Scanner data in the Swiss CPI: An alternative to price collection in the field

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1 Abstract

For the initial phase of the price collection using scanner data, the Swiss Federal Statistical Office (FSO) relied upon traditional survey and index calculation methods. This concerned in particular the calculation and weighting of the indices and the number of items in the sample. Scanner data were mainly used to replace the price collection carried out hitherto in the retail outlets. This enables many of the important advantages of scanner data to be achieved rapidly without having to take unnecessary risks or wait for long preliminary studies. In a second stage, alternative collection and calculation methods intended to make more of the improvement and rationalisation potential of scanner data will be tested.

2 Introduction

The Swiss consumer price index (CPI) and the Harmonised Index of Consumer Prices (HICP) are Lowe indices with annual re-weighting of their baskets of commodities that contain the goods and services representative of the consumption of resident private households. The basket of commodities is based on the COICOP and includes more than 200 published items at the lowest weighting level. The basis for the weighting of the basket comes from the annually conducted Household Budget Survey (HBS) as well as other sources. The items with the lowest weighting are further divided into more than 1000 survey positions. The latter are implicitly weighted by the specified number of items to be surveyed.

For each of the lowest weighted positions an elementary index is calculated with the non-weighted geometric mean of the price changes. This corresponds to Jevon's formula. However, the higher aggregates are based on Lowe's formula. They are chained and reweighted in December each year. In addition, there are several regional and distribution channel weightings that group together individual retail chains or several similar enterprises (e.g. all discount stores or department stores). Because the scanner data collected by the FSO do not cover the whole market, this weighting information is currently purchased from a market research institute. But in future refinement of these weightings on the basis of sales volume contained in the scanner data could be envisaged.

Each month, approximately 50,000 prices are collected in eleven regions throughout Switzerland. Much of the collection, particularly for groups of commodities with regional price structures, was outsourced in the year 2000 to an independent market research institute with professional price collectors. The latter normally register the prices directly at the retail outlets on one or two days during the first two weeks of the month. In contrast, groups of commodities with uniform nationwide price structures are mostly still collected by Swiss Federal Statistical Office (FSO) staff.

Since July 2008 in addition to traditionally collected prices, the FSO has also been using scanner data for the index calculation of the commodity groups food and near-food (products for personal care, washing and cleaning products as well as animal food). The FSO thus aims to achieve an improvement in the quality of data, savings on collection costs and a reduction in the administrative burden on retail chains. Currently scanner data from the two largest retail store chains in Switzerland, with a joint market share of about 60-70%, is evaluated every month. Over the coming years, the gradual extension of scanner data surveys to other retail chains and groups of goods is planned.
3 Gradual approach in practical implementation

FSO analyses and experience in other countries have shown that the productive introduction of scanner data into the consumer price index involves a considerable number of practical problems and difficulties. This is why the FSO has decided on a gradual introduction of the use of scanner data for the price collection. This involves several aspects:

- The use of previous collection and calculation methods in the initial phase
- The gradual integration of retail chains and product groups
- Software development in several stages

3.1 The use of previous methods in the initial phase

Scanner data not only contain extremely detailed information about prices and sales, they are also available after a very short period of time. Basically, completely new perspectives are opened up. For instance, the introduction of superlative indices or weighting at item level becomes conceivable. However, as price collection using scanner data already represents a major challenge in itself, scanner data in the consumer price index should, for the time being, be used exclusively for improving the existing price collection system. This is why initially the same collection and index calculation methods are used as for the traditional collection in retail outlets. This concerns in particular the calculation and weighting of the indices, the number of items in the sample and the procedure for missing prices. Therefore for the time being scanner data is considered more as an alternative data source with improved quality than as a new collection method. However, in a second stage, from 2010, alternative collection and calculation methods intended to make more of scanner data's potential for improvement and rationalisation will be tested. Especially the survey of non-food groups of goods which is more demanding from a methodological point of view is particularly interesting.

3.2 The gradual integration of product groups and retail chains

Price collection using scanner data was to be first tested and optimised on the basis of one retail chain and not extended to further companies until later. This approach meant that vital experience could be gained; intensive analyses could be carried out thus reducing the risk of mistakes before the widespread introduction of scanner data into the CPI.

Some problematic product groups are especially demanding for price collectors, particularly when items are replaced and the relevant quality adjustments made. This includes, in particular, most non-food groups of goods, but also wine for example. Therefore the FSO has decided to continue collecting the prices of these products in the retail outlets for the time being.

In contrast, price collection with scanner data is particularly valuable for foodstuffs. First, Switzerland is probably in a unique position in that its two biggest retail chains hold a combined market share of some 60-70% in the Retail Food sector. This means that, by including "only" two companies, a considerable proportion of all sales can already be collected. Second, the prices of all foodstuffs with different regional pricing (particularly fresh products) are now collected by a private market research institute. The costs incurred can be avoided by the use of scanner data. In a second phase, which starts in the second half of 2010, the survey of some non-food groups of goods is also being tested in parallel. For instance some implicit quality adjustment procedures, which promise more automation for price collection, will be evaluated.
3.3 Software development in several stages

At the beginning of the project, one retail chain was particularly interested in the introduction of the scanner data collection in view of the anticipated reduction in the administrative burden. Thanks to close cooperation with this enterprise, in mid-2008 the FSO was able to develop and efficiently introduce an internet-supported pilot software. This covers all aspects of the survey process from the regular reading of the delivered pre-aggregated scanner data to the stipulation of the item sample and the actual price survey. This proved the feasibility of the systems for the food and near-food groups of goods.

However, the pilot software is geared towards the specific circumstances of a single retail chain and cannot be used for the price survey for other enterprises. But it enabled us to gather important experience and knowledge for the development of a new application which was introduced at the start of 2010. As a generic tool the latter made it possible to collect prices with scanner data from any price reporting point chosen. This was possible due to an identical interface definition for all retail chains. On the one hand a uniform format was provided for data supply while on the other each retail chain could also supply variables that were specific to them. Thus, the in part greatly varying information available to each retail chain could be taken into account. Retail chains pre-aggregate the data according to the required period of time and regions before its delivery to the FSO. The monthly creation of data files by the retail chain is fully automated, thus reducing to a minimum the burden on the enterprise.

The new application "scanner data" was developed as a new module of the existing CPI-IT platform. It is mainly used as a new price collection tool, but for the index calculation the same software module can be used as for the traditional price collection. The application covers every aspect of price collection, including the following functions:

- Regular importation of data files from the retail chain and the market research institute (see chapter 5.4).
- Provision of a graphic surface for manual administration of the scanner data (above all, selection and replacement of the items for the CPI basket of commodities)
- Possibility of manual correction of the item allocation provided by the market research institute (see chapter 5.4).
- Detailed retrieval of (average) prices, sales, item characteristics, etc. at various levels of aggregation. A photograph of each item can also be displayed.
- Implementation of automatic checking operations. The software generates warnings in the event of significant changes in sales, missing price reports, non-coherent user input, etc.
4 Advantages and disadvantages of scanner data

4.1 Advantages

By using previous collection and index calculation methods, several important advantages of scanner data were realised:

- The main advantage of scanner data lies in the marked improvement in data quality in various respects:
  - The representativeness of the positions sampled can be substantially increased. On the basis of the sales figures available, the best-selling items per elementary aggregate can be exactly pinpointed. In the traditional system, on the other hand, the price collectors are dependent in this respect on the information of sales staff at retail outlets.
  - In the traditional system, prices are collected once a month on one or two days of the first two weeks of the month. With scanner data, on the other hand, it is possible to carry out collection continuously for the first fourteen days of the month, thereby recording price changes that occur before and after the traditional survey. In fact, all actually paid transaction prices can be registered including all special offers from all sales outlets in a retail chain throughout Switzerland. This corresponds to a full survey per item and survey period at no extra cost.

- Using scanner data reduces the retail chains' workload. With the traditional survey the sales staff of the retail chains is regularly asked for information by price collectors, especially as regards the best-selling products and item characteristics. With the use of scanner data this is no longer necessary.

- At the same time, the use of scanner data cuts some of the costs incurred in traditional price collection. The biggest savings can be made in connection with fresh products (food), the prices of which are collected on a regional basis by the professional price collectors of a private market research institute. Although the total time and effort involved in the price collection has been considerably reduced by the introduction of scanner data, there has been a transfer of the remaining work from the retail outlets to the FSO.

4.2 Disadvantages and risks

Unfortunately, the implementation of scanner data in the consumer price index entails some further drawbacks and risks besides the initial outlay. A key issue is quality assurance of the data collected. As the FSO has no influence on the collection of the scanner data by the retail chains, mistakes are sometimes hard to spot. It is therefore all the more important to carry out regular checks. This quality assurance covers several aspects. In the first instance, most major retail chains subject the scanner data to intensive internal checks before they are supplied to the FSO. In the FSO itself, the data are subjected to further plausibility checks. Various quantitative checks are already carried out when the data is imported to the FSO application. Changes in the master data in comparison with the previous period are monitored by the software and signalled to the user. In addition a series of further plausibility functions are available before, during and after the actual price collection. External information could also be useful here, such as advertising material and/or random tests at retail outlets. Furthermore, during a test phase of at least six months, the data supplied from each retail chain are compared with the results of the traditional collection before they are incorporated into the consumer price index.
Despite agreements with retail chains it cannot be excluded that an enterprise is unable in the short-term to make its scanner data available. An emergency plan has been created for such an event. This allows for a price collection to be conducted in the retail outlet concerned at short notice. The risk of several or indeed all data supply being unavailable at the same time is kept at a minimum by the independent collection and supply of data by each individual retail chain.

5 Some procedures and practical experience in detail

5.1 Collaboration with retail chains
At the beginning of the scanner data project, the FSO conducted a survey among the ten largest retail chains in Switzerland. An important aim of this was to discover the willingness of the retail chains to collaborate with the FSO. Fortunately the feedback was extremely positive. Although sales volumes contain sensitive data, all enterprises were basically ready to make their scanner data available to the FSO.

In the meantime however, with the arrival of new retail chains from abroad, the situation as regards competition has changed. Today not all enterprises are prepared to supply their scanner data to the FSO just like that. Therefore the FSO has adapted the Ordinance on the conduct of Federal Statistical Surveys. Enterprises are now obliged to make their electronic data collections available to the FSO in a suitable format.

In order to ensure that the process of delivering scanner data is reliable and on time, the FSO also has additional agreements with the individual retail chains. These establish the main elements and obligations of the collaboration.

5.2 Calculation method
The traditional index calculation method has already been described in chapter 2. Basically, there is no change in the existing calculation method with the introduction of scanner data – there is merely an improvement in the underlying information. In traditional collection, the price of an item charged at a particular branch on a particular reference day is compared with the price of the same item the previous month. With scanner data, on the other hand, the average transaction price (sales/quantity) paid per item throughout Switzerland in the first 14 days of the month is compared with the price in the preceding period. The calculation of the indices, however, is done in exactly the same way as for the price collection in the retail outlets. If the item is one where the price is set regionally (mainly fresh products), the change in price is still calculated separately for each collection region.

5.3 Item sampling

5.3.1 In-store item numbers instead of EAN
In order to identify items unambiguously, the in-store item numbers of the retail chain are used and not the EAN codes. For certain product groups (in particular fresh food products) EAN codes can be freely allocated by the retail chains or even individual retail outlets. This can mean that the same EAN code can be allocated to different items. In contrast, the in-store item numbers are always unambiguous.
5.3.2 Representativeness vs. continuity

The items whose price changes are to be included in calculating the CPI are selected separately for each survey position. The number of items to be selected is predetermined for each position (implicit weighting) and corresponds to that of the traditional survey. Consequently, the entire item sample has the same size.

For the correct selection of the items in the sample, the same selection criteria apply as under the traditional system:

- **Representativeness**: For each elementary aggregate, those items are selected which are most representative of private household consumption. Representativeness is measured by the sales volume of the item.

- **Continuity**: With the exception of seasonal products, those items should be selected which continuously generate high sales in the retail chains’ product line. This is meant to make it possible to track the price of the same item as long as possible.

In practice, consumer buying habits and therefore the sales strength of items change on a regular basis. As a result, the two selection criteria often lead to a conflict of goals: If an item selected for the price survey loses sales strength and is outperformed by another non-selected item, there are basically two approaches:

1. **Ensuring continuity**: The item selected until now is not replaced immediately and its price is tracked as long as possible. However, the longer the replacement of items is put off, the less representative (in terms of sales strength) the sample becomes over time.

2. **Ensuring representativeness**: The item selected until now is immediately replaced by the new item which registers higher sales. The faster items are replaced, the shorter the period in which the price of the same item can be tracked and the more frequent quantity adjustments need to be made. This despite the fact that the replaced item often continues to be sold.

Consequently, the FSO has empirically attempted to find an optimal compromise between the two criteria. To this end, precise sales validation rules were defined for the replacement of items. Here the absolute sales value of an item is generally not the decisive factor, but rather its position in the ranking list of the items with the highest sales strength within the same survey position. The rules were established in such a way that a short-term significant sales increase due to a sales promotion is not in itself sufficient for the item to be immediately selected for the price survey and then has to be replaced as early as the following month. This is because in addition to sales during the current period, the sales of the previous three months are generally also included in the analysis. If the conditions for an item replacement are met, the software automatically informs the user of this by means of a warning message. Consequently, the monthly expense is largely limited to dealing with the displayed warnings (approximately 2-3% of all selected items). For all items that are not affected by this, the most recent price is automatically surveyed.

The composition and quality characteristics of the items cannot be judged by the software, so the user must always select and replace items manually as this procedure cannot be automated with the current survey methods. Though the software does generate notices for the user, for quality assurance reasons, it cannot make any changes itself.

Although the criteria of continuity and representativeness of an item play a decisive role for the selection and the replacement of an item both in the traditional survey and in the scanner data survey, in practice a precise knowledge of the sales strength of an item does result in differences during item sampling. This is because generally speaking, the price collector at the retail outlet can only get a rough idea of which items actually sell best by consulting with the sales staff. As a result, items are replaced less often and their price is tracked as long as possible. Moreover, if several replacement products are available, the one which is most similar in terms of quality is generally selected. This makes it possible to make necessary quality adjustments. With scanner data, however, the software clearly indicates the replacements item because of its sales strength.
and independently of its quality characteristics (though all items within the same survey position usually have more or less similar characteristics). As a result, when an item is discontinued, there is often a greater difference between the new and the old product than with the traditional survey. Therefore, the decision as to which method of quality adjustment is to be used when replacing an item is more complex. But the same options (direct substitution, overlapping link method, new price series) are available as in the traditional survey.

Moreover, as a result of continuous monitoring of changes in sales, items generally have to be replaced more frequently than is the case with the traditional survey.

5.3.3 Identification of the price reference quantity

When selecting a new product, the volume to which the calculated average price of an item refers must always be checked and manually entered by the price collector. This is because although in the scanner data, a sales unit and volume (e.g. 300 gram) for each item are given; the calculated average price sometimes refers to a standard volume (e.g. 1000 grams). Whether such a conversion has taken place is not explicitly stated in the scanner data of most retail chains and must therefore be checked by the price collector. To do this, various methods are available, such as comparing the average price with similar items or searching the item in an online shop, etc.

5.4 Allocating items to the COICOP

All retail chains use their own basket of commodities with specific range structures which are not identical to the nomenclature used for the current international consumer price index, the COICOP nomenclature, also used by the Swiss CPI. Therefore, for the price survey with scanner data, every item must be allocated to the correct survey position in the CPI basket of commodities.

In the pilot software, the items are allocated by linking the product range structures at an aggregated level (as high as possible and as low as necessary). Instead of linking each item individually, groups of commodities, which generally contain various items, are allocated to the CPI basket of commodities. This allows the time and expense of the initial allocation to be significantly reduced. In addition, items which are subsequently incorporated into the product range of the retail chain can automatically be allocated to the CPI basket of commodities by means of higher-level link and do not have to be allocated manually.

The retail chains’ product range structures are often structured according to different criteria from the COICOP (e.g. brands vs. type of items such as deodorant, body lotion, face cream, etc.). This leads to a number of multiple allocations of positions and overlaps which have to be laboriously corrected by the price collector at the item-level. The resulting additional work expended is considerable.

Retail chains’ product range structures are also subject to permanent and sometimes weekly changes which are usually announced on very short notice or even after the fact. Therefore, the correct allocation after each change at the aggregated commodity basket level is very costly and time-critical for the price collection. Consequently, the extension of this allocation process to additional retail chains could lead to time constraints and an increased susceptibility to errors. As a result, an alternative solution for the allocation of items to the CPI basket of commodities was sought.

Some market research institutes have long been receiving scanner data from the retail chains on a regular basis and evaluate them for their own purposes. All items are first individually allocated by specialist staff to the nomenclature of the market research institute. Linking this nomenclature with the COICOP is a small effort for the market research institutes and is also a new opportunity to gain additional benefit from their work to date. In this way, this information can be purchased relatively cheaply.
For the FSO, the purchase of item allocation data also has several advantages: Because the allocations are carried out by the institute's trained specialised staff, their quality is generally high. The main advantage, however, is the separate allocation of each individual item to the COICOP instead of a linkage of higher-level positions, as is the case with the pilot software. In contrast to the FSO, the market research institutes have the necessary personnel resources for this. The allocation at the individual item level means that the very frequent changes in product range structure made by the retail chains no longer have any effect on existing links. Time constraints can thus be avoided and the error rate of the system markedly reduced.

Since the purchase of allocation data means that the FSO does not have to carry out an initial allocation of all items, there are considerable time and cost savings. Staff members can focus instead on their core competence, price collection, and no longer have to deal with the allocation of items. As a result, it is now hardly ever necessary to ask the retail chains to clarify uncertainties, which eases the burden on the latter. Because the market research institutes have a very broad data base, this new solution also guarantees flexibility as far as extending the scanner data collections to additional retail chains and groups of commodities is concerned.

Consequently, the FSO has decided to purchase from a market research institute item allocation data for each retail chain which are updated on a monthly basis.

### 5.5 Chronological sequences

This Swiss consumer price index for month $y$ is published at the very beginning of the following month $y+1$. To allow enough time to make a plausibility check of the results, manual monthly updating of item selection and export of the relevant data to the CPI software application must be concluded by the 20th of the month at the latest. However, as scanner data are available after only two to three days and because a week is reserved for the updating of the item sample, the collection period is in principle confined to less than ten days per month.

This constraint is to be overcome, however, by dividing data delivery into two parts. The retail chain transfers its scanner data twice a month (on the 9th and 16th of the month) to the FSO. Prior to sending, data are pre-aggregated for three different periods of time:

1.) Analysis period AP (the first 7 days of the month)
2.) Collection period CP (the first 14 days of the month)
3.) Total month TM (all days of the month)

The first data delivery that takes place on the 9th day of every month includes the pre-aggregated sales volumes and quantity of the

- analysis period AP (7 days) of the current month and of the
- total month TM (31 days) of the previous month

Using the data from the first delivery, an update is carried out between the 10th and 14th day of the month of the sample of the best selling items. In order to increase the continuity of the item sample, the total monthly sales volumes of the few previous months are also used for most item groups.

The second data delivery takes place on the 16th day of the month, containing the data from the first 14 days (collection period CP). The prices it contains are used for the calculation of the CPI on the basis of the previously updated item sample.

Dividing the data delivery into two parts enables monthly updating of the item sample before the availability of all data that are used for the index calculation. By so doing the collection period can be extended over 14 consecutive days of the month.
5.6 Treatment of multipacks

The term "multipacks" refers to temporary special offers on an item (e.g. "three for two"), which are sold for a certain time alongside the single item. These special offers are usually packed separately and are given a different item number from the single item. For that reason, it is unfortunately not possible with scanner data to identify multipacks and single items as the same product. For price measurement in the CPI, however, multipacks up to a maximum of three products are regarded as a normal price reduction (in a special "three for two" offer, the price change, disregarding the single item still on sale, is -33.3%). The significance of multipacks in terms of sales is comparatively high in Switzerland and should not be ignored when measuring price changes in the CPI. The user therefore has to inform the software when a multipack and a single item are the same product. The application then adds up all the sales and quantities of this product (single items and multipack combined) and divides the total sales price by the total quantity sold. The average transaction price paid per item calculated in this way is then compared with the price in the previous period. However, the user is dependent on external information to find out which single items match which multipack(s). To this end, most retail chains use special offer registers that they make available to the FSO every month.

5.7 Treatment of seasonal items and missing prices

Because of their irregular availability, seasonal items require separate treatment both in traditional price collection and in collection using scanner data. The Swiss CPI software for price collection with scanner data therefore makes provision for indicating seasonal items as such and for stipulating the specific collection months in each case. In addition, separate validation rules for monitoring sales movements are implemented for seasonal items, to prevent the software generating irrelevant warnings outside the season (when there are no sales).

By selecting the best selling items on one hand and with every single transaction from every outlet nationwide being registered in scanner data on the other hand there are usually not many missing prices to be treated (except for seasonal items). When it happens the FSO uses the "carry forward" method for a short period of time.

5.8 Results of the test price collections

Before the productive introduction of scanner data collection, a test price collection was carried out among the previous retail chains using data from the past. For the first enterprise this covered a period of 24 months and for the second, a period of 12 months. A comparison of the results with the indices of the traditional price collection of the same period ("traditional indices") produced similar results with both retail chains:

- Some clear differences emerge as to the evolution of indices for individual positions and groups of commodities. These can be explained by the extended spatial and temporal coverage of price data and in particular by the improved item sample.

- The volatility of the scanner data index is generally higher especially at the lower aggregation level. This can be explained in particular by the systematic inclusion of all special offers and sales promotions.

- In the case of one retail chain, the differences observed between the indices in particular at the lower level are on the one hand levelled out at the aggregation to higher groups of commodities. On the other hand, the remaining differences at higher aggregation levels during some periods are levelled out over a period of time.

- For the test price collection at the other retail chain, a considerable difference remains between the traditional and scanner data index at a high aggregation level and over a period of time. Detailed analysis showed that the difference observed can be explained in particular by the improved item sample in conjunction with the unusual price trend of a spe-
cial large product line. Its items are distributed throughout the whole product range in numerous product groups. However, the frequency with which they are included in the sample by the traditional collection and the scanner data collection varies considerably depending on the sales volume information that is available. This is accordingly noticeable in the indices. However, by excluding the items of this particular product line from the index calculation, the two indices followed a similar trend in the case of this retail chain too.

- A similar observation could be made with regard to temporary price reductions, e.g. in the form of special offers. Because the latter involve costs for the retail chain and have to be financed, they are usually primarily carried out for the items with the highest sales volume from a group of commodities. During the test price collection it was shown that for one retail chain the total number of special offers and thus the price level of the whole range of products changed significantly from one year to the next. When asked, the retail chain confirmed the modification in their marketing strategy that was behind this change. But because it did not allow for systematic selection of those products with the highest sales volume, this difference was less evident with the traditional collection. Therefore scanner data allows better recognition and representation of special offer strategies over a wide product range.

6 Conclusion and unanswered questions

The experiences gathered thus far show that the price collection with scanner data brings real advantages also when used in conjunction with traditional collection methods. The improved data set that includes not only a greater temporal and spatial coverage of price information but also with sales volume figures makes available in particular the necessary basis for a targeted selection of the best selling items, is clearly reflected in the results. At the same time, not having to carry out price collection results in medium-term savings and a reduction in the burden on the retail chains.

Despite the numerous advantages already achieved, the current method does not, however, realise the full potential of scanner data for the collection of prices. Therefore while extending scanner data to other retail chains, the FSO is also examining alternative collection and calculation methods that should make even better use of the improvements and rationalisation that scanner data can bring. The question of the suitability of the implicit methods of quality adjustment for a scanner data collection in the non-food area is particularly interesting. In order to answer this and other questions, the FSO will be seeking increased exchange of information and collaboration in important areas at international level in the future.