should adopt all the necessary measures to collect the prices and to provide data collectors with recommendations and instructions. In particular, the NSO should authorize (and publicly communicate this decision) the use of data collection techniques that are new and/or alternative to those traditionally used.

2.10 It should be remembered that field price collection for CPI necessitates human interaction. Typically, a field force of staff will visit outlets, marketplaces or service providing establishments to collect price data. At all times the health and safety of all those involved should be paramount and should never be compromised. Price collectors are the group of staff who are more exposed to the risks of such a health emergency as Covid-19. They must be protected with sufficient safety measures when they are allowed to operate in the field and the importance of their activities in the lockdown period has to be explicitly stressed and appreciated.

2.11 Online training for price collectors should be held and innovative tools to support the new modes of price collection provided, such as smartphones or PCs with Internet connection considering that part of their activities could be carried out at home. Data collectors should be quickly trained to use telephone to interview retailers, on how to consult web sites to collect prices of the outlets they usually visit. The NSO may consider the development of standard scripts to use. The price collectors should be provided with (and trained in the use of) electronic sheets to send to retailers to collect price information via e-mails if this is an option available for price collection. Eventually, price collectors and CPI office staff may take the opportunity of their personal shopping to collect prices for the purpose of CPI, although this should be seen as a last resort for the collection of price data.

## 2.3 Communication with outlets and respondents

2.12 Field price collection for the CPI (described in detail in the *CPI Manual*, chapter 5) is reliant on a good relationship between the NSO (or price collection field force) and the outlet where price collection takes place. Likewise, the NSO is reliant on the goodwill of respondents who may provide regular price data for use in the CPI.

2.13 A lockdown situation will quickly put pressure on the price collection process depending on the severity of restrictions being put in place within a country. It is essential that the NSO has a clear plan for

communicating with both the outlets that are to be visited and the respondents who provide CPI data through survey questionnaires to ensure continuity of collection where possible.

2.14 At the onset of any lockdown activity, the NSO should identify those areas of the CPI basket that are likely to be impacted. This initial investigation should be carried out by consulting:

- Government advice
- Trade websites
- Retailers' websites
- Discussion with price collectors, or if price collection is outsourced, the third-party responsible for price collection
- Other relevant sources

2.15 The purpose of this investigation is to compile an accurate list of outlets and respondents in the CPI sample that are either available for price collection, that are open but are likely to refuse price collection or that have temporarily closed.

2.16 Despite an outlet being open, the NSO should be mindful that local price collection may not be welcomed during periods of lockdown or where strict social distancing guidelines are in place. The NSO should already have the location and contact details for each outlet in the CPI sample and should aim to confirm the availability of the outlet for price collection by making contact via telephone or email. Where possible, the NSO should attempt to agree a collection period that minimizes the impact on the outlet. Reassurances should also be provided to the outlet that a price collector will take full safety precautions, such as personal protective equipment, as necessary. The NSO may consider being more flexible with the timing of price collection than is usually the case, such as extending the collection period by a couple of days to ensure enough time is allowed to visit outlets at quieter periods.

2.17 When contacting the outlet, the NSO should also attempt to collect auxiliary information to support planning for future, potential lockdowns. This may include details regarding the availability of prices for that outlet via alternative means (email, website or telephone) and if the outlet is closed, when the outlet will likely reopen.

2.18 The NSO should remain considerate of any additional burden the price collection may have on outlets both in terms of physical price collection during a period of lockdown or asking for the supply of price data via alternative methods.

2.19 The list of closed outlets and respondents should be shared at the earliest opportunity with the price collectors to ensure an accurate list of remaining, available outlets to visit is maintained. The NSO should maintain this list on a frequent basis using the methods noted above.

2.20 It is likely to be the case that as price collection takes place during lockdown, the list of outlets may quickly become outdated as outlets shut at short notice, or outlets refuse price collector access due to safety restrictions or concerns. In this case, the price collector should feed this information back to the head office or the NSO. Where an outlet has closed or refuses entry, the price collector should not attempt to visit an alternative outlet to collect prices. It is good practice for a price collector not to switch between outlets in the field, in the event of a sampled outlet being closed or refusing the price collector access. The prices for the outlet should be treated as temporarily missing until such time that access is resumed.

2.21 The NSO should continue to monitor the list of closed outlets and respondents with the aim to keeping it as up to date as possible. Where outlets are closed, but have advertised that they are to reopen, the NSO should aim to reintroduce this outlet into the CPI collection at the earliest opportunity.

2.22 Despite the reopening, outlets may still be reluctant to welcome price collectors for a period. The NSO should be respectful of this and arrange to collect prices at a convenient time or by alternative modes

(if available) until normality is resumed. If no collection of prices is possible, despite the outlet being open then the NSO should continue to utilize the most suitable imputation approach (see chapter 3).

2.23 The Covid-19 pandemic has highlighted the importance of the NSO maintaining comprehensive and up to date contact information on the outlets and respondents in the CPI sample. This should be reviewed frequently (even outside of pandemic and lockdown situations) and where possible, supplemented with information regarding the potential availability of price data via alternative modes (such as a website, e-mail or telephone) should lockdown restrictions occur again.

2.24 The NSO should be clear and transparent regarding the impact of lockdown (or similar events) on the quality of CPI. As a minimum, alongside the published CPI the NSO should identify all items in the CPI basket that were unavailable for collection or where alternative modes of collection were used as a result of lockdown restrictions. Chapter 5 of this guide provides more detailed guidance on the communication of such issues.

2.25 The clear and early communication by the NSO of both the impact of a lockdown on CPI collection and the procedures taken to mitigate against this is not only essential to ensure transparency for users of CPI data, but also for those who are involved in the collection process, such as field force staff/central collection staff and outlets, where prices are collected. The NSO should aim to provide clear metrics alongside the published CPI to detail the impact of any lockdown restrictions on the amount of prices collected, and the mode of collection used.

### Box 2.1 Data collection in the UK and in Italy

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In response to the Covid-19 pandemic and the emerging lockdown restrictions in the United Kingdom (UK), the Office for National Statistics (ONS) set out the implications of lockdown restrictions on the UK CPI and the plans to mitigate against this in an article<sup>1</sup>, published as soon as possible on the ONS website. This provided users with a transparent and clear understanding of the approach ONS were taking to mitigate against the impact of Covid-19 on CPI price collection. Likewise, a follow-up article was also published by the ONS to set out the clear steps ONS were taking to resume the local collection<sup>1</sup> of price data when the lockdown restrictions are relaxed.

In Italy, as the pandemic spread, the national statistical office (Istat) established a dedicated website (<https://www.istat.it/it/archivio/239854>) informing users and respondents about measures adopted to deal with the consequences of the pandemic on statistical activities. On this website, in April 2020, users and respondents were informed of changes in data collection methods because of the lockdown. Field price collection was replaced by Computer Assisted Telephone Interviewing (CATI) and online price collection.

1) <https://www.ons.gov.uk/economy/inflationandpriceindices/articles/coronavirusandtheeffectsonukprices/2020-05-06>

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## 2.4 Alternative modes of price collection

2.26 The Covid-19 pandemic has highlighted the increasing potential for alternative data sources to support the production of CPI. More frequently, alternative data sources and price collection methods are being introduced for CPI such as the use of electronic point of sale (scanner) data or scraping prices directly from outlets with an online presence. Not only can alternative data sources provide NSOs with price data to supplement areas of the CPI basket where collection may be restricted by lockdown, it can also provide real-time intelligence on the impact of such restrictions and allow the NSO to plan for any potential shocks in the future collection of data for CPI.

2.27 The Covid-19 lockdown measures pushed NSOs to quickly use alternative sources and techniques to collect prices of products to overcome the restrictions to physical data collection. In some cases, alternative sources and collection techniques were already in use, in other cases the NSO had to quickly adapt and use these new modes of collection for the first time.

2.28 Anyway, the NSO should have a clear definition for what is deemed as an available item for price collection and should make every attempt to adapt data collection techniques to circumvent the need for a physical collection in the most severe restrictions. This may necessitate the move towards a multi-method collection during lockdown periods, utilizing such methods as collection over the internet, telephone or even scanner data.

2.29 The main alternatives to traditional price collection in terms of sources and techniques available are collection via the outlet websites (also queried through web scraping or crawling techniques), telephone calls, e-mails, newspapers advertisements, in person price collection, scanner data and other 'big data' sources. Most of these other sources and methods to collect prices are discussed in chapter 5 of the *CPI manual* (5.175 – 5.206).

**Table 2.1 CPI data sources and collection modes**

- 
- Field price collection
  - Outlets reporting through survey questionnaires (electronic questionnaire they send by e-mail or an online questionnaire on the NSO data reporting portal)
  - Newspapers advertisements, catalogues etc.
  - e-mail
  - Telephone
  - Outlets' websites
  - Scanner data
  - Bulk download of data from the web
  - Administrative data

In person price collection (as a last resort for the collection of price data and just in the case of small shops for a few items)

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### Outlet websites

2.30 The use of outlet websites for the collection of price data under lockdown restrictions is widely strengthened and it has a twofold aim: replacing the activities of data collectors who cannot temporarily visit physical outlets and collecting prices of retailers that are allowed to offer exclusively online their products in the period of restrictions imposed in response to the pandemic.

2.31 Concerning the first case (replacement of the physical collection by price collectors but where the products are available), for the prices collected online it is essential, as far as possible, that they represent the price offered in the physical outlet. A phone contact with the outlet to check this is recommended. One aspect to be aware of is that online prices may refer to a national price and this may miss out any regional variation that is shown in physical outlets across the country. The NSO should ensure such cases are investigated.

2.32 Concerning the second case (collecting prices of retailers that can offer their products exclusively online), the recorded prices should represent the transaction prices that would be proposed in the physical outlet. In this case, concerning the online collection of prices for goods, possible charges relating to a delivery service should be considered in the price collected (see section 2.5).

2.33 If appropriate and the NSO has sufficient capability, websites could be queried by automatic procedures to scrape or ‘crawl’ the data (typically referred to as web scraping). Where this is possible as an option to collect prices, the NSO should be aware of the outlet website terms and conditions regarding automated web scraping. To avoid activation of robot exclusion protocols NSOs should inform and ask permission from outlets and agree to the most suitable web scraping technique.

### Telephone, newspapers advertisements

2.34 Making recourse to telephone, e-mails, newspapers advertisements, in person price collection (where this means collecting prices when the staff of the NSO or field collection team visit an outlet for personal shopping) is mainly aimed at replacing the activities of data collectors who are temporarily not able to visit physical shops. Whilst these modes of collection provide the NSO with the opportunity to fulfil the collection of prices in time of a lockdown, the NSO needs to ensure the prices collected reflect the products being priced pre-lockdown. As such the NSO may need to invest additional resources in the quality assurance of prices collected via these modes.

2.35 The main disadvantages of price collection by telephone, e-mails and newspaper advertising mainly consist of the difficulties in assessing the continuity of the price collection in terms of the characteristics of the product offer. In the case of telephone and e-mail this issue could be partially overcome by interviewing the retailer asking carefully the price of each specific product included in the sample, (but it should be noted this is burdensome both on the outlet and NSO) or sending a questionnaire where the characteristics of the product offer are well specified. Newspaper advertising implies the absence of interaction with the outlet or respondent and therefore it is a source to be used when the other ones are not available at all.

### Scanner data

2.36 Scanner data are discussed in detail in chapter 10 of the *CPI manual*. Utilizing scanner data provides the NSO with a solution to deal with the issues arising from lockdown restrictions but it is not easy to implement quickly, is reliant on developed expertise and technology and such data are not immediately suitable for use in CPI compilation. If the NSO is already developing the systems and processes for collection of scanner data, then the lockdown period could represent the opportunity to speed up the process of their adoption. If scanner data are already used in the CPI compilation process, the possibility to expand their coverage to other groups of products is another potential solution to deal with the issues of data collection in lockdown period.

2.37 Other ‘big data’ sources represent alternatives to the traditional CPI data collection techniques during periods of lockdown, and the use of third-party web scraping tools to implement bulk download of prices from the web may provide an opportunity to maintain the price data for CPI. In this context the cooperation with such ‘big data’ providers could be considered, but may come at additional cost and would need to be covered by guarantees regarding the transparency of collection and the compliance of the methodological choices adopted with the statistical requirements of CPI production.

### In person price collection

2.38 A ‘last resort’ option to mitigate against the problems of data collection in periods of lockdown, if the aforementioned ones are not feasible, is presented by the collection of prices during personal shopping. This collection could feasibly be carried out by staff from the NSO or the price collection team. In this case, the staff member could visit an outlet already in the sample and take the opportunity of his/her personal shopping to collect prices of items selected, avoiding the need to formally visit the outlet for price collection in a health emergency. This solution is feasible only if prices of a few items have to be collected in a specific outlet and the NSO should be mindful of the need to quality assure those prices



collected by staff who are not familiar with the price collection for CPI. It should be strongly stressed that such instances of price collection should only be carried out as a last resort.

## 2.5 Maintaining the principles of CPI price recording

2.39 Regardless of the mode of price collection, in response to a lockdown, such as during the Covid-19 pandemic, the prices of goods and services are likely to be impacted by some of the measures introduced to adhere to government restrictions or health and safety requirements. Likewise, outlets and service providers may need to adapt their products to ensure they are still available for consumption during the pandemic. Examples may include the need to provide personal protective equipment, catering services being provided as takeaway only, or delivery charges now being added to the cost of a good that can no longer be purchased in person. Every effort should be made to collect the same quality of good or service although the NSO should be aware that there will be difficulties presented given the issues mentioned. As a result, there may need to be a slight loosening of the collection rules regarding comparable and non-comparable products depending on the level of restrictions and the impact of the pandemic. The availability of resources and time will dictate how each NSO can handle such issues, but the following is intended to provide a general sense of how specific issues may be treated for the collection of prices during a period of lockdown.

2.40 At this stage, it is worth revisiting the underlying principle of a fixed quality price index. The *CPI Manual* explains the importance of the ‘matched-model methods’ (MMM) in chapter 6. The measurement of changes in the level of consumer prices is complicated by the appearance and disappearance of new and old products, as well as changes in the quality of existing ones. A period of lockdown, particularly in response to a pandemic such as Covid-19, is likely to put strain on the ‘MMM’ approach as the economy reacts to the impact of lockdown and restrictions. The *CPI Manual* (6.6) states:

“The NSO typically go to great lengths to ensure measured price changes are not influenced by changes in the quality of items. By measuring the price change of a fixed, constant quality basket of goods and services, NSOs use the MMM.”

2.41 This means the price collector should attempt to price the exact same good or service each period to fulfil the requirement of a ‘like for like’ price collection. Clearly the lockdown will present challenges. Some of the changes in products during and post lockdown will be subtle, while other changes will clearly be changes in quality. The NSO will need to provide regular support and guidance for the price collectors, however, the underlying principle should be that the quality of a product, based on the discernible price determining characteristics should be as close as possible in the pre, during and post lockdown collection. Any element of doubt regarding comparable or non-comparable products should be raised immediately with the NSO, so the lockdown could lead to an increased number of collection queries for which the NSO should be prepared.

### Extra charges and delivery charges

2.42 Prices recorded for the CPI should be purchasers’ prices. The purchaser’s price is the amount actually paid by the consumer. It includes value added tax (VAT) and any other indirect taxes paid by the purchaser. It excludes taxes deductible by the purchaser and subsidies.

2.43 In some cases, the consumer has no choice but to pay an extra charge, in addition to the advertised price, to acquire the product. In cases where most customers will pay the extra charge, the charge should be added to the advertised price to determine the price for the CPI.

2.44 In the event where extra charges are passed onto the consumer to account for pandemic related extras like face masks or sanitization requirements, these charges should be included in the price and

recorded as a price increase where it is not possible to obtain the product without the additional charge. This fulfils the principle that the underlying product is deemed as sufficiently comparable to the one supplied without extra charges before the pandemic. From a conceptual perspective any increases in production costs that are passed onto the consumer should lead to increases in the CPI. However, if these pandemic related extra charges are optional, the charges should be omitted from the collected price

2.45 The delivery of a product may include a *delivery charge*, whether the product has been purchased by visiting the outlet, over the phone or online. For CPI compilation, charges that are directly connected to the delivery of the product and not separately invoiced, should be included in the price. If the delivery charge is separately invoiced or relates to the purchase of several items, it should not be included in the price for the CPI. Instead, it should be included under transport services. The *CPI manual* provides more details on the treatment of extra charges and delivery charges (see paragraphs 5.18-5.19, 5.196, 11.57 and 11.78- 11.79).

## Box 2.2 Treatment of extra charges

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### An optional extra charge

A gentlemen's hair cut prior to a pandemic cost \$15.00. This is a basic dry cut, no further styling. In response to the pandemic, government guidance states, if asked by the consumer, the barber should provide protective face masks and hand sanitization for all customers. The cost of the face mask and hand sanitizer is \$4.00, so if the consumer includes these optional extras the price increases to \$19.00. The price collector should collect the price without the optional extras, so the service is comparable with the pre pandemic service

### A non-optional extra charge

A gentlemen's hair cut prior to a pandemic cost \$15.00. This is a basic dry cut, no further styling. In response to the pandemic, government guidance states barbers are required to provide protective face masks and hand sanitization for all customers and provide additional sanitization of equipment before each cut. These additional safety requirements increase the production cost for the barber by \$2.00 per customer, so the price of a basic cut increases to \$17.00. The price increase should be taken into account for the CPI collection.

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2.46 In response to lockdown restrictions or a pandemic more generally, the government may intervene to manage the setting of price levels. For example, a period of lockdown restrictions may lead to temporary (or longer-term) loss of employment. As a result, the government may introduce rent controls to limit the increase in price of private rents whilst the market uncertainty caused by the pandemic settles. Similarly, the lockdown may lead to panic-buying by consumers wishing to stockpile high demand products, such as paracetamol or sanitization goods leading to the introduction of products by government at nominal prices. In these cases, the NSO should continue to collect and include these products in the CPI on the assumption that the recorded price reflects the amount actually paid by households for consumption. The NSO should closely monitor these situations and ensure any updated price development is captured once any interventions have ceased.

## Restaurants and cafes

2.47 The collection of price data for restaurants and cafes is likely to be impacted during a period of lockdown. Depending on the severity of restrictions, such establishments may only offer limited 'dine in' services or offer a reduced menu for takeaway or delivery. The NSO will need to distinguish if the outlet is

open for business before making any further decision regarding what price data can be collected and via what mode (field collection or via alternative data sources). As a guide:

- If the outlet is not open for consumers (either for 'dine in' or takeaway), then the price sample for that outlet should be treated as temporarily unavailable, even though the price list may be available online. See chapter 3 for imputation options.
- If the outlet is open for consumers, but additional costs are now added to the price of a meal to cover any pandemic related measures, such as face masks, health and safety requirements etc. then these additional costs *should* be included in the price collected.
- If an outlet is open for consumers, but they are providing a limited menu for takeaway only, the price collector will need to determine if the available menu items are considered as comparable to the pre-pandemic meal that was collected. If the lockdown menu item is deemed as comparable, then the price should be collected and used in the CPI. If the lockdown item is considered non-comparable then standard replacement and quality adjustment methods can be applied (see chapter 6 of the *CPI Manual*).
- In some cases, where the outlet is providing a takeaway/delivery menu only, the price will include an additional cost for the delivery of the item. Where possible the price collector should attempt to collect the price excluding delivery costs. If these delivery costs are clearly displayed and available, they should be *excluded* from the price collected. However, there may be instances where these costs are not separately identifiable and, in this case, the full price should be *collected and included* in the CPI.

### Box 2.3 Charge for restaurants' delivery of a menu

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In response to lockdown restrictions, a restaurant closes its 'dine in' facility but offers a limited delivery menu. The products on the limited menu are comparable to the pre-lockdown products that were collected. Before the lockdown restrictions were in place, a dine in meal of cheeseburger and chips was priced at \$18. This same meal is now available for delivery. The menu price is now \$19 plus an additional \$3 delivery charge. The price collector records the price as \$19, ignoring the additional delivery costs.

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2.48 The travel and transport sector will present many difficulties for the collection of suitable prices during a period of lockdown. In the most severe restrictions, most travel will be suspended and therefore unavailable for consumption. A general rule to follow in this instance, where travel is unavailable for consumption is to mark the prices as unavailable and impute the price using the methods outlined in chapter 3.

## 2.6 Issues to consider when changing mode of price collection

2.49 Taking into account the aforementioned alternative data sources and alternative collection options which could realistically be implemented in a period of lockdown, it is crucial (and potentially complicated) that the NSO understands the limitations and issues in running this mix of data collection sources, retail trade channels and data collection techniques. The main ones concern the quality differences that may exist, the replacements between product offers, the sample representativeness and the weighting schemes connected with the progressive change in the survey design.

2.50 Some of the questions that need to be considered:

- Eating a meal at home that is delivered by a restaurant - is it the same as eating a meal in the restaurant, with the table service etc.?
- Following a gym class online at home, is it the same as physically attending the gym (where people have use of changing rooms and showers etc.)?
- Choosing an online product - is it the same as choosing a product in the outlet where the consumer could ask for assistance and clarification?
- If a good is delivered to your home, is the price the consumer pays comparable with the price he/she will pay in the physical shop where he/she must go to buy that specific good?
- Are prices compiled using scanner data for a group of products comparable with prices collected via traditional data collection for the same group of products?

2.51 Moving data collection from one source to another or using a different technique/mode raises issues of comparability between prices for products collected that are not new but that assume a specific importance in lockdown period.

2.52 The NSO needs to pay particular attention when the new data source or data collection technique means a potential change in the quality of the items previously selected in the sample. Broadly speaking, if the new data source or technique is adopted just to replace the activity of data collectors who cannot visit physical shops, a quality change should not arise, if the NSO are sure that the product offer is the same as it was pre lockdown. When the new data source or technique means a change (also temporary) in the distributional channel (from the physical to the online one) a quality change could emerge and if possible and appropriate the NSO should adjust the price collected to take into account this change.

2.53 The change in the selected distributional channel is evident when the sample unit has to be replaced if it is not able to adapt to the lockdown restrictions (for instance a clothing or footwear outlet that is not able to move to the online trade) and it closes without a perspective of reopening. The replacement of this sample unit with a new one in general produces an issue of quality change unless the new sample unit belongs to same category of shops and it sells the same variety of products. This is evident and necessary if the data collection is forced to move to typical e-commerce players. Even if the same product offer is available, direct comparison cannot be carried out and at least an implicit quality adjustment of price should be carried out.

2.54 The price sample, in terms of both primary (outlet) and secondary (product offer), could be strongly affected by the changes that the NSO are forced to introduce to deal with the issues in lockdown period for price collection.

2.55 The sample is also affected in terms of time, which is one of the crucial dimensions of sampling when measuring inflation. Moving from the traditional data collection (that in general means collecting prices once or twice a month) to a new data source such as scanner data or bulk download of online prices, does not allow a direct comparison of prices (properly for sampling reasons) and also in this case at least some implicit adjustment should be carried out in order to compare the new price derived from the new data source with the previous one collected by traditional methods.

2.56 In some cases, changes in the sample should be implemented by the NSO to keep it representative. For example, if online sale for a group of products was disregarded before the lockdown period as it was negligible, it could be necessary to consider it in the sample by replacing or complementing the physical shops with the new channel. For instance, if the selling of appliances on the web increases suddenly its relevance in terms of households' expenditure, the sample may need to be changed in order to include this new channel, so that the sample of products in the CPI remains representative.

2.57 Changes of the sample design should produce a revision of the sample weights associated to the sample units and to different retail trade channels. If it is known that the replacing outlet has a turnover

clearly higher than the previous one (because similar outlets were not available), it should have a higher sampling weight. If the prices that are available online start to be considered, this channel must be considered with its own weight in the compilation of indices at the elementary level.

2.58 The NSO should manage any lockdown changes to introduce alternative data sources, techniques and above all sample with the objective to keep the CPI sample as representative as possible. However, the NSO should be mindful of the wider difficulties and implications of a lockdown and therefore remain flexible in their approach. In such times, the conceptual ideal for a CPI may be very difficult to achieve so the NSO should attempt to make the best use of resources (prices, sample, data collection etc.) as possible.

## **2.7 A permanent level shift in households' purchases on Internet**

2.59 Household may purchase goods and services over Internet where the goods or services are then delivered online or physically. It includes both domestic and international, cross-border transactions. The potential savings from purchases over Internet are substantial in terms of reduction in travel and search costs. Because of the potential cost reductions, purchases over Internet may be expected to continue growing, facilitated by digitalization and the availability of online tools and apps to select and purchase goods and services. In many countries, the movement towards Internet purchases was accelerated by the lockdown under the Covid-19 pandemic. While purchases over Internet to some extent may revert to pre-lockdown level it may still be expected to increase in the longer term reflecting more permanent changes in households' consumption behaviour.

2.60 In a period of lockdown restrictions, households are unlikely to be able to purchase products in physical outlets (or where this is possible, they can purchase them with restrictions in terms of opening times or with difficulties due to social distancing requirements, such as long queues) and therefore make wider recourse to online purchases. This is particularly true for technological products, but also for clothing, footwear and for meals, food and beverages offered by restaurants, pizzeria, cafes, and the like. Moreover, purchases over Internet becomes increasingly more popular as it adapts to the increased demand such as for grocery products, and, for an example, allow to arrange online delivery for extended periods.

2.61 The expected structural changes in households' consumption behaviour should be taken into account in CPI sample design and thus in the organization of data collection: If the sample for the CPI survey should increasingly be designed by taking into account the structural change (post pandemic), the NSOs should also consider tailoring the price collection to represent it.

2.62 The development in retail trade channels should be monitored in order to flank the traditional data collection in the outlets (also by using innovative data sources such as scanner data or administrative data) with the use of the internet as a data source aimed not at replacing the activities of data collectors but at detecting the temporal evolution of prices related to the e-commerce channel.

2.63 A matrix approach could potentially be used to design the organization of data collection. For each main category of products (at whichever detail of COICOP or other classification is used, depending on the characteristics of the market in each country) the percentages in terms of turnover of each retail trade channel should be estimated and consequently the sample and data collection designed based on this. Any consequences in terms of weights to group indices referred to in different channels should be considered.

**Table 2.2 Example of matrix of turnover by retail trade channel and COICOP divisions.**  
**Percentage values**

COICOP EXPENDITURE DIVISIONS	Large scale retail trade channels	Traditional distribution	Service provider establishment or companies	Internet purchase	Others	Total
01 Food and non-alcoholic beverages	60	20	0	20	0	100
02 Alcoholic beverages, tobacco	50	30	0	25	5	100
03 Clothing and footwear	30	40		0	0	100
04 Housing, water, electricity, gas, other fuels	10	10	50	20	10	100
05 Furnishings, household equipment and routine household maintenance	40	30	10	20	0	100
06 Health	20	30	40	10	0	100
07 Transport	10	30	30	30	0	100
08 Communication	30	20	20	30	0	100
09 Recreation and culture	20	20	30	20	10	100
10 Education	0	0	100	0	0	100
11 Restaurants and hotels	0	0	60	40	0	100
12 Miscellaneous goods and services	20	20	20	30	10	100

## 2.8 Recommencing regular price collection after lockdown

2.64 Having considered the impact on CPI during a period of lockdown we should now think about how the NSO returns to a more regular price collection once restrictions are lifted. The NSO should prepare for coming out of a lockdown period and any implications this may have on the comparability of price collection. In particular, the period of lockdown may impact supply chains for a period of time leading to the temporary unavailability of certain items despite the lifting of lockdown conditions. Likewise, a sustained period of lockdown may lead to the permanent closure of outlets. The NSO should have clear and well communicated advice available to deal with such situations.

2.65 The impact of lockdown on price collection for CPI may lead to some substantial short-term changes in well-established methods, such as the collection of price data via alternative means (telephone, email, online or scanner data). It is highly likely that lockdown restrictions will be gradually eased rather than removed in one go. Therefore, the NSO should plan for how best to re-introduce the pre-lockdown collection of observed prices and importantly, how this should be communicated with key users and stakeholders.

2.66 Central to any decision by the NSO to resume regular price collection will be government guidance on the lifting of lockdown restrictions, the impact of any lifting of restrictions on outlets and the availability of the price collection field staff to resume duties. The NSO should continue to keep in close contact with both sampled outlets and the field price collection staff, remembering that safety and adhering to any restrictions are top priority.

2.67 As with all aspects of managing the impact of lockdown restrictions on CPI, the NSO should remain flexible and ready to adapt to emerging issues as they arise. Even the best laid out plan may need to be adapted to reflect any short-term changes in restrictions or the availability of price collectors.

2.68 A return to regular price collection will introduce several issues that potentially need to be overcome. A period of lockdown, such as the one caused by the Covid-19 pandemic may lead to a level change in both the economy and availability of products that consumers purchase. Likewise, as lockdown restriction ease there may be changes in the quality of goods and services when comparing back to what was available pre-lockdown. Clear guidance for price collectors should be developed and regularly maintained by the NSO to ensure these issues are accurately captured.

2.69 An underlying principle for the reintroduction of regular field price collection is the change between the last pre-lockdown price and the first post-lockdown price is correctly captured, independent of any price collection or imputation applied during the lockdown period. This means any replacement items or imputations applied during the period of lockdown will be discarded and the NSO should aim to collect updated prices for all those goods and services observed in the last pre-lockdown collection.

2.70 When reintroducing regular field price collection, the change between the last pre-lockdown price and the first post-lockdown price must be correctly captured, independently of any price collection or imputation applied during the lockdown period. This means that any replacement items or imputations applied during the period of lockdown will be discarded and the NSO should aim to collect updated prices for all those goods and services observed in the last pre-lockdown collection.

2.71 Because of this principle, there may be some unusual movements in the index calculations as the reintroduction of the pre-lockdown sample replaces imputations, online/alternative data source prices or observed prices with low sample sizes. This effect may be felt for a few periods, particularly where there is a phased loosening of restrictions which may delay the reinstatement of pre-lockdown price chains. Unfortunately, it is not possible to implement an approach that does not impact the CPI calculations in some way. The NSO should ensure a full description of the plan for reinstating regular field price collection and the impact of doing so on the CPI be shared with key users and stakeholders<sup>1</sup>.

2.72 In a return to a regular, field price collection, all attempts should be made to maximize the collection of observed prices from outlets. However, there may be issues to overcome. Depending on the length of lockdown, price collectors may find it difficult to find the products previously priced before restrictions, price collectors may need to queue for access to outlets due to social distancing and the whole collection process may be less efficient than in normal times. With this in mind, there should be flexibility in the amount of time allocated for price collection, certainly in the first few periods after lockdown. NSO's may wish to allow an extended collection period to overcome such issues, but regularly review this with the goal of returning to 'normal' as soon as possible.

2.73 The time spent under lockdown restrictions may vary from one month to many months. The greater the period spent in lockdown, the more likely there are to be changes in the availability and quality of products that were available pre lockdown. Guidelines for handling comparable and non-comparable replacements are provided in chapter 6 of the *CPI Manual*. However, the price collector should pay particular attention to such issues following a period of lockdown. Where possible, price collectors should make every effort to re-price the original, pre-lockdown product and only if this is unavailable should replacements be introduced. The decision on whether a replacement is comparable or not may need additional consideration following lockdown, and NSOs should provide more detailed guidance for price collectors where possible.

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<sup>1</sup> For example, the UK published such an article:  
<https://www.ons.gov.uk/releases/resumingafielddbasedpricecollectionforconsumerpricestatistics>

2.74 Following on from this, the identification and treatment of quality change will be of increased importance in a post-lockdown price collection. There may be a shift in the quality of products when comparing the pre and post lockdown collections, and the NSO should ensure there is consistency in how the quality change is treated. While the *CPI Manual* provides full details of accounting for quality change in chapter 6, of particular note following a period of lockdown are as follows:

- There is unlikely to be a ‘one rule fits all’ solution for dealing with changes in quality. The NSO should be mindful of the principles that underpin the compilation of a CPI. A change in price should not be used as the basis for deciding if two products are comparable or not. The price collector should consider any differences in the product characteristics or conditions of supply post lockdown to make any decision on quality change.
- Given that the impact of a pandemic and lockdown restrictions may lead to quite frequent changes to the quality and availability of products that were available pre-lockdown, it may be increasingly difficult to both identify and quantify a change in quality from the perspective of the CPI. In such cases, where the change in quality cannot be explicitly accounted for, it should be implicitly considered (by using traditional approaches such as bridged overlap or class mean imputation).

2.75 One of the main quality issues that will present itself to price collectors on the return to regular price collection is the inclusion of Covid-19 related fees, which were not present pre-lockdown. This may be particularly apparent in personal services, such as haircuts, where costs for personal protective equipment or sanitization material is added to the price. As a general rule, as explained in section 2.5, for the lockdown period, these additional costs should be reflected as a price increase in the CPI, reflecting the fact that the consumer must pay this additional charge to consume the good or service. This rule applies if the underlying product is deemed as sufficiently comparable to the pre-lockdown product.

2.76 The lockdown period may have a significant impact on the purchasing habits of consumers. This may lead to a shift in the type of product being purchased that may not typically be included in the CPI. For example, in response to the Covid-19 pandemic, face masks and sanitization products such as hand gel have gained importance. The NSO should consider such cases and determine if the shift in consumption for a particular product is likely to be sustained. Should the shift in consumption mean that the current sample of products being collected is unrepresentative, then the NSO can account for this through the selection of replacement products or in extreme circumstances by resampling. The process of resampling can be carried out mid-cycle if the current set of products are no longer representative and their continued inclusion is likely to have a detrimental impact on the CPI. Resampling mid-cycle should only be carried out when deemed essential by the NSO, and it should be remembered that prices for the new sample must be available for two consecutive periods to allow for the chaining of the new sample into the previous basket. The new sample of products should remain consistent with the other products in the existing elementary aggregate.

2.77 An unfortunate implication of a period of sustained lockdown is that some outlets will be forced to permanently cease trading. As a result, when price collection resumes the outlet will no longer be available for price collection and this could lead to a permanent loss of sample size and quality in the CPI. Where possible, the NSO should try and identify any store closures, either through using (amongst others) reports in the media, trade websites or through their price collection field force in advance, and follow the usual processes for sample replacement as described in chapter 4 of the *CPI Manual*.

2.78 Following lockdown, there are likely to be specific issues with recommencing price collection for services such as air travel, package holidays and accommodation services. In July 2020, Eurostat<sup>1</sup> issued

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<sup>1</sup> [https://ec.europa.eu/eurostat/documents/10186/10693286/HICP\\_lifting\\_lockdown\\_measures\\_guidance.pdf](https://ec.europa.eu/eurostat/documents/10186/10693286/HICP_lifting_lockdown_measures_guidance.pdf)



guidance related to the resumption of price collection in these areas noting that as prices become available, the market situation is likely to be different from the one before the onset of lockdown restrictions. To summarize the advice:

2.79 Air travel is likely to be one such service where the reintroduction of regular collection may cause issues for the NSO. As a general rule, observed prices should be included in the CPI in the month in which the service resumes. For services such as air travel, prices are typically collected in advance (such as 1-month, 3-months and 6-months). Where prices have been collected in advance, for example before the onset of lockdown restrictions they should be included as long as the actual service is supplied.

2.80 If the price collection scheme for services such as air travel is considered to no longer be representative of current (post lockdown) consumer behaviour, and if the current consumption changes are considered to persist, the price collection should be reviewed by the NSO. Any changes in the price collection, such as collection one month in advance instead of three or if changes in travel dates are associated with changes in quality then, in line with CPI principles, they should be subject to quality adjustments. However, quantifying the change in quality attached to such changes in booking specifications are likely to be difficult and as such, these changes may have to be ignored by NSOs.

2.81 Where such changes have occurred, the ideal solution would be to explicitly value the quality difference between the old and new products to adjust the price however, it is acknowledged this is likely to prove very difficult. The direct comparison approach should be used when differences between the old and new products are considered not to be substantial, or when these differences are difficult to quantify. In each case, the NSO should consider the most suitable approach.

2.82 In some cases, a service may be gradually introduced after the lockdown. This could mean that the price collection sample is based on both observed prices and a proportion that are still missing, so need to be imputed. In such cases, if enough prices can be observed for services that are consumed, then preference should be given to the imputation of the missing prices with the price change of the available services. The NSO should closely monitor the availability of observed prices and how representative these are. If the number of observed prices is deemed to be insufficient by the NSO, then imputation methods, as detailed in chapter 3 should be used.

## 2.9 Making price collection more resilient in the long-term

2.83 The lockdown following the Covid-19 pandemic demonstrated that relying on only one or few data sources and collection modes exposes the CPI compilation to risks when these are no longer available or not available to the same extent. This was in particular the case with field price collection that in many instances could not be carried out. NSOs' efforts to investigate and utilise new data sources and collection modes was crucial to ensure enough prices could be collected for the compilation of the CPI. Without the use of alternative data sources and collection modes, the compilation of the CPI would have been seriously hampered and additional imputations would have been required. However, experiences also showed that changing data sources and collection mode require carefully planning and time since it involves changing operational and administrative procedures and data processing steps.

2.84 To develop more resilient production systems in future, CPI compilation may have to be increasingly based on a multi-source and multi-mode approach to data collection. This involves investigating and utilising a range of available data sources and methods in which to collect data for the CPI, including field price collection, internet portals for respondents, scanner data, Internet (manual collection from websites and web scraping), administrative data and other providers of relevant data (e.g. market research institutes), reducing the dependency of any single data source or collection mode.

2.85 Moving toward the use of electronic data sources, including scanner data and price collection from Internet, requires investments in suitable software, training of staff and adaption of data processing and

calculation steps. Use of multiple sources and multiple data collection modes will require a redesign of the sample and weighting schemes and the way in which collected prices are aggregated into price indices. However, implementation of electronic data sources and collection modes will be crucial in establishing more resilient and efficient data collection.

2.86 The content of this chapter is not meant to be exhaustive but represents the emerging best practices and thinking for the collection of prices during and after a period of lockdown. Key principles running through this chapter are the need for NSOs to remain flexible in response to a price collection during a pandemic, where possible uphold price index principles regarding constant quality and importantly, effective communication with price collectors, outlets, and users.

## 2.10 Key points

- During a lockdown scenario (or a similar shock event) an item/product should be defined as *available* if it is possible for a consumer to purchase it from either outlets that remain open, or via alternative means, such as online, telephone etc. An item/product should be defined as *unavailable* if it is no longer possible for a consumer to purchase it from either outlets or via alternative means, such as online, telephone etc.
- Assuring the health and safety of both the field collection staff and those personnel working in the sampled outlets (where prices are collected) should be the highest priority for NSO. Regular price collection should only resume once it is safe to do so.
- It is good practice for a price collector not to switch between outlets in the field, in the event of a sampled outlet being closed or refusing the price collector access. The prices for the outlet should be treated as temporarily missing until such time that access is resumed.
- Extra charges that are introduced because of the lockdown, for instance for personal protective measures, in general should be included in the price recorded for the CPI. However, if extra charges are clearly optional, they should be excluded from the price recorded for the CPI. Delivery charges that are directly connected to the delivery of the product and not separately invoiced, should be included in the price for the CPI. After the lockdown, when such charges are lifted, a reciprocal treatment must take place to ensure the long-term rate of change of the CPI over the lockdown period is not affected by temporary extra charges during the lockdown.
- The change between the last pre-lockdown price and the first post-lockdown price must be correctly captured in the index, independently of any price collection or imputation applied during the lockdown period. This means that replacement items or imputations applied during the period of lockdown will be discarded and the NSO should aim to collect updated prices for all those goods and services observed in the last pre-lockdown collection.
- Changing data sources and data collection modes usually will involve operational and management decisions and take time. Alternative data sources and collection modes, therefore, should be considered as part of a CPI contingency plan.
- To develop more resilient and efficient production systems in the longer-term, NSOs would need to apply a multiple source and multiple collection mode approach, utilizing available data sources and different methods and techniques for the collection of data.

# Chapter 3 Imputation

## 3.1 Introduction

3.1 Beginning in early 2020, the spread of the coronavirus (Covid-19) worldwide began to disrupt economic markets, creating challenges to NSOs and their CPI business operations. By April 2020, the amount of missing data and input price data that went uncollected due to the pandemic had exponentially increased beyond historic norms. In some situations, supply chains were disrupted preventing inventory from getting to retail locations. Some businesses and retail establishments were closed by order of government mandate. Others were temporarily forced to close due to lack of demand. In other situations, stores and shops were open for business, but CPI data collectors were prevented from traveling and collecting prices on-site for health and safety reasons. In short, the pandemic and resulting lockdowns created an abrupt surge in missing and potentially unusable input data for CPI calculations.

3.2 In order to calculate and publish the CPIs, considerable strain was exerted on the established imputation methods. Could the established procedures fully accommodate the sheer quantum of missing data? Could novel situations brought about by the pandemic be adequately addressed by existing, default imputation mechanisms? Were interventions or new procedures required? In effect, the pandemic had called into question the prudence of long-standing imputation procedures.

3.3 This chapter provides best practices recommendations for CPI imputation during periods of large-scale market interruption. Section 3.2 outlines cases where imputation is needed and discusses definitions of imputations. Section 3.3. presents imputation methods and practical examples distinguishing between imputations for available and unavailable products. The section also provides guidance on the treatment of products with pronounced seasonal price variation and. Section 3.4 suggests a classification for deriving imputation rates. Section 3.5 discusses adjustment for change in data collection mode and Section 3.6 provides a few hints for data validation under lockdown. Section 3.7 discusses the choice of imputation methods, illustrated by examples of decision trees. Section 3.8 summarizes key points of the chapter.

## 3.2 Imputation defined

3.4 By and large, national statistical offices (NSOs) traditionally have relied upon sampling and survey data to gather the requisite information needed to compile the CPI. Over the past decade, NSOs have partially transitioned to the automated capture of high volume, high frequency data (e.g., scanner transaction data, web-scraped prices) to meet input data needs more efficiently. Neither traditional data collection nor alternative data provide the input data with perfection. Both processes result in situations where a required data element is missing (e.g., due to nonresponse) or is unusable (e.g., due to non-sampling errors). For these reasons, NSOs have developed imputation methods and techniques to ensure the calculation of each monthly CPI, while mitigating the impact any missing or unusable input data might have on total measurement error.

3.5 Imputation methods are designed to handle a variety of phenomena governing the availability of consumer goods and services in the marketplace and situations commonly afflicting CPI business operations. These include:

- Item temporarily missing
- Item permanently missing
- Seasonal item

- Collection frequency less than monthly
- Outlet temporarily closed
- Outlet permanently closed
- Outlier observation
- Erroneous (incorrect) observation
- Essential change in quality of observed item

3.6 The term ‘imputation’ can take on several different meanings:

- A procedure of entering a value for a specific data item where response is missing or unusable.<sup>1</sup>
- Replacing either missing or invalid data with accepted data. Normally performed in accordance with predetermined decision rules.<sup>2</sup>
- Estimation of an implied value in a situation where an actual market value does not exist, e.g. imputed market rental value of an owned home.<sup>3</sup>

3.7 In the CPI context, extensive explanation of, and application guidance for, imputation techniques is provided by the *CPI Manual*. The manual does not provide a definition of the broad term ‘imputation’ but the manual’s Glossary of Main Terms defines the specific term ‘imputed price’ as:

“The price assigned to a variety for which the price is missing in a particular period. The term “imputed price” may also refer to the price assigned to a variety that is not sold on the market, such as a good or service produced for own consumption, including housing services produced by owner-occupiers, or one received as payment in kind or as a free transfer from a government or non-profit institution.”

3.8 Figure 6.3 of the *CPI Manual*, reproduced below, provides a comprehensive summary illustration to the treatment of missing prices for CPI calculation.

3.9 The choice of method turns on the objective – what is the goal of imputation in the first place? Under the match-model approach, the immediate objective is to select the best proxy price of the prior period priced product to minimize measurement error. This could be the price of a like-kind, close-match substitute. Or it could be an estimate of the price based on the modelled price movement, usually an average, of highly similar, homogenous products. Or, perhaps the objective is not focused on the measurement of the missing price of just one sampled item; the priority might be to minimize measurement error of an aggregate estimate. For example, one might choose to impute to the mean to minimize variance, even when the best proxy for a particular observation is a different price along the sampling distribution, e.g. the missing observation is characteristic of behaviour in the tails. Thus, the choice of proxy can vary due to the reason why price of the matched item is missing or unusable. The following sections examine best practices prior to the Covid-19 pandemic, and how agencies followed, or deviated, from those practices to handle novel situations exposed by the lockdown.

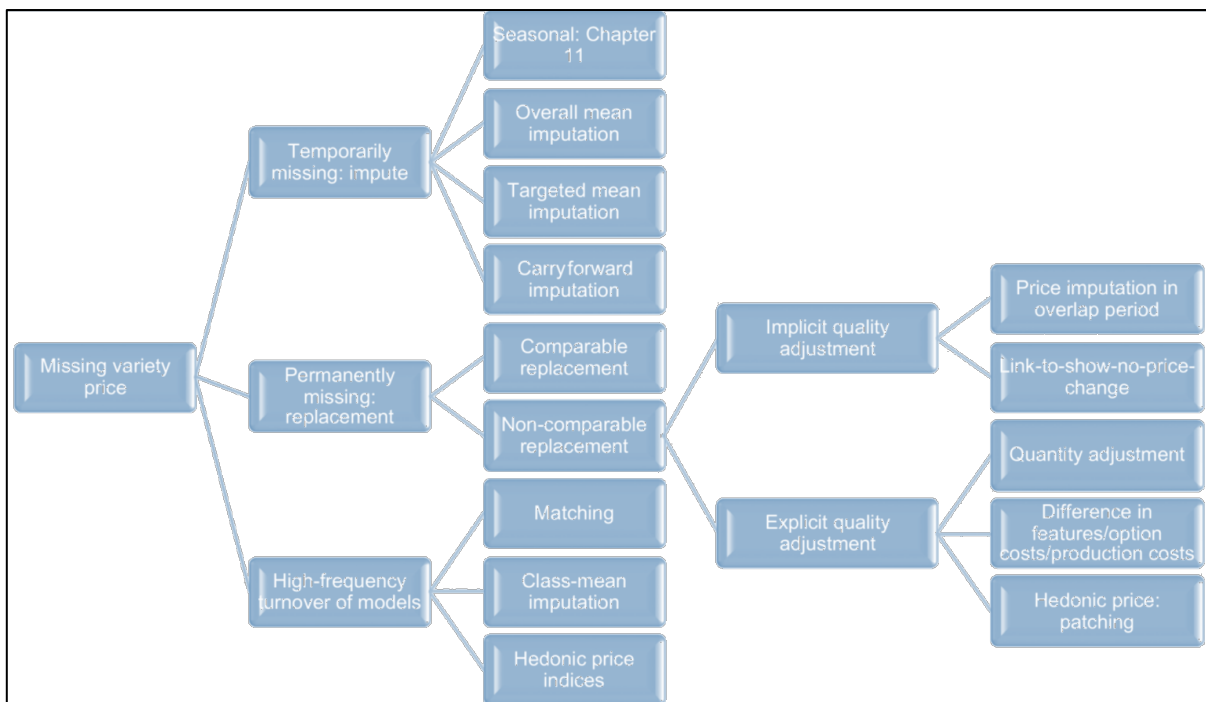
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<sup>1</sup> UNECE "Glossary of Terms on Statistical Data Editing", Conference of European Statisticians Methodological material, Geneva, 2000.

<sup>2</sup> Glossary of Terms, Statistics Canada, <https://www150.statcan.gc.ca/n1/edu/power-pouvoir/glossary-glossaire/5214842-eng.htm#i>

<sup>3</sup> System of National Accounts (2008), ¶13.75, p. 26. <https://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf>

Figure 3.1 **Methods for imputation of missing prices**



3.10 The choice of method turns on the objective – what is the goal of imputation in the first place? Under the match-model approach, the immediate objective is to select the best proxy price of the prior period priced product to minimize measurement error. This could be the price of a like-kind, close-match substitute. Or it could be an estimate of the price based on the modelled price movement, usually an average, of highly similar, homogenous products. Or, perhaps the objective is not focused on the measurement of the missing price of just one sampled item; the priority might be to minimize measurement error of an aggregate estimate. For example, one might choose to impute to the mean to minimize variance, even when the best proxy for a particular observation is a different price along the sampling distribution, e.g. the missing observation is characteristic of behaviour in the tails. Thus, the choice of proxy can vary due to the reason why price of the matched item is missing or unusable. The following sections examine best practices prior to the Covid-19 pandemic, and how agencies followed, or deviated, from those practices to handle novel situations exposed by the lockdown.

### 3.3 Imputation methods

3.11 To discuss imputations during a lockdown it is useful to distinguish between *imputations for available products* and *imputations for unavailable products*. For available products, although the product continues to be transacted, prices can be missing. For example, the specific variety included in the CPI is temporarily unavailable at the sampled outlet, or the sampled outlet is closed altogether, but the variety and similar varieties of that product continue to be sold, perhaps in other outlets. Prices can also be missing because price collection could not be carried out as usual although it continues to be possible for households to purchase the relevant products.

3.12 The situation with unavailable products arises when products are no longer available for sale and there are no transactions of the product on the market. This may happen if markets or outlets are closed, so that certain products are not sold anymore, and select services are simply not available for consumption anywhere. Such kind of lockdown measure may be implemented at a sub-national level, or even at the

national level. Transactions that typically are part of household consumption expenditure cease to exist. Consequently, entire aggregates of the CPI basket could be missing.

### 3.3.1 Imputation for available products

3.13 As stated above, it may happen that a price planned to be used in the CPI calculations is missing and must therefore be estimated. For example, the specific variety to be priced may be temporarily out of stock and therefore a price for that variety cannot be observed. Prices can also be missing if price collection failed, although the specific variety continues to be sold. For example, during lockdowns, statistical agencies may reduce price collection in the field, and it is not always possible to obtain prices through other means. Where a price has not been collected, an imputed price can be obtained by multiplying the previously collected price with an estimated price change. The objective consists in estimating a price change that would have been observed had the product been on offer in the outlet or had the prices data been properly collected.

3.14 The Intersecretariat Working Group on Price Statistics (IWGPS) recommends imputing the missing prices using the price changes of similar products or of the nearest higher aggregate ('nearest aggregate estimation'). For example, it may be possible to collect prices of the same or similar commodities in other outlets or other areas of the country, on which to base the imputation. If an entire elementary aggregate is missing, its prices should be imputed based on the average price change of similar elementary aggregates or the nearest available higher-level price index.

#### Box 3.1 Imputation for available products

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Prices for available products may be imputed by:

- The price changes of comparable products
  - The change of the elementary price index
  - The change of a comparable elementary price index or nearest available higher-level price index
  - Carry forward
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3.15 One practice consists in simply carrying forward past prices. Such a method is usually easy to implement and has the benefit of being transparent and easy to explain. It is however not neutral on the results. The more prices are imputed with carry forward, the more the aggregate monthly price change converges to zero. The IWGPS discourages the use of carrying forward prices unless in duly justified circumstances.

3.16 The example provided in Table 3.1 illustrates imputation within an elementary aggregate (example prepared by UNECLAC). Prices for national lager beer are only observed in supermarkets. The average price change for the three first varieties is used to impute a price for the three missing varieties.

3.17 Imputing with the average change in the prices of the varieties that remain included in the elementary aggregate is equivalent to omitting the missing observation from the calculation. This has practical and variance minimizing benefits, especially for replicate-based variance estimators. This approach does decrease the statistical power of the pool of available data by decreasing the effective sample size. This technique could result in the introduction of a bias.

Table 3.1 Example of imputing within an elementary aggregate

Item code	Level	Outlet code	Description	Specification	Price (t-1)	Price (t)	Relative (t/t-1)	Geometric mean	Variety-Outlet index	Variety index
02.13	Class		Beer							
02.13.0	Subclass		Beer							
02.13.0.1	Product		National beer							
02.13.0.1.1	Variety		National lager							101.09
02.13.0.1.1	Variety-Outlet	101-1	Supermarket 1	Bavaria, bottle	1 090	1 100	100.92		100.92	
02.13.0.1.1	Variety-Outlet	101-2	Supermarket 2	Pilsen 6.0, bottle	770	775	100.65		100.65	
02.13.0.1.1	Variety-Outlet	101-3	Supermarket 3	Imperial, 710 ml can	1 180	1 200	101.69	101.09	101.69	
02.13.0.1.1	Variety-Outlet	103-1	Off-licence 1	Pilsen 6.0, bottle	818	827			101.09	
02.13.0.1.1	Variety-Outlet	103-2	Off-licence 2	Imperial, bottle	1 190	1 203			101.09	
02.13.0.1.1	Variety-Outlet	103-3	Off-licence 3	Bavaria, bottle	1 030	1 041			101.09	
02.13.0.1.2	Variety		National dark beer							
02.13.0.2	Product		Imported beer							
02.13.0.2.1	Variety		Imported lager							
02.13.0.2.2	Variety		Imported dark beer							

3.18 Under lockdown conditions, the number of missing prices may be unusually high. In practice, it may be useful to set a threshold for how many prices should be available before deciding on the imputation rules. For instance, a threshold could be that minimum 20% of prices should be collected. If minimum 20% of prices are collected, the index can be calculated as usual. In many cases this implies that the missing prices are imputed with the average price change of the collected prices. Elementary indices for which less than, say, 20% of the prices are collected should be reviewed and their reliability assessed. If the collected prices are still found to provide a reliable estimate of the elementary index, the missing prices may be imputed by the price development of the observed prices. However, if only few prices are collected and/or the collected price do not provide reliable information about the average price development of the elementary index to which they belong, they may be left out of the index calculation. The elementary index may then be imputed by the development of a comparable elementary index or the nearest available higher-level price index (the parent index). The imputed prices and their impact on higher-level aggregates may also be identified during the validation phase of the CPI production process (see section 3.6).

3.19 Suppose that a subclass<sup>1</sup> (or a more detailed micro-class) is sub-divided by region or by outlet-type. It may happen that within an elementary aggregate (or stratum) all prices are missing. Another, ‘similar’, elementary aggregate could then be used as a basis for imputation. For example, missing prices in one region could be imputed with the price changes observed in a nearby region, or missing prices for a given outlet-type could be imputed with the price changes observed in another outlet-type. In practice, decisions must be made on what is meant by a ‘similar’ elementary aggregate. Such rules could be designed by studying past correlations of price changes. For example, if price changes for a product across different regions are highly correlated (because for example of national pricing strategies), it makes sense to impute missing prices with the prices data collected in other regions of the country.

3.20 If all of this fails and prices for a subclass are missing in all outlets and in all regions, an index from the next level index hierarchy should be used as a basis for imputation. This strategy is based on the idea that products and product groups can be considered the closest substitutes for the non-available products; and they are therefore next to each other in the classification structure used for the CPI.

3.21 In the example in Table 3.2, taken from the IWGPS guidance note, a class consists of three subclasses. The third subclass is missing and is imputed using the combined price change of the first two subclasses.

<sup>1</sup> See figure 8.1 of the *CPI Manual* for an illustration of such an aggregation structure

Table 3.2 Example of imputing a missing subclass

	Weight	Index 100=2019-12			Monthly change in April 2020
		2019-12	2020-03	2020-04	
Subclass 1	0.50%	100.00	103.00	105.00	1.94%
Subclass 2	0.70%	100.00	101.00	102.00	0.99%
<b>Subclasses 1 and 2</b>			<b>101.83</b>	<b>103.25</b>	<b>1.39%</b>
Subclass 3	1.20%	100.00	105.00	106.46	1.39%
Class	2.40%	100.00	103.42	104.86	1.39%

3.22 In general, the donor price change should come from products as similar as possible to the missing product. However, there are trade-offs. A more targeted imputation is likely to ensure a more representative price movement for the missing variety, but it may be less reliable if based on a smaller number of price observations. The average price change derived from a larger number of prices or elementary aggregates may be more reliable, but less representative for the specific variety that is missing.

### 3.3.2 Imputation for unavailable products

3.23 The imputation for unavailable products raises the question of a target price of a product that is not transacted anymore. From a theoretical perspective, Diewert and Fox (2020) argue that the missing prices in the absence of consumer demand correspond to a reservation price. However, the measurement of reservation prices is not straightforward. Reservation prices are typically not implemented as part of the regular CPI production routines.<sup>1</sup>

#### Box 3.2 Imputation for unavailable products

Prices for unavailable products may be imputed by:

- The change of a comparable elementary price index
- The change of the nearest available higher-level price index
- The change of the overall CPI
- Carry forward

3.24 Where an entire aggregate of the CPI is missing, it is important that the imputation method is implemented in a transparent manner. In general, the imputation methods are based on a selection of available, observed, price changes. This type of procedure ensures that the imputations remain consistent with the observed prices data. For example, suppose that the prices for the missing elementary aggregate A are imputed with the average price change of the elementary aggregate B. The combined price change

<sup>1</sup> See Diewert W. E. and K. J. Fox (2020), Measuring real consumption and CPI bias under lockdown conditions, NBER Working paper 27144.



of elementary aggregates A and B is then equivalent to omitting the missing elementary aggregate A from the calculation. The recommendation of the IWGPS is to use one of the following imputation methods.

### Impute with a comparable elementary price index.

3.25 A similar elementary aggregate can be selected, and the price change observed for this be used as a basis for imputation. This method relies on the assumption that the expenditure has been substituted to that similar product group. For example, the price change of drinks in restaurants could be measured with the price change of drinks bought in supermarkets. This procedure ensures that the combined price index of drinks in restaurants and drinks in supermarkets is consistent with a price index without imputations and only consisting of drinks sold in supermarkets. In the absence of relevant expenditure data, judgements must be made in selecting a comparable index.

### Impute with the nearest available higher-level price index

3.26 The CPI baskets are based on hierarchical product classifications, such as COICOP. If an index is missing (for example a subclass index), one could use the next level index in the classification hierarchy (for example the class index) as the basis for imputation (see previous section).

### Impute with the overall CPI

3.27 Imputing off the all-items level corresponds to leaving the missing product out of the CPI calculation. This method can be justified in cases where markets have been closed and where there are zero or only negligible transactions.

3.28 Let  $I_i^{t-1,t}$  denote the month-on-month index of elementary aggregate  $i$  to which a weight  $w_i^{t-1}$  is attached.<sup>1</sup> We suppose that the weights over all elementary aggregates sum to unity. The month-on-month all-items index is derived as the weighted average of the month-on-month indices for the elementary aggregates.

$$I^{t-1,t} = \sum_{i \in N} w_i^{t-1} I_i^{t-1,t} \quad (3.1)$$

3.29 Let us suppose that the set of elementary aggregates  $N$  can be split into ‘available’ elementary aggregates  $A$  and ‘missing’ elementary aggregates  $M$ . Within a missing elementary aggregate, all the prices must be imputed. We denote by  $\hat{p}_j^t$  the imputed price of a product  $j$  in period  $t$  and by  $p_j^{t-1}$  the observed price of the same product  $j$  in the previous period  $t-1$  in such a missing elementary aggregate. We then have the following imputation rule for the missing prices based on the average price change of all available elementary aggregates:

$$\hat{p}_j^t = p_j^{t-1} \frac{\sum_{i \in A} w_i^{t-1} I_i^{t-1,t}}{\sum_{i \in A} w_i^{t-1}} \quad (3.2)$$

3.30 We assume that the formula for the missing elementary index is such that if all prices in period  $t-1$  are multiplied with the same factor to impute period  $t$  prices, the index changes by that factor between  $t-1$  and  $t$ . It follows that for all missing elementary aggregates  $i \in M$  we must have:

$$I_i^{t-1,t} = \frac{\sum_{i \in A} w_i^{t-1} I_i^{t-1,t}}{\sum_{i \in A} w_i^{t-1}} \quad (3.3)$$

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<sup>1</sup> The weights correspond to the weights used in the price reference period that are price-updated to period  $t-1$  and normalized:  $w_i^{t-1} = \frac{w_i^0 I_i^{0,t-1}}{\sum_{i \in N} w_i^0 I_i^{0,t-1}} = \frac{w_i^0 I_i^{0,t-1}}{I^{0,t-1}}$

Then it can be shown that:

$$I^{t-1,t} = \sum_{i \in N} w_i^{t-1} I_i^{t-1,t} = \sum_{i \in A} w_i^{t-1} I_i^{t-1,t} + \sum_{i \in M} w_i^{t-1} I_i^{t-1,t} = \frac{\sum_{i \in A} w_i^{t-1} I_i^{t-1,t}}{\sum_{i \in A} w_i^{t-1}} \quad (3.4)$$

3.31 This result shows that with this specific imputation method, the index boils down to an index without any imputations. In other words, imputing with all available sub-indices corresponds to an implicit reweighting, where the weight of the missing sub-indices is set to zero and the weight of the available sub-indices is rescaled to sum to unity. This implied weighting structure can still differ a lot from the actually observed expenditure pattern during the lockdown periods.<sup>1</sup>

3.32 The imputation with the overall CPI may be the preferred solution. There can be various implementations of this method. For example, only reliable sub-indices, i.e. sub-indices that are not subject to a significant imputation, could enter the calculations of the imputed price change. The regional dimension may also play a role. For example, the imputation could be based on the all-items of a specific region, or on the all-items of the entire country. In reality, the implementation and interpretation of this method is further complicated by the fact that the set of ‘available’ and ‘missing’ sub-indices is changing over time.

3.33 Table 3.3 shows some examples of products (in this case services) that were imputed with respect to the all-items during lockdowns in some countries.

**Table 3.3 Country examples of products imputed with the overall CPI**

Austria (May 2020)	Spain (May 2020)	Australia (June quarter 2020)
<ul style="list-style-type: none"> <li>Recreational and sporting services – Attendance</li> <li>Cinemas, theatres, concerts</li> <li>Museums, libraries, zoological gardens</li> <li>Secondary education</li> <li>Restaurants, cafés and dancing establishments</li> <li>Canteens</li> </ul>	<ul style="list-style-type: none"> <li>Driving lessons, tests, licences and road worthiness tests</li> <li>Passenger transport by sea</li> <li>Recreational and sporting services - Attendance</li> <li>Recreational and sporting services - Participation</li> <li>Cinemas, theatres, concerts</li> <li>Museums, libraries, zoological gardens</li> </ul>	<ul style="list-style-type: none"> <li>Urban transport fares</li> <li>Domestic holiday travel and accommodation</li> <li>International holiday travel and accommodation</li> <li>Sports participation</li> <li>Other recreational, sporting and cultural services</li> </ul>

Data sources: Austria, Spain: <https://ec.europa.eu/eurostat/web/hicp/methodology>

Australia: <https://www.abs.gov.au/articles/methods-changes-during-covid-19-period#measuring-the-consumer-price-index-during-a-time-of-covid-19>

### 3.3.3 Products with pronounced seasonal price variations

3.34 The prices of some products are known to follow pronounced seasonal patterns. Examples are flights, package holidays, or accommodation services. Such seasonal patterns may not be reflected using the month-on-month price change of available products. This can be achieved, for example, by imputing with the annual rate of change of available products<sup>2</sup>. Another strategy to respect seasonal patterns consists in imputing with the monthly price change of the seasonal product observed one year ago. By respecting the seasonal pattern of the series, the impact of the imputations on the annual rate of change at the all-items level is minimized. A consequence of repeating past seasonal behaviour is that the monthly price changes during the lockdown will reflect market developments seen under normal circumstances.

<sup>1</sup> See also Diewert and Fox (2020) for the impact of ‘inflation-adjusted carry forward’ prices

<sup>2</sup> See Appendix in Statistics Sweden (2020) for a formalization of this method

3.35 The impact of possible seasonal patterns of the series on imputation is best shown by the example in Table 3.4 (presented in the IWGPS guidance note).

**Table 3.4 Imputation for products with a seasonal pattern**

	2019		2020	
	March	April	March	April
All-items excl. accommodation services	100.0	100.5	102.0	103.5
Monthly rate of change				1.5%
Annual rate of change				3.0%
<b>Option 1: Imputing with the monthly rate of change of all items excl. accommodation services</b>				
Accommodation services	100.0	112.0	101.0	101.0* 103.5/102.0 = <b>102.5</b>
Monthly rate of change				1.5%
Annual rate of change				-8.5%
<b>Option 2a: Imputing with the annual rate of change of all items excl. accommodation services</b>				
Accommodation services	100.0	112.0	101.0	112.0* 103.5/100.5 = <b>115.3</b>
Monthly rate of change				14.2%
Annual rate of change				3.0%
<b>Option 2b: Imputing with the monthly rate of change of accommodation services one year ago</b>				
Accommodation services	100.0	112.0	101.0	101.0* 112.0/100.0 = <b>113.1</b>
Monthly rate of change				12.0%
Annual rate of change				1.0%

3.36 In the European Union<sup>1</sup>, the decision was made to adopt an imputation that preserves the integrity of the seasonal pattern. This choice had significant consequences on results. An index derived solely from using a carry forward imputation mechanism would have resulted in significant lower inflation rates in the Euro Area<sup>2</sup>.

### 3.3.4 Seasonal products

3.37 To the extent possible, seasonal products should be treated as they normally are. Prices of out of season products should be imputed using one of the imputation methods described in chapter 11 of the *CPI Manual*. Compilers should be aware that a lockdown may change the month in which a seasonal product is re-introduced in the index. For instance, a given type of fresh fruit may usually be entered in the CPI calculation in June. However, because of a lockdown it may only be possible to collect prices from, say, August. Such cases may have an impact on the CPI that differ from the usual seasonal pattern.

<sup>1</sup> See Eurostat (2020)

<sup>2</sup> See Lamboray et al. (2020)

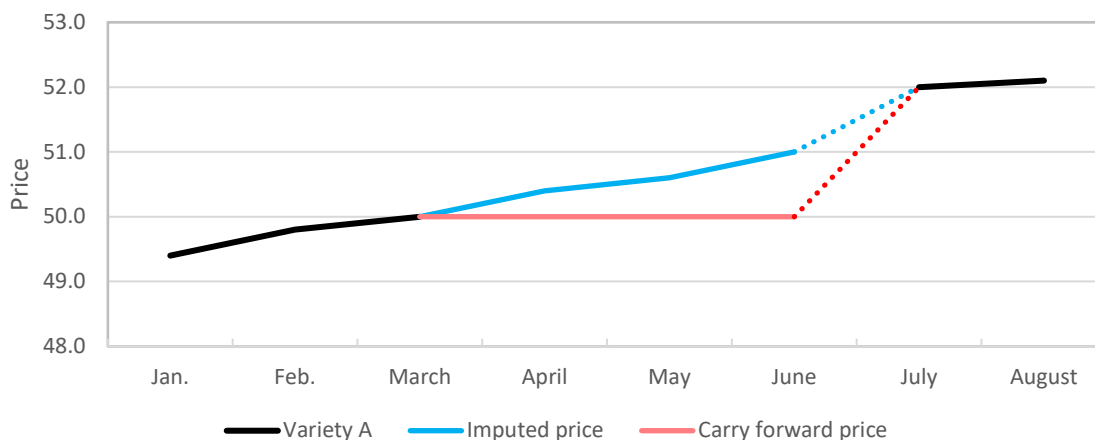
### 3.3.5 Imputation periods

3.38 Under normal circumstances, prices for temporally missing varieties are imputed only during a limited period (for example 2 to 6 months) before they are substituted with a replacement variety. Under lockdown, a more flexible approach is warranted regarding the length of imputations. Prices of products may be imputed for much longer. Moreover, with a continuous tightening and relaxation of restrictions, imputation patterns can become quite irregular and complex. For example, after a first lockdown period, prices may become available for some time before being unavailable again thereafter.

3.39 An important principle is that the imputation of a given sampled item should be 'self-correcting'. This means that the long-term price change in the first period after the lockdown compared to the last period before the lockdown is correctly reflected, irrespective of how prices in the interim are imputed. Box 3.3 illustrates self-correction with an example. Given the uncertainties of the imputations, this can sometimes lead to an unusual price change between the last imputed price of the lockdown period and the first observed price of the post-lockdown period. However, it may be difficult to explain such technical price changes to users.

#### Box 3.3 Self-correction

In April variety A disappears from the market. The last observed price in March is 50. The variety reappears in July at a price of 52. From March to July this is an increase of 4%, or an index of 104 ( $52/50 \cdot 100$ ).



	Jan.	Feb.	March	April	May	June	July	August
Variety A	49.4	49.8	50.0				52.0	52.1
Imputed price			50.0	50.4	50.6	51.0		
Carry forward price			50.0	50.0	50.0	50.0		

The missing price may be imputed with a suitable price index that is available. In the example, this leads to an imputed price of 51 for variety A in June. The change from the last imputed price in June to the observed price in July (52), an increase of 1.96%, must be included in the calculation to ensure the index reaches the correct level in July. When all short-term, monthly price relatives are chained into a long-term index, the index will show the correct price development from March to August ( $50.4/50 \cdot 50.6/50.4 \cdot 51/50.6 \cdot 52/51 = 52/50 = 1.04$ ).

If the price is carried forward, the same principle applies. In this case, the change from the last carry forward price in June (50) to the observed price in July (52), an increase of 4%, must be included in the calculation to arrive at the correct level of the long-term price index in July ( $50/50 \cdot 50/50 \cdot 50/50 \cdot 52/50 = 52/50 = 1.04$ ).

3.40 Self-correction must also be ensured in the treatment of extra charges and fees that temporarily have been introduced during a lockdown. Suppose pre-pandemic a burger was priced at a restaurant for \$10. Then, after lockdown, the price was obtained online from the restaurant's website, for \$15 including a \$4 delivery fee. Under the match-model approach the \$4 delivery fee would be discarded and leaving a price of \$11. If the mode change was considered comparable, then no further quality adjustment should be made and the price of \$11 recorded for the index calculation, even though the \$1 mark-up could cover the restaurant's cost for operating the website. Upon return to pricing the burger at the restaurant when the lockdown is lifted, then this mode change must be treated reciprocally as comparable without quality adjustment.

3.41 In practice, there are additional complications. For example, it may happen that prices are imputed until the end of the planned pricing cycle of a product in the index. At that moment, the imputations simply stop and there is no self-correcting adjustment. It may also happen that the selection of a variety is not possible at the planned period of initialisation and, consequently, no price can be collected. One solution consists in inserting a notional price for that variety in the missing periods based on the imputed price movements once price collection is successful<sup>1</sup>.

### 3.4 Compiling the imputation rate

3.42 When compiling 'imputation rates' for CPI price data, a definition of what constitutes an 'imputed' price is needed. Under one approach, only imputation of temporarily missing prices are included in the calculation of the imputation rate. Under an alternative view, imputation of permanently missing items could also be included. This distinction has consequences. Under the first approach, e.g., the imputation rate for CPI in the U.S. was 12.2 percent in the six-month period from April to September 2019. Thinking somewhat more broadly and including as imputation also all situations where the price of the previous month match-model was not collected, e.g. because of bimonthly pricing or because a substitute replacement item was selected, then one arrives at an imputation of 40 percent. During the first part of the pandemic period (April to September 2020), the rate of imputation at the narrower definition was 24% compared to 52% at the broader definition in the U.S. Moreover, if a change in the mode of collection (e.g., from in store to internet) is also considered an impute, then the imputation would leap up to 90% for the U.S. during lockdown. Hence, the definition matters to public perception, and in adjudicating whether sufficient prices have been observed to publish aggregate indexes (see chapter 5).

3.43 Under the traditional match-model approach to index estimation, Table 3.5 itemizes eight possible different classification of a CPI sample categorized by price collection outcome that are used by the Bureau of Labor Statistics (BLS), with hypothesized sample sizes for illustration.

3.44 Response rate is typically defined as  $(a+b+c+d+e)/(a+b+c+d+e+f) = 87.5\%$ . The subset of the sample where collection is not attempted is usually excluded from the ratio, because behavioural scientists are interested in the response action to the active survey collection. The bilateral classification of the sample into response-nonresponse outcomes (87.5%-12.5%) is slightly different than the bilateral classification of the sample into observed-imputed data.

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<sup>1</sup> See section 6 of ONS (2021) for a discussion on this issue in the UK.

Table 3.5 Classification of sample used for CPI index calculation

Total sample targeted for calculation		100,000
Price observed (collected)		
a	Same item as previous month, price used	65,000
b	Same item as previous month, outlier price not used	250
c	Substitute item - comparable, price used	2,000
d	Substitute item - quality adjusted, price used	1,500
e	Substitute item - noncomparable, price not used	1,000
Price unobserved (not collected)		
f	Collection attempted, price unobserved	10,000
g	Collection unattempted by design, off-cycle	20,000
h	Collection unattempted by design, permanent	250

3.45 Under a very broad interpretation, the imputation rate could be defined as  $(b+c+d+e+f+g+h)/(a+b+c+d+e+f+g+h) = 35\%$ . This is not closely tethered to the nonresponse rate and could be misleading to users. A narrower definition of the imputation rate is recommended as  $(b+e+f+h)/(a+b+c+d+e+f+h) = 14.4\%$ , which is more in sync with the nonresponse rate of 12.5%. The narrower definition treats substitute items, for which a usable, if adjusted, price was obtained, as a non-impute. In the abstract, one could posit the price of the substitute item, while not precisely the price of the same unique item as required for calculation, is an exact proxy of what the price of the same item would have been, such that it equates to the targeted observed price and not an 'imputed' price.

3.46 In a similar fashion, if the price of an item is intended to be collected in-store, but a data collector is prevented from visiting the store to observe the price, and instead observes the price online for the exact same item from the exact same retail company, this can be viewed as merely a change in the mode of collection, or a trivial change in the attributes of the unique item, essentially classifying the price as a match-model price. The extension of this argument, then, is that a comparable item, although a variant item and not a genuine match-model, is by definition a perfect match for quality purposes. Hence, its price should be regarded as the observed price of the match, and not an impute.

3.47 Where an entire aggregate of the CPI is missing, it is important that the imputation method is implemented in a transparent manner. In general, the imputation methods are based on a selection of available, observed, price changes. This type of procedure ensures that the imputations remain consistent with the observed prices data. For example, suppose that the prices for the missing elementary aggregate A are imputed with the average price change of the elementary aggregate B. The combined price change of elementary aggregates A and B is then equivalent to omitting the missing elementary aggregate A from the calculation. The general recommendation of the IWGPS is to use one of the following imputation methods.

3.48 To estimate the share of consumption expenditure that is imputed, the imputation rates for the elementary should be weighted using the weights attached to these elementary aggregates. This was the approach taken by Eurostat<sup>1</sup> and European countries when disseminating imputation rates at an aggregate level (for example all-items level). The calculation of imputation rates is illustrated in Table 3.6.

<sup>1</sup> Imputation rates can be found at the following website <https://ec.europa.eu/eurostat/web/hicp/methodology>

Table 3.6 Calculation of imputation rates

	Nbr prices (Total)	Nbr prices (Imp.)	Weight	Imputation rate (weight)	Imputation rate (number)
Total	420	120	100%	$(60\%*13\%+40\%*92\%)/100\%=$ <b>45%</b>	$(20+100)/(300+120)=$ <b>29%</b>
Aggregate 1	300	20	60%	$(20\%*40\%+40\%*0\%)/60\%=$ <b>13%</b>	$(20+0)/300=$ <b>7%</b>
Elem. Aggr. 1.1	50	20	20%	40%	$20/50=40\%$
Elem. Aggr. 1.2	250	0	40%	0%	$0/250=0\%$
Aggregate 2	120	100	40%	$(15\%*80\%+25\%*100\%)/40\%=$ <b>92%</b>	$(80+20)/120=$ <b>83%</b>
Elem. Aggr 2.1	100	80	15%	80%	$80/100=80\%$
Elem. Aggr 2.2	20	20	25%	100%	$20/20=100\%$

### 3.5 Change in data collection mode

3.49 Alternative collection modes can be used in case of failure of the regular price collection in the field. For example, prices previously collected in outlets are now obtained from the web, over the phone, or from transaction data that may be available to the statistical agency.

3.50 There are different ways to interpret and treat such a change in data collection mode.

#### Directly compare the prices of the different collection modes

3.51 This approach relies on the assumption that the price collected under the new collection mode is a reasonable estimate of the price that would have been observed in the same period under the previous collection mode. The way that the product is supplied could differ. There could be, for example, shipping costs or take-out fees that must be deducted from the price observed with the new mode. Alternatively, one could also argue that some of these extra charges should be taken into account and recorded as a price increase on the grounds that it is not possible to obtain the product without the payment of the additional charge.

#### Make a quality adjustment between the prices of the different collection modes

3.52 One could argue that the product sold in an outlet is of different quality than a product sold on the web. In addition to possible changes in the specifications of the product that is priced, changes in the way that the product is supplied contributes to changes in the quality of the product. There is a need to decide if price differences observed from the different collection modes should be treated as genuine price changes or as a change in quality. Explicit quality adjustment methods remain difficult to apply in such circumstances. Therefore, implicit quality adjustments methods are applied in practice.

#### Resampling

3.53 During a lockdown there may be a shift towards online purchases. Products typically not covered by CPI (e.g. face masks and disinfectant) suddenly gain importance. New outlets (for example web stores) and new products (either in already selected or in newly selected outlets) could be introduced into the

index through re-sampling. Ideally, sample rotation could be implemented without further delay in order to capture the changes in consumption. In practice, it may only be possible to update samples following the normal sample rotation schedule which could even be delayed due to logistical problems caused by the lockdown.

## 3.6 Data validation

3.54 Additionally, analysis of outliers may be helpful to eliminate possible measurement errors and/or non-representative price quotations. This is especially important when the total number of registered prices is low, due to unavailability of items or outlet closure. Under such circumstances even one outlier may distort the total index significantly. Outlier analysis can be performed using median price ratios and standard deviations, quartiles, or a Tukey algorithm and other more advanced methods.

3.55 For example, in the U.S. BLS, a semi-automated data review process automatically flags certain sampled items for manual review, if the price change of the item is outside established tolerances levels, set by historical standard error data. Upon review, if a non-sampling error is detected, e.g., a misclassification of the product into the wrong item category, or a keying error, and the error cannot be corrected in time for publication, then the analyst can remove the item from index calculation and it will be imputed. If the price and all price adjuncts are verified as correct, the price is usually accepted for index calculation. Price changes are winsorized such that each one-month price relative for a sampled product is bounded between  $0.05 \leq r \leq 20$ .

3.56 However, outlier analysis should be conducted with caution to avoid unjustified price deletion. Possible interventions NSOs may take in response to outlier detection include (1) to accept the outlier price as is, (2) modify the price based on auxiliary information that might suggest a non-sampling error has contributed to a wrong price, or (3) to convert the outlier price to missing so that it can be imputed.

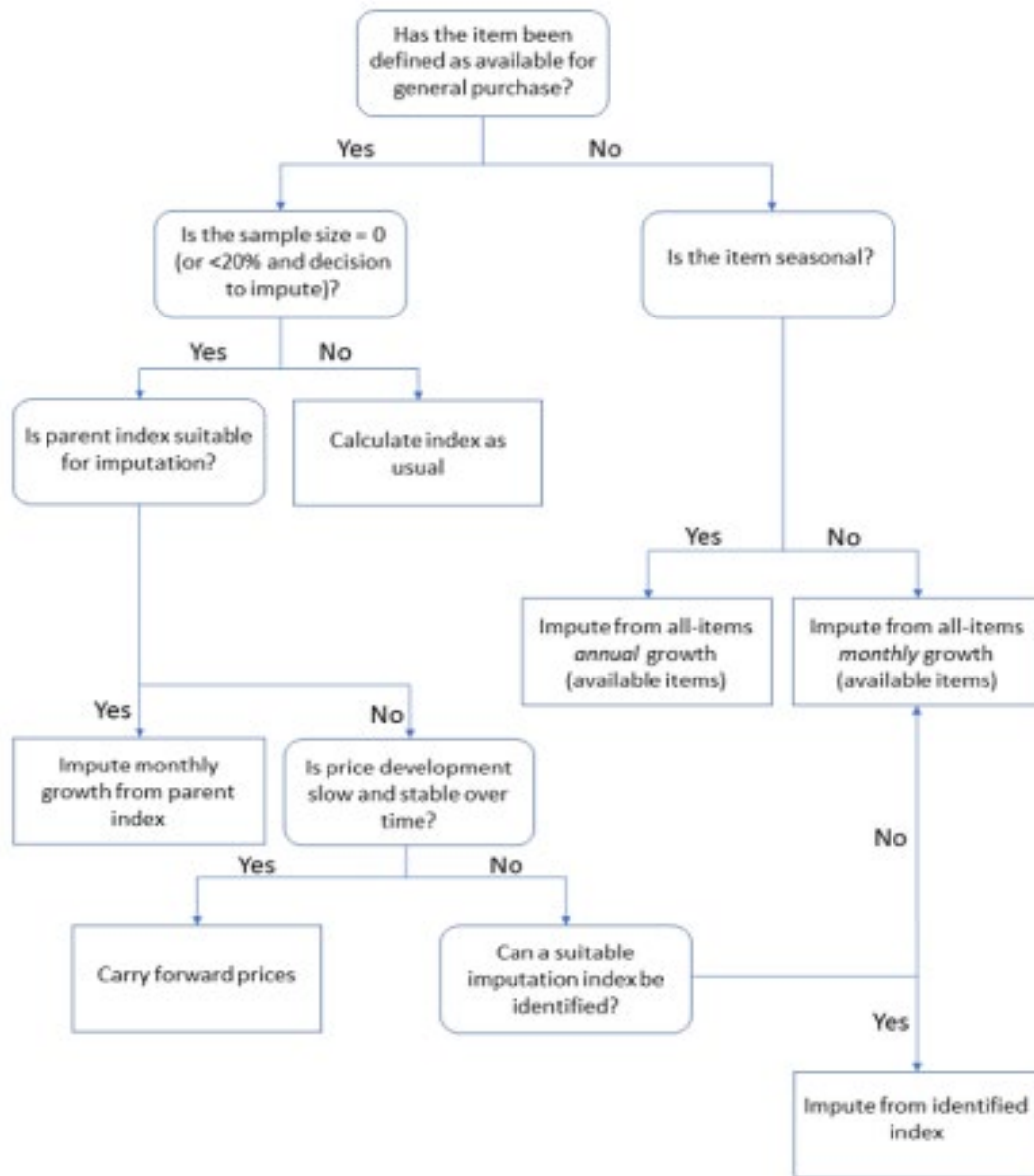
## 3.7 Choice of imputation method

3.57 Given the variety of possible imputation methods, decisions must be made about which imputation method is used for which product. Decision rules or principles can be formalized to make the imputation process more organized and transparent. Even if the decision process is structured, judgements must still be made by the NSO at the different stages, for example for the selection of a specific donor index.

3.58 In response to the lockdown, the ONS developed an imputation policy as represented by the decision tree in Figure 3.2. For available items a threshold for the minimum size of the sample helps to decide if missing prices should be imputed as usual, or if special lockdown procedures for imputation should be applied. The threshold is calculated at the first suitable level of aggregation, which may be at the level of elementary indices or below that. If the number of prices is too low, or if all the prices of the elementary aggregate are missing, then the prices are estimated using an appropriate imputation method. Depending on circumstances, imputation can be based on the parent index, or carry forward may be applied. If none of these strategies is suitable, any other donor index, including the all-items index, may be used instead. Items that are not available anymore for general purchase are imputed using either the annual (for seasonal items) or the monthly (for non-seasonal items) rate of change observed for the available items.



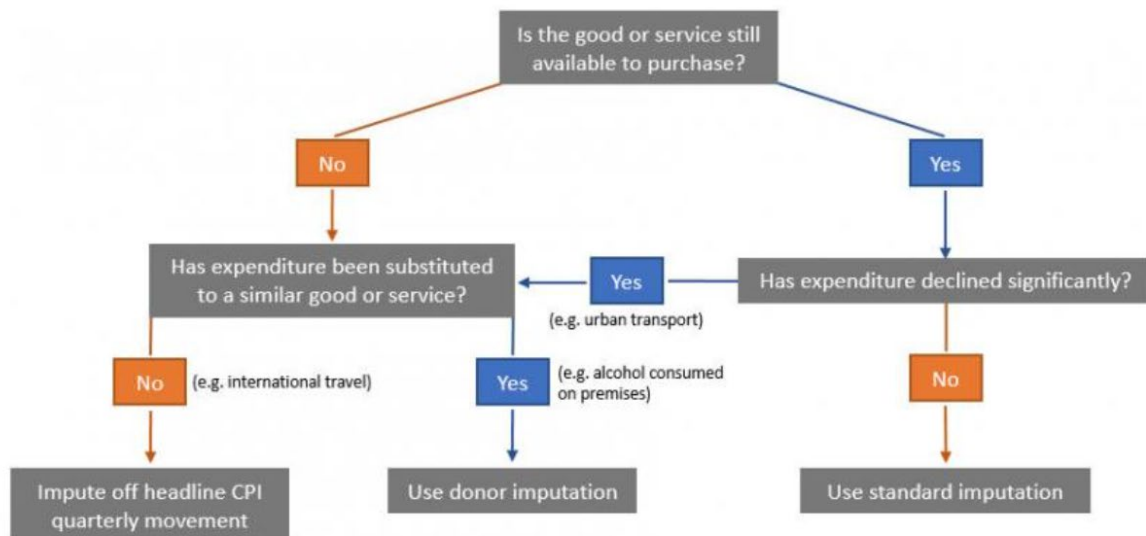
Figure 3.2 Decision tree (Office for National Statistics, United Kingdom)



3.59 Another decision proposed by the Australian Bureau of Statistics is shown in Figure 3.3<sup>1</sup>. In this example, standard imputation methods are used for products that are still purchased in sufficient amounts. In the other cases, the imputations are based on a substitute product where possible and otherwise on the overall CPI. For example, it could be assumed that households have substituted alcohol consumed on premises to takeaway alcohol. In such a case, the price change of takeaway alcohol (the ‘donor’) is used to estimate the price change of alcohol consumed in the restaurants. When it is not possible to identify a donor index, imputation is applied with respect to the headline CPI.

<sup>1</sup> See <https://www.abs.gov.au/articles/methods-changes-during-covid-19-period#measuring-the-consumer-price-index-during-a-time-of-covid-19>

Figure 3.3 Decision tree (Australian Bureau of Statistics)



3.60 Other statistical agencies have developed similar decision support tools or rules not necessarily formalized in a decision tree. Box 3.4 includes an example by Bureau of Labor Statistics, United States.

#### Box 3.4 Imputation decision model of the Bureau of Labor Statistics (BLS)

The BLS uses the following hierarchical model for deciding on imputation:

- (1) If at least one price quote is available within the item-area cell, impute from within the same elementary item-area cell – usually via a cell-mean or from a similar response from the sample.
- (2) If no source sample is available in the home cell, impute from the exact same item in a different but similar city. Identification of ‘similar’ items and areas are predetermined in a concordance parameter file.
- (3) if all imputation source pools are empty in (2) then impute via carry-forward.

During the Covid-19 crisis, the large majority of cases were handled using rule (1), whereas the remaining cases managed to be treated using rule (2). Carry forward (rule 3) happened to be used only on very rare occasions. These decision rules favoured imputations of the same item across different regions, instead of moving up in the index hierarchy. Carry forward was seen as a method of last resort.

3.61 It is up to the statistical office to set suitable thresholds on the share of available prices within an aggregate when making decisions on imputation methods. The threshold should be high enough to ensure that the resulting indices have the necessary quality. A common threshold for all elementary indices is easy to implement and monitor but requires careful assessment of the resulting list of products or elementary aggregates that do not meet the minimum requirement. In addition to the proportion of prices that are collected, also the divergence in expected price changes and the weight of the elementary index should be considered. It may be easier to accept a larger share of missing observations for elementary indices that consists of products with expected similar price movements and for elementary indices with relative low weights. In all cases it is helpful to consider the potential impact of imputed prices on the CPI.

### 3.8 Key points

- The imputation strategy for available products should follow a bottom-up approach considering the reliability of the imputations. The imputations could be based on the average price change of all, or of a subset of available items within the same elementary aggregate. As a next option, the imputation could be based on the price change of a close elementary aggregate. Otherwise, the imputation could be derived from the price change of the parent index in the index hierarchy.
- Specific imputation methods could be considered for products that are not transacted anymore during a lockdown. Options include imputing with a comparable elementary price index, or with the nearest available higher-level price index, or with the overall CPI.
- It is important that the imputation methods are self-correcting. The self-correcting principle ensures that the imputations do not introduce a permanent bias into the index after the lockdown. Similarly, a change in the collection mode or in the specification of the product during the lockdown and a subsequent return to the initial collection mode or product specification after the lockdown should be treated in a symmetric manner.
- NSOs should develop consistent metrics to monitor the extent of imputations in the CPI. The definition of imputation rate for public disclosure should fit with related quality metrics such as official response rate definitions and published response rates.
- Statistical agencies should develop and communicate to users a comprehensive imputation policy. These methods and rules should be implemented in the CPI production systems so that they can be applied at any moment. In addition to standard non-response encountered in a CPI, such a policy should consider the possibility of major disruptions such as those seen during the COVID-19 crisis.



# Chapter 4 Weights

## 4.1 Introduction

4.1 While the focus of imputation is typically on the price side of the CPI calculus, it is important not to neglect the impact of missing or unusable expenditure data. The global pandemic caused abrupt changes in spending behaviour as consumers reacted by stockpiling many grocery items and household supplies. In other cases, consumers were prevented from purchasing many services due to local, regional, and national lockdown orders. In some cases, these sudden changes persisted for several months and remain sustained throughout the pandemic, resulting in level-shifts in spending time-series data. This shock to an otherwise historically relative stable pattern of consumer expenditures could undermine the integrity of a CPI which relies upon lagged weight data and fixed assumptions about consumer utility.

4.2 Section 4.2 briefly explains about the possible impact of a lockdown on the CPI though a change of expenditure weights. Section 4.3 discusses the challenges of deriving weights for future CPIs based on data from the lockdown period and presents examples of different approaches. Session 4 summarizes key points.

## 4.2 Impact on weights of the lockdown

4.3 Most CPIs are based on annual weights. A CPI based on annual weights shows the monthly change in the price of buying the same annual fixed basket. This is conceptually clear but requires use of estimated/imputed prices for products that are not available throughout the year. It is recommended to keep expenditure weights fixed adhering to the regular schedule for updating weights. Changing expenditure weights within a year is not consistent with the fixed basket approach and will make it difficult to interpret the CPI since changes may be caused by changes both in prices and in expenditure weights.

4.4 Ad hoc changes of the weights may also be questioned and may harm the credibility of the CPI. While it is recommended to keep expenditure weights constant it should be noted that imputing missing elementary indices with the all-items CPI corresponds to leaving these out of the CPI compilation, i.e., setting their weights equal to zero and rescaling the weights of the remaining elementary indices to sum to unity (see section 3.3.2).

4.5 Most NSOs calculate the CPI and all higher-level price indices as the expenditure weighted average of the elementary aggregate indices. The weight reference period will usually refer to a year, or an average of several years, that precedes the period in which they are introduced in the CPI. Due to this lag, the weight data used as input to CPI calculations had already been collected and processed prior to the emergence of the pandemic.

4.6 However, the changes in the relative budget shares of consumers brought about by the pandemic were perceived to be significantly larger than normal, calling into question the integrity of the underlying assumptions used to weight the CPI. The issue, then, was whether an NSO should employ some sort of intervention or weight adjustment to realign the lagged spending weights with current conditions.

4.7 Under normal conditions, expenditure weights are relative stable. From year to year changes in the weights usually have only little effect on the overall CPI. Changes in the weights only impact the overall CPI to the extent that the price development of products differ from the average price development. In the hypothetical case where all elementary indices increase by the same rate of change, the weights will

have no influence on the overall CPI at all. Even though this is an unlikely scenario, it highlights the fact that the CPI can be statistically robust to weight variance or large swings in component budget shares alone. To impact the overall CPI, changes in weights must be accompanied by changes in relative component prices.

4.8 Assume, for illustration, that we have two sets of weights,  $w_A^i$  and  $w_B^i$ , for the same one set of elementary price indices,  $P^i$  (for example updated weights and the previously used weights). We can then calculate two CPIs,  $P^A$  and  $P^B$ , by aggregating the elementary indices with the two sets of weights. Subtracting these two indices shows the effect of the weights on the overall CPI:

$$\begin{aligned}
 P_{0:t}^A - P_{0:t}^B &= \sum w_A^i \cdot P_{0:t}^i - \sum w_B^i \cdot P_{0:t}^i \\
 &= \sum (w_A^i - w_B^i) P_{0:t}^i \\
 &= \sum (w_A^i - w_B^i) (P_{0:t}^i - \bar{P}_{0:t}) + \bar{P}_{0:t} \sum (w_A^i - w_B^i) \quad (4.1) \\
 &= \sum (w_A^i - w_B^i) (P_{0:t}^i - \bar{P}_{0:t})
 \end{aligned}$$

where  $\sum w_A^i = \sum w_B^i = 1$  and  $\bar{P}_{0:t}$  is the average price change from 0 to  $t$  ( $P_{0:t}^A$  or  $P_{0:t}^B$ ).

4.9 The calculation in (4.1) illustrates that differences in weights only affects the overall CPI to the extent price changes differ. If an elementary index is identical or very close to the average price development, changes in its weights will have no influence on the overall CPI. This also gives a hint to be careful with the treatment of products with particular price developments, e.g., products with pronounced seasonal price variations, since these potentially may have large effects on the overall CPI.

### 4.3 Estimation of weights for future CPIs based on data from lockdown periods

4.10 Moreover, as weights are periodically updated, eventually the time period encapsulating the pandemic would be used as the reference period for future CPI calculations. Would it be appropriate to select the pandemic period as a base-period to represent future CPI calculations? This section provides a summary of how select NSOs responded to this issue and corresponding guidance issued by select oversight agencies.

4.11 Eventually, consumption expenditure data for 2020 will be used for deriving the weights of future CPIs. Because of the lockdown the weights may be unusual, which can justify a special treatment. The *CPI Manual* recognizes problems with unusual weight reference periods (paragraphs 3.72-3.75). It is preferable to choose a “normal” consumption period as the basis for weights and avoiding periods in which there are special factors of a temporary nature at work. To arrive at “normal” weights, the manual suggests adjusting the data to overcome irregularities by e.g. smoothing erratic data or taking averages of more than one year. If the 2020 weights will be used to compile the CPI for, say, 2022-2025 it can also be argued that the weights should be as representative as possible for the average consumption expenditure pattern of this period. It may be necessary to carefully examine the weights of goods and services that have been particularly affected by the pandemic, for example for such markets that have been closed. In these cases, additional adjustments of the weights may be justified. Possible adjustment techniques include using 2019 data instead of 2020, composite estimating or averaging 2020 data with prior period data to smooth out outlier changes or forecasting 2020 data from historical time series.

## EUROSTAT

4.12 The HICP is an annually chained Laspeyres-type index. Each year, the weights are updated at the beginning of the year and are kept fixed throughout the year. The weights are based on national accounts data from t-2, and the corresponding expenditure shares are reviewed and updated to make them representative of year t-1. In the context of the pandemic, the legal and conceptual framework of the HICP has been kept unchanged. In line with this framework, guidance for the compilation of HICP weights in cases of large changes in consumer expenditures was issued by Eurostat<sup>1</sup> in December 2020. The main principle of the HICP guidance is that the 2021 HICP weights should be based on the best estimates possible for household consumption expenditure patterns in 2020. As a result, the weights used in 2021 include the significant effect that the Covid-19 pandemic has on household consumption patterns.

4.13 In practice, Eurostat outlines an eight-step process to follow for the estimation of 2020 household consumption expenditures by ECOICOP for use in calculating 2021 indexes. Generally, this guidance directs NSOs to use the commensurate 2019 to 2020 change in quarterly consumption observed at least for the three first quarters of 2020 to update 2019 expenditure data.

## Australian Bureau of Statistics

4.14 The Australian CPI has been annually re-weighted since 2018, predominately using household expenditure data lagged by 18 months. In response to Covid-19, the Australian Bureau of Statistics (ABS) used a range of more timely retail trade data for approximately 20 per cent of the CPI basket for the 2020 annual re-weight. <sup>2</sup> For the remaining 80 per cent of the basket, traditional updating techniques were used. The weight update framework developed by ABS in response to the pandemic is illustrated in Figure 3.4 below.

Figure 3.4 **Weight derivation (Australian Bureau of Statistics)**



<sup>1</sup> See <https://ec.europa.eu/eurostat/documents/10186/10693286/Guidance-on-the-compilation-of-HICP-weights-in-case-of-large-changes-in-consumer-expenditures.pdf>.

<sup>2</sup> See <https://www.abs.gov.au/statistics/research/2020-annual-re-weight-australian-consumer-price-index>.

## Statistics Canada

4.15 In Canada, basket weights are derived primarily from Statistics Canada’s Survey of Household Spending (SHS) and are updated every two years. Weights were updated in February 2019 using 2017 SHS data. Statistics Canada decided to delay the 2021 update, planned for February 2021, to July 2021 to assess how actual spending in 2020 may deviate from the 2019 SHS estimates.

4.16 Partnering with the Bank of Canada, Statistics Canada obtained temporary access to aggregated spending data from March, April, and May 2020 representing nearly all CPI product categories, and used these data to simulate an experimental index with more contemporaneous weights compared to the official Canadian CPI. The experiment provided insight into how CPIs can be affected by sudden, extreme shifts in purchasing patterns and the specific impact of Covid-19. The evidence suggested inflation was slightly higher than the headline CPI in April and May.<sup>1</sup> Following the ABS framework, Statistics Canada plans to make adjustments for item categories that had large changes in 2020. Statistics Canada also plans to execute another weight update in 2022, which usually would not be done, to remove any adjustments made for 2020 that are no longer needed.

## Office for National Statistics, United Kingdom

4.17 The Office for National Statistics (ONS) in the U.K. followed Eurostat guidance, and proceeded with their weight update in 2021 using national accounts data as the source of the weights. The update for 2021 would normally use 2019 data as a reasonable proxy for 2020. However, based on Eurostat guidance, ONS used early estimates of 2020 Q1-Q3 to adjust 2019 data to be more reflective of 2020 spending. When there was no evidence of a significant change, ONS used the unadjusted 2019 data.<sup>2</sup>

## 4.4 Key points

- NSOs should avoid making instantaneous changes to index aggregation formula and changes in the frequency of weight updates as a reaction to a lockdown or economic shock.
- If a planned weight update involves spending data for the lockdown period, and those data have higher measurement error than recent history or otherwise could be considered as non-representative, NSOs may modify the planned weight update by skipping the weight update for the impacted year, averaging the impacted year with prior year data, or delaying the weight update until additional analysis can be performed on the spending data.
- For annually updated CPIs, it is possible to derive weights based on the most recent expenditure data. There can be trade-offs between the quality and the timeliness of data sources available for deriving weights. Data sources permitting, shifts in consumption expenditure patterns caused by the lockdown can be incorporated in the index with the annual update of the weights. The NSO may or may not decide to further adjust some of the expenditure data covering the lockdown period (for example by excluding or averaging) considering the measurement objective of the CPI. The weights can be updated again the following year.
- NSOs could develop and produce ex-post experimental or research versions of the CPI that use a superlative index formula to aggregate component indexes into the all-items CPI, or that otherwise use current period spending weights, in order to compare and contrast to the headline CPI that was published using lagged weights.

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<sup>1</sup> See <https://www150.statcan.gc.ca/n1/pub/62f0014m/62f0014m2020010-eng.htm>.

<sup>2</sup> See <https://www.ons.gov.uk/economy/inflationandpriceindices/articles/coronaviruscovid19andconsumerpriceinflationweightsandprices/2021>.



# Chapter 5 Communication

## 5.1 Introduction

5.1 Because of the widespread use of the CPI for both indexation purposes and as a measure of inflation it is crucial to maintain the public trust in the statistics. To this end, NSOs must ensure transparency which means that information about data sources and methods should be made publicly available to the users of the CPI. Enough documentation and explanations must be provided to facilitate correct interpretation and use of the statistics. Careful communication is particularly important in periods of lockdown to inform users of possible impacts on the statistics and maintaining public trust in the CPI.

5.2 In this chapter, section 5.2 gives broad recommendations on the communication with users and stakeholders under lockdown. Section 5.3 provides more details about measures of quality and reliability of the CPI, including the ratio of imputed prices, sensitivity analysis and decomposition, illustrated with practical examples. Section 5.4 gives examples of analytical or experimental CPIs that may be compiled to compliment the headline CPI, and on special CPI aggregates that may be useful to inform users. Section 5.5 summarizes key points of the chapter.

## 5.2 Communication with users and stakeholders

5.3 The CPI should be published following best practices for the dissemination of official statistics and the recommendations of the *CPI Manual* chapter 14 on Publication.

5.4 During a lockdown, users will continue to need CPI series at a detailed level. NSOs, therefore, should continue to publish all index series that are usually disseminated whenever possible. Imputed series should be flagged and clearly communicated to users and accompanied by additional information about index quality. This provides users with a full set of index series and helps to ensure transparency.

5.5 Because of the lockdown there may have been considerable changes in the sample of goods and services. New price collection methods and new data sources may have been implemented and new imputation methods may have been applied. Users should be informed about changes in data sources and methods that may affect the statistics. Hence, changes in the sample, data sources, and compilation methods should be documented, published and explained to users. The price collection period is of key importance for the CPI. If this has been changed users should be informed. Additional information about the impact of the lockdown on the quality of the CPI may also be published (see section 5.3 below).

5.6 The monthly (or quarterly) production process may be delayed because of the lockdown, which may make it difficult to meet the pre-announced publication date of the CPI. Eventually, it may not be possible to release the CPI at the announced date. The NSO needs to evaluate if there is a risk of missing the publication date. If the release must be postponed users should be informed about this in advance and a new release date should be communicated. NSOs are encouraged, if possible, to estimate when the publication schedule is expected to return to its pre-defined dates.

5.7 If the release of the CPI is postponed some NSOs may consider publishing a preliminary CPI. However, in this case the statistics should be clearly marked as preliminary. If the CPI is subject to particular uncertainty this should also be highlighted. Users should be informed when the final CPI will be released and that this may deviate from the preliminary CPI.

5.8 The CPI is used for a variety of purposes, including indexation of wages, pensions and social benefits and as a measure of inflation in monetary and economic policy. When communicating the CPI the large and diverse group of users should be considered. User groups may have different needs for information and documentation so various information should be provided to meet these needs. Examples of such information are given below.

5.9 Suitable information should be made available together with the release of the CPI. Documentation and information may be provided through the official website of NSOs, through social media and press-conferences. It may also be possible to create a separate webpage that entails the relevant documentation and explanations in relation to the lockdown and its effect on the CPI and FAQs. This is especially user-friendly and timesaving for those who need quick access to specific information.

### Reaching out to users and stakeholders

5.10 Online press conferences or webinars are useful communication tools to give more detailed information to users. There is also the possibility of organising online events/webinars for specific user groups, for instance researchers, the government sector or others to focus on the issues most relevant to these groups. Timely, comprehensive and transparent information provided to users and stakeholders helps to increase credibility of NSOs in public and their trust in official statistics. Efficient communication with user groups during Covid-19 related lockdowns was carried out, for example, by statistics offices of Australia<sup>1</sup>, Germany<sup>2</sup>, France<sup>3</sup>, United Kingdom<sup>4</sup> and United States US<sup>5</sup>.

5.11 It is useful to be proactive in communication with users. For instance, the NSO may reach out to key users such as central banks, ministries of finance and labour in advance and inform them about expected changes. This could also include economists, researchers and users that use the CPI for indexation purposes, including governments and labour organizations. In cases where the CPI is used for indexation this is likely to create additional interest in the possible effect on the CPI of the lockdown since this may have significant consequences for groups that have their income or pension indexed with the CPI. At the same time, it is highly important to ensure equal availability of information for all user groups, in line with the Principle of “Impartiality and Objectivity” of the European Statistics Code of Practice and the UN Fundamental Principles of Official Statistics.

5.12 Two-way communication with user groups may help to establish relationships. Contact to key users may also be used for consultation and soliciting inputs and views that may be helpful to the NSO when deciding on methods and communication. Consultations may take place bilaterally or the NSO may organize (online) briefings for selected users. Important changes in data sources or methods should be communicated to the public well in advance and would also in many countries involve consultation with user groups and advisory boards on CPI.

## 5.3 Informing users about the quality and reliability of the CPI

5.13 Changes in the sample of goods and services or in compilation methods caused by the lockdown are likely to affect the quality of the CPI. Countries are recommended to compile and release measures to inform users about how much the lockdown may have impacted the quality of the CPI.

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<sup>1</sup> [https://unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.22/2020/Importance\\_of\\_communication.pdf](https://unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.22/2020/Importance_of_communication.pdf)

<sup>2</sup> <https://www.destatis.de/EN/Themes/Economy/Prices/Consumer-Price-Index/Methods/corona-cpi-hicp.html>

<sup>3</sup> [https://unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.22/2020/UNECE\\_webinar\\_Insee\\_202011.pdf](https://unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.22/2020/UNECE_webinar_Insee_202011.pdf)

<sup>4</sup> <https://www.ons.gov.uk/economy/inflationandpriceindices/articles/coronavirusandtheeffectsonukprices/2020-05-06>

<sup>5</sup> <https://www.bls.gov/covid19/effects-of-covid-19-pandemic-on-consumer-price-index.htm>

5.14 Statistical agencies should develop and communicate to users a comprehensive policy on publication adequacy. The policy should directly and objectively adjudicate a publication decision for each index and data product planned for publication, evaluating whether sufficient input data have been directly collected to achieve public confidence in the published measure. The objective adequacy rules developed by each NSO should be sample size or variance based, and robust to contemplate small to significant amounts of nonresponse and imputed prices. Adequacy rules should not be subjectively changed in response to market shocks that may temporarily alter the amount of collected input data.

### 5.3.1 Publication of heavily imputed index series

5.15 An immediate issue created by an increase in imputation utilization is the reliability of the resulting published indexes. Should indexes be suppressed from publication if a large percentage of the index is estimated without directly observed prices? If so, what constitutes a 'large' percentage? This section highlights the publication practices of example NSOs regarding the impact of imputation on the quality of officially released statistics:

#### Bureau of Labor Statistics, United States

5.16 The U.S. CPI employs an adequacy criterion to determine whether a particular aggregate index estimate is worthy of publication of each month. The rule is three-part:

- (1) First, each elementary cell is assigned a dummy variable, 1=Non-imputed, 0=imputed. A cell is deemed 'non-imputed' if at least one sampled item in the cell has a directly observed price. This includes prices observed for match-model products, comparable substitutes, and quality-adjusted substitutes.
- (2) Second, a weighted average of the binary 0,1 variables for each elementary cell defining the aggregate is computed, using the aggregation spending weights assigned to each elementary cell. The result is an 'average' non-impute rate for the aggregate,  $0 \leq \alpha \leq 1$ .
- (3) If  $\alpha > 0.5$  then the aggregate index is deemed 'adequate' for publication. That is, if more than 50% of the weighted inputs are non-missing, then the aggregate estimate can be published. If  $\alpha \leq 0.5$ , then the index estimate is suppressed from publication and footnoted accordingly in published news releases and tables.

5.17 At first glance, the BLS adequacy rule seems to suggest at least 50% of the sample must be collected to publish results. But that is not the case. Closer inspection reveals that just one collected price in each elementary building block is required. This equates to roughly 5% of the total sample size. Moreover, if the collected prices were distributed in the largest weighted categories, e.g. rent, gasoline, food away from home, then the U.S. CPI could be deemed adequate for publication with as low as 2.5% of the total sample collected.

#### Eurostat

5.18 Guidance from Eurostat on this issue is two-part. First, if there is more than 50% imputation in a published index product, countries are to flag or denote the index as such. Moreover, for each flagged index, additional information on the imputation method and the imputation share are published each month. This guidance permits the publication of all sub-indices. For each product, the European Union index is compiled as the weighted average of the country product indexes. A European Union index is flagged if composed of more than 50% (in terms of weight) of country indexes flagged as imputed.

## Office for National Statistics, United Kingdom

5.19 The United Kingdom adopts a similar, but slightly varied policy relative to the Eurostat guidance. In extreme lockdown cases, very small samples at the low-level strata classification level have been rejected and the item index imputed. A flag is included at the item level which indicates whether the item is fully imputed or partially imputed. At higher COICOP levels, series are flagged which are based on less than 50% of the usual sample size.

### 5.2.2 Ratio of imputed prices

5.20 In addition to flagging indices with a high ratio of imputed prices the ratio of imputed prices may also be published. This ratio can be a simple count of the number of imputed prices out of the total number of prices (more details are given in section 3.4). The ratio can also take the weight of the individual price relatives into account. Aggregating the weighted price relatives or indices would give an indication of how much of the weighting basis of the overall CPI has been imputed, and how large impact potentially this may have on the overall CPI.

### 5.3.3 Ratio of closed outlets

5.21 The ratio of closed outlets will be an indication of how much different markets have been impacted by the lockdown and hence how much different sub-indices may have been impacted. If compiled monthly, it will also be an indicator of the severity of the lockdown.

### 5.3.4 Indicators of data source and price collection method

5.22 It is also possible to compile ratios or other types of indicators to reflect how the total number of observed prices is distributed on different data source/data collection methods. For instance, the share of prices collected in the field by price collectors visiting the outlets, from the web, from survey questionnaire or by phone or e-mail. While information on data source / collection method may not be of interest to all users it may be relevant so some, and for the index compilers it may help to follow shifts in data sources and/or collection methods over time.

5.23 Examples of such auxiliary data can be found on websites of statistical agencies, including United States (figure 5.1), Canada (figure 5.2) and Belgium.<sup>1</sup>

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<sup>1</sup> <https://statbel.fgov.be/en/news/impact-covid-19-index-calculation-and-measurement-inflation>

Figure 5.1 Report on price collection mode under lockdown (US Bureau of Labor Statistics)

Month	2019			2020		
	Personal visit	Telephone	Online	Personal visit	Telephone	Online
March	74	10	16	44	14	42
April	74	10	16	0	18	82
May	74	10	16	0	17	83
June	73	10	17	0	17	83
July	74	10	16	0	17	83
August	73	10	17	0	17	83
September	73	10	17	0	17	83
October	73	10	17	0	16	84
November	73	9	18	0	16	84
December	72	10	18	0	16	84
Average, Feb 2019–Feb 2020	73	10	17			

Source: <https://www.bls.gov/covid19/consumer-price-index-covid19-impacts-december-2020.htm>

Figure 5.2 Report on item availability and outlet closure during lockdown (Statistics Canada)

Consumer Price Index product and outlet availability, field, scanner and web scraped data collection modes, April 2020 and April 2019

	Basket weight at link month (%)	Average rate of out of stock product offerings (%)		Average rate of temporarily closed outlets (%)		Average rate of prices received as scheduled (%)	
		April					
		2020	2019	2020	2019	2020	2019
<b>Total</b>	<b>100</b>	<b>13.9</b>	<b>4.4</b>	<b>3.2</b>	<b>0.3</b>	<b>82.9</b>	<b>95.3</b>
Food and non-alcoholic beverages	16.48	11.3	1.8	1.3	0.1	87.5	98.1
Shelter	27.36	9.0	2.4	5.2	0.9	85.7	96.7
Household operations, furnishings and equipment	12.8	20.2	6.2	1.9	0.2	77.9	93.6
Clothing and footwear	5.17	15.1	14.1	9.0	0.4	75.9	85.4
Transportation	19.95	1.8	0.9	7.6	1.4	90.6	97.7
Health and personal care	4.79	28.6	3.0	6.4	0.1	65	96.9
Recreation, education and reading	10.24	14.8	5.7	5.7	0.5	79.5	93.7
Alcoholic beverages, tobacco products and recreational cannabis	3.21	9.3	1.9	1.1	2.8	89.6	95.3

Source: <https://www150.statcan.gc.ca/n1/pub/62f0014m/62f0014m2020006-eng.htm>

5.24 Measures of the impact of Covid-19 on CPIs can be published as supplementary information together with the index data, for each aggregation level that is disseminated by an NSO. As an example, NSOs may use CPI reports with Covid-19 related outputs of EU-member countries, which are available on Eurostat's website<sup>1</sup>. Another example of index figures and corresponding analytical information about index quality is presented in Table 5.1.

**Table 5.1 Example of auxiliary information for CPI publication**

COICOP divisions	Number of price observations under normal circumstances	Number of price observations in lockdown month	Share of imputed prices	Share of closed outlets	Flag (share of imputed prices >50%)
<b>Overall CPI</b>	<b>16065</b>	<b>9146</b>	<b>43.1%</b>	<b>39.4%</b>	-
01 Food and non-alcoholic beverages	5561	4292	22.8%	13.9%	-
02 Alcoholic beverages and tobacco	387	318	17.8%	12.9%	-
03 Clothing and footwear	2297	145	93.7%	96.4%	Flag
04 Housing, water, electricity, gas and other fuels	540	308	43.0%	33.0%	-
05 Furnishings, household equipment and routine household maintenance	1855	764	58.8%	48.5%	Flag
06 Health	1069	855	20.0%	17.9%	-
07 Transport	916	634	30.8%	27.3%	-
08 Communication	288	171	40.6%	44.6%	-
09 Recreation and culture	1392	442	68.2%	77.4%	Flag
10 Education	186	146	21.5%	19.4%	-
11 Restaurants and hotels	282	78	72.3%	69.5%	Flag
12 Miscellaneous goods and services	1292	993	23.1%	20.6%	-

### 5.3.5 Measures of statistical certainty

5.25 When products are collected through probability sampling the statistical certainty of an index can be calculated by use of variance estimation of the price relatives. However, while probability sampling may be used for some product groups, it may not be used for others which make it difficult to derive a measure for the statistical uncertainty of the overall CPI<sup>2</sup>.

5.26 Analysis of index variance may also be used for decisions about flagging or not a particular price index, in parallel with information about share of imputed prices. A threshold can be estimated by index compilers above which the index data will be considered as of low quality. When analysing the variance NSOs must take into account differences between outlet types and products. E.g., threshold for food and beverages can be set higher than the one for services. Also, smaller outlets can have very different pricing strategies, compared to larger outlet chains and open-air markets.

<sup>1</sup> <https://ec.europa.eu/eurostat/documents/272892/272974/Overview-flagged-HICP-sub-indices-Jan-2021.xlsx/>

<sup>2</sup>When non-probability technics are used, some additional analysis should be conducted (see *CPI Manual*, chapter 12, paragraphs 12.13-12.16).

5.27 Attention should be paid also to the quality of regional indices (if produced and disseminated). Some regions may be affected more heavily by the lockdown than others and, as a result, their index quality will deteriorate more than other regions' indices or the national CPI.

### 5.3.6 Sensitivity analysis

5.28 Users may ask how and how much the lockdown has impacted the CPI. To this end, it may be useful to inform users about the importance (the weight) of goods or services for which markets have been closed temporarily, and what potential impact this may have on the overall CPI. This could also include information about how missing goods or services are treated in the CPI, where these have a significant weight or have been attracting media interest, for instance childcare institutions, air travels or hotels/restaurants.

5.29 When the CPI is based on annual weights it can be helpful to explain to users what implications this has, i.e. that (temporary) changes in the consumption pattern during the lockdown is not fully reflected in the CPI and that the CPI may differ from households' perceived inflation.

5.30 Also changes in the price collection period may impact the CPI. While in general the regular price collection period should be maintained, the NSO may have extended the period with some days to allow more prices be collected. As a result, figures of a particular month may represent inflation of a period longer than one month, while the next or previous figure will represent inflation of less than one month. Such effects will be of temporary nature and eliminated when returning to the regular price collection period.

### 5.3.7 Decomposition

5.31 Users of the CPI may be interested in how much different sub-indices contribute to the change in the overall CPI. This can be compiled by decomposing the change in the overall index into its constituent parts. Such decomposition showing, for instance, the contribution of each aggregation level of COICOP (or another classification used on national level) to the overall CPI is common in many countries as part of the regular publication of the CPI. Decomposition and the construction of a decomposition table are explained in the *CPI Manual* (9.104-9.114).

5.32 Under normal conditions, each sub-index contributes to the rate of change of the overall CPI according to the weight of the sub-index, irrespective of whether some of the prices entering the sub-index are actually observed or are imputed. However, during a lockdown some elementary aggregates or even commodity groups/headings may not be available. Indices for unavailable elementary aggregates may have been imputed by other available elementary price indices or by the overall CPI (corresponding to leaving the elementary index out of the calculation of the CPI). In such cases, in order to calculate the actual contribution of each elementary index or each sub-index, the weights must be rescaled to sum to unity based only on products that are available on the market, i.e., those elementary indices or sub-index for which prices have been observed. This will result in contributions that are assigned only to products available for purchase (but still summing up to the total inflation rate), which can be easily explained to the public. An example is presented in Table 5.2 for illustration.

Table 5.2: Index decomposition

	COICOP divisions	Group weights % (1)	Index January/ December (2)	Available indices (3)	Normalized weights (4)	Contribution to the monthly index in January (Dec. = 100) (% points)**
1	Food and non-alcoholic beverages	32.2%	100.2	100.2	39.3%	0.08
2	Alcoholic beverages and tobacco	6.4%	100.0	100.0	7.8%	0.00
3	Clothing and footwear	3.8%	99.75*			
4	Housing, water, electricity, gas and other fuels	9.0%	100.9	100.9	11.0%	0.10
5	Furnishings, household equipment and routine household maintenance	5.3%	99.75*			
6	Health	7.8%	103.1	103.1	9.5%	0.29
7	Transport	13.0%	95.3	95.3	15.9%	-0.74
8	Communication	3.6%	102.4	102.4	4.4%	0.11
9	Recreation and culture	3.7%	99.75*			
10	Education	4.6%	97.2	97.2	5.6%	-0.15
11	Restaurants and hotels	5.4%	99.75*			
12	Miscellaneous goods and services	5.3%	101.0	101.0	6.5%	0.06
	<b>Total index/sum of weights</b>	<b>100.0%</b>	<b>99.75</b>		<b>100.0%</b>	<b>-0.25</b>

\* Since these groups are unavailable in the current period, the total CPI is used for imputation.

\*\* Contributions are calculated based only on indices of available groups and corresponding normalized available weights (4).

As an example, the contribution of the group “Food and non-alcoholic beverages” is calculated below<sup>1</sup>:

$$\begin{aligned}
 & \text{Contribution of group1 in monthly inflation of January} = \\
 & = \frac{(\text{Index of group1 in January} - \text{Index of group1 in December})}{\text{Total index in December}} \times \\
 & \quad \times \frac{\text{Weight of group1}}{\text{Sum of weights of available groups}} \times 100 = \\
 & = \frac{(100.2 - 100)}{100} \times \frac{32.2\%}{81.9\%} \times 100 = 0.08 \text{ percentage points}
 \end{aligned}$$

<sup>1</sup> Users may not obtain the same result due to rounding.



## 5.4 Analytical and experimental CPIs

5.33 While the general recommendation is to continue compiling the regular headline CPI based on existing annual weights and imputed missing prices it may be useful to compile supplementary experimental or analytical CPI series. These may not meet the quality standards of the regular CPI but may still help to picture the development and meet user needs. Analytical series may be produced simultaneously with the official CPIs or with a certain time lag, depending on the information they require.

### 5.4.1 Approach 1: Omitting unavailable products

5.34 This is the easy option, which simply omits unavailable products/elementary indices and calculates the “Lockdown CPI” on this basis. Compilers may calculate different scenarios, such as changing weights for automotive fuel, excluding international travel, air transport, etc. Administrative data sources and expert judgment can be used where possible to obtain a more reasonable up-to-date weighting structure.

5.35 When using this method, indicators such as marginal propensity to consume and consumer preferences (demand elasticity) should be considered. Some consumers may be willing to spend less in response to uncertain economic situation during lockdown. At the same time, they are usually less prone to reduce consumption of food products, as opposed to durables (even if the latter are available for purchase online). Therefore, CPI compilers are advised to discuss such economic peculiarities with corresponding area experts.

### 5.4.2 Approach 2: Estimating lockdown weights

5.36 If weights during the lockdown period are available or can be estimated, it may be possible to compile an experimental CPI reflecting the price development of the lockdown basket. These weights may be more volatile and less reliable than annual weights derived from the regular Household Budget Survey but may still serve as estimates. Timely short-term (monthly or quarterly) expenditure weights estimates may also provide insight into consumer behaviour, which information may be published or shared with interested users.

5.37 This approach may be implemented in two ways. (1) The experimental CPI can be based on weights that are kept constant throughout the lockdown period. (2) The experimental CPI can be based on monthly weights, or quarterly weights, if a quarterly index is compiled.

5.38 Lockdown weights may be derived from several data sources:

#### Continuous household expenditure survey

5.39 Some countries use the practice of a continuous survey of household expenditures, which can provide valuable information on change in expenditure pattern during pandemic. However, conducting such surveys on a rolling basis is either of lower quality due to a smaller sample size (compared to annual surveys) or is related to significant financial costs and thus not suitable for low-income countries.

#### Scanner data

5.40 Countries that already have integrated scanner data in their CPI surveys can use this data to obtain up-to-date information on consumer expenditures. Since scanner data is usually received automatically right after the end of reference period (or even several times during the reference month), this will enable NSOs to calculate  $t$ -period weights for pandemic period, which can be used then to estimate impact of pandemic on the CPI. However, this method is not suitable for all countries, since scanner data is not always available. Besides, some outlets or open-air markets may not have scanner equipment at all;

therefore, data on some item sales will be missing in the scanner data although being available for purchase. Based on this, scanner data can mostly be used only as auxiliary information.

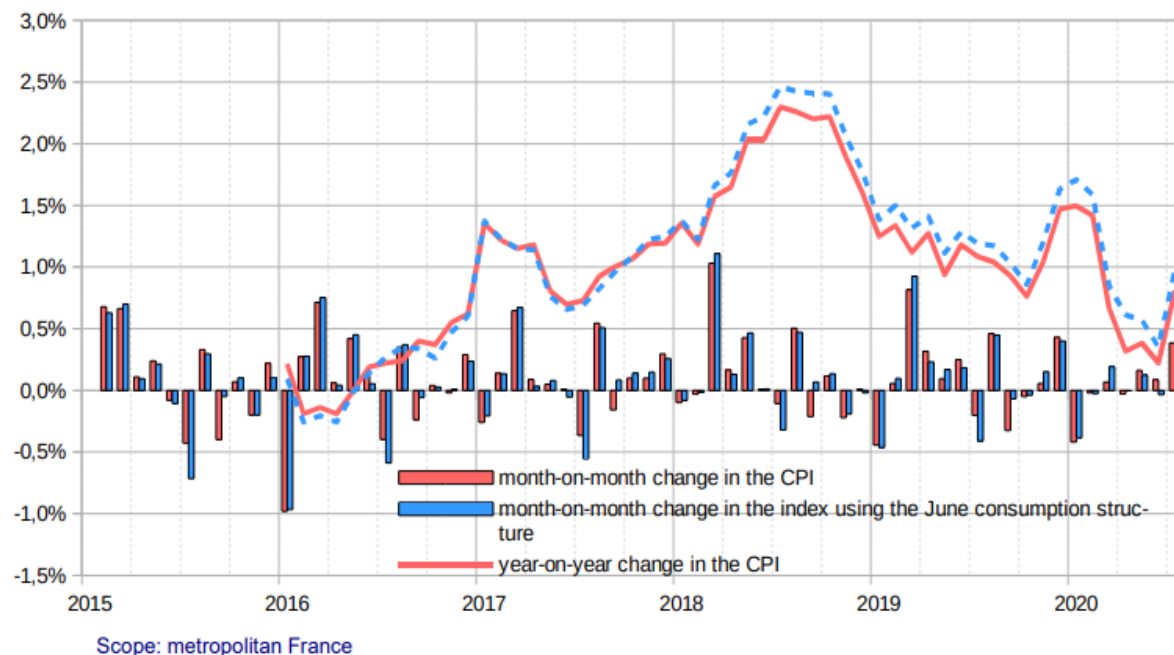
### Credit and debit card information

5.41 Using this data for weights calculation requires close communication with financial institutions to obtain transaction data about households, but this may not always be possible due to legal restrictions. Besides, some purchases are conducted using cash instead of bank cards. Therefore, using this type of data has similar limitations as scanner data. However, during the Covid-19 pandemic, consumers tended to use bank cards more frequently, making this type of data more complete than in usual circumstances.

5.42 It should also be considered that some periods may be characterized by panic buying of essential products. This may result in highly unstable weight structure from month to month. Therefore, it is recommended to systematically update the new experimental set of weights using all available information (e.g. taking average the expenditure pattern for several past months). Comparing the weights of the regular CPI with the estimated weights for the lockdown period can provide a useful indication of the potential impact of the change in consumption pattern and which products are particularly affected.

5.43 An experimental CPI can be compared with the regular CPI based on historical weights. To achieve this, NSOs can calculate a Paasche or a Fisher price index and compare the results with the regular CPI. However, it should be considered that an index based on monthly (or quarterly) weights is subject to bias due to frequent chain-linking. The experimental CPI should not replace the regular CPI. Instead, it can be used for internal analysis only or be published as supplementary information. The example in Figure 5 shows the CPI and an experimental index for France.

Figure 5.3 The CPI and an alternative index using the consumption structure observed in June 2020 (INSEE, France)



Source: "How to compute a Consumer Price Index in the context of the Covid-19 crisis?" Insee, 2020v

### 5.4.3 Publication of special aggregates

5.44 Special aggregate indices can be derived as part of the regular CPI compilation by grouping the relevant set of elementary indices or sub-indices. Such aggregates can be compiled and published at almost no additional costs. Depending on the situation in a country and user needs, numerous indicators can be derived and disseminated based on the existing CPI data:

- CPI for food products and beverages
- CPI for essential products<sup>1</sup>
- CPI for automotive fuels (due to increased expenditures for operation of personal transport equipment where public transport services were suspended)
- CPI for water supply, electricity, gas and other fuels
- CPI for online purchases
- CPI for education (prices may change due to massive switch to online learning)
- CPI for telecommunication services, etc.

5.45 Lockdown may be accompanied by economic and social programs, aimed at supporting business activities and households. This might include reduced or deferred taxes, subsidies on public transport fees, childcare, health care or other services. CPI compilers should pay attention to such programs as they may affect consumer prices and thus must be reflected in the CPI. An example is government subsidies on childcare in Australia<sup>2</sup>. While the *CPI Manual* provides recommendations on incorporating such kind of subsidies in the CPI (paragraphs 2.110, 2.112, 8.26, 11.295, 11.298, 11.280; table 11.14), NSOs can produce additional indicators such as CPI without subsidies for analytical purpose, if these subsidies bring large fluctuations to the index and cause questions among users.

5.46 However, production of alternative indicators should be treated with cautions. As stated in the *CPI Manual*, index compilers should avoid confusing the users with different inflation measures. It should be always clearly stated which indicator measures the headline inflation and which is an analytical, auxiliary index. Besides, the purpose and use of each indicator should be explained, to avoid misuse and misunderstanding of the published data. Finally, all additional CPI data should be in compliance with existing methods and recommendations, should not be in contradiction to and should not replace the headline inflation measure.

## 5.5 Key points

- During lockdown NSOs should continue disseminating CPI data at the common level of disaggregation, according to the pre-defined publication calendar, whenever possible.
- Proactive communication with users and stakeholders is necessary to maintain transparency and credibility of disseminated figures. Changes in data sources, data collection modes and compilation methods that may happen during lockdown should be documented and made public.
- When data quality is heavily impacted by lockdown, it is advisable to publish auxiliary information about the CPI figures, such as: ratio of imputed prices, ratio of closed outlets, measures of statistics uncertainty, contributions, etc.
- Various analytical indicators can be produced to accompany the headline inflation figures. These may be derived by estimating lockdown basket weights or constructing various aggregates from the exiting microdata.

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<sup>1</sup> <http://www.statssa.gov.za/?p=13253>. See also Reinsdorf, M. (2020).

<sup>2</sup> <https://www.abs.gov.au/articles/methods-changes-during-covid-19-period#measuring-the-consumer-price-index-during-a-time-of-covid-19>



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