

Weighting of Outlet-types and Regions – a new Weighting System for the German Consumer Price Index

1. Introduction

1.1 Background

A new weighting system in consumer price statistics has been introduced in Germany in January 2008. This regards the German Harmonised Consumer Price Index (HICP) as well as the German national Consumer Price Index (CPI). The aim was to improve and to ensure the quality of the sample with respect to the representation of outlet-types and regions.

During the last decades, it could be observed that consumers are increasingly geared to a number of different shopping possibilities and that their loyalty to retail outlets in the neighbourhood decreases. At the same time, both an increasing price orientation and increasing brand awareness can be recorded.

These trends of consumer behaviour cause changes of the retail landscape. Thus, the relevance of price oriented outlet-types as “discount shops” or “retail warehouses” outside the city further increases. With regard to the regional dimension, the area of action when choosing an outlet is less characterised by a system of central locations where all goods of a certain consumption period are bought in the nearest centre. Rather an increasing multiple-orientation of consumers can be observed. Purchases are made not only in the nearest localities but also in neighbouring localities or in distant centres.¹

A challenge for consumer price statistics results from these structural changes to adequately consider the different outlet-types and to combine them with the regional dimension of the sample. A European regulation on the HICP states that all monetary transactions of private households on the economic territory of a member state shall be represented.² The population to be covered by the sample thus consists of all product-offers in Germany that are obtainable for private consumers. In this context it is not only relevant which products are offered but also in which outlets and regions these products are obtainable. Furthermore, the European regulatory framework regulates that member states are responsible for establishing and maintaining a clear design of the target sample.³

Germany is a big country. For the sample of German consumer price statistics, data are collected from roughly 30,000 outlets or service providers in approximately 190 municipalities.⁴ Further-

¹ See Bundesamt für Bauwesen und Raumordnung, Raumordnungsbericht 2000, pp. 73-74, Bonn 2001, or Linz, Stefan: Strukturwandel im Einzelhandel – Herausforderung für die Raumordnungspolitik, Frankfurt am Main 2002.

² See European Council Regulation (EC) No 1688/98, 1998. Furthermore, the European Commission Regulation (EC) No 1334/2007 states that “The ‘coverage’ of the HICP, that is the statistical ‘target universe’ to be represented by the HICP, means the set of all transactions falling within the scope of household final monetary consumption expenditure.”

³ See European Commission Regulation (EC) No 1749/96, Article 9d, 1996, amended by Commission Regulation (EC) No 1334/2007.

⁴ The sample does at the same time deliver the data for the calculation of the HICP and the national CPI.

more, the German Statistical System is organised in a federal way, dividing work between the Federal Statistical Office and 14 independent Land Statistical Offices.

Following the Basic Constitutional Law of the Federal Republic of Germany, the Federal Länder shall execute federal laws in their own right. This does also apply to the German official price statistics, which is legally based on federal laws as well as on directly effective legal acts of the European Union.⁵ Therefore, in general it is the task of the Land Statistical Offices to conduct the data collection related to consumer price statistics. On the other hand, the Federal Statistical Office is responsible for a methodological and technical preparation and further development of federal statistics in consultation with the Land Statistical Offices.⁶

The authority of the Federal Statistical Office is thereby limited to ensuring that the Land Offices execute their duties in accordance with the respective laws. But the relevant laws do not give exact guidelines for the sample of price statistics prescribing in which outlets and regions the prices shall be observed. A rigid prescription on a detailed level would anyway not be sensible as the consumer habits are constantly subject to changes. Thus, the Federal Office may only work towards ensuring a uniform and duly implementation of federal statistics. This, however, does not obligate the Federal Länder – they have a scope of action, which allows for deviation from the requirements of the German Federation.

Against this background, it is important for ensuring the quality of the sample that the Federal Statistical Office and the Land Offices voluntarily agree on common conventions regarding the quality of the consumer price statistics sample. These conventions should be accepted by all parties. Furthermore, they have to be flexible enough to allow for reactions on changes in the consumer behaviour and for specific regional circumstances in Germany. At the same time, they should be concrete enough to ensure both quality and uniformity. Finally, they should be explainable to the users of price statistics.

It is an important advantage of the new weighting system that it creates such a commitment for the sample of German consumer price statistics. In principle, the same rules apply to all Federal Länder: Every outlet-type with market relevance of more than 5% shall be covered by price collection. The German territory is systematically divided in roughly 100 regions whereby prices shall be collected in each region. This applies in general to all goods covered by price statistics, except for certain durable goods and for clothing, as will be described below. Furthermore, the number of price observations collected in the regions should reflect their regional economic importance. Summing up, comprehensive conventions for the construction of the sample are already – or respectively will be – created with the new system.

In order to achieve these conventions, a stepwise process is applied:

- (1) The Federal Statistical Office first calculates rough benchmark values, which are systematically derived from retail statistics, regional national accounts, market research institutes, etc.
- (2) In some cases, the regional breakdown is not detailed enough so that the rough benchmark data have to be adjusted to the specific circumstances within the different Federal Länder. Furthermore, aspects of cost efficiency have to be taken into account. It may for example not be

⁵ See German Law on Price Statistics: Gesetz über die Preisstatistik, 1958, as well as Eurostat: Compendium of HICP reference documents, Luxembourg 2001.

⁶ See German Federal Statistics Law: Gesetz über die Statistik für Bundeszwecke, Article 3 (1), 1987.

reasonable for a Land Office to send a price collector to a far-off city just to observe prices for a single product in one specific outlet-type. In some cases, data collection costs have to be put in relation to increases in accuracy. The adjustment of the rough benchmark values to the regional circumstances within the Federal Länder is done by the Federal Statistical Office in close cooperation with the Land Offices. The results will be concrete guiding values for the number of prices to be observed for every product, outlet-type, and region within Germany.

(3) Having settled the guiding values, it is the duty of the Land Offices to adjust their price observation samples to the agreed figures. This needs some time, as considerable rearrangements might become necessary. Overall, roughly 300,000 prices are observed in Germany each month. The new weighting system shall not fundamentally change the sample size – the overall number of price series shall thus remain rather constant. However, in order to meet the above stated requirements, around 30 to 50 per cent of the price series need to be reallocated to outlet-types and regions.

The implementation of the new system is being carried out stepwise. The first step was taken in 2008 with the introduction of the outlet-type weighting. Simultaneously, the Federal Statistical Office and the Land Statistical Offices began to introduce the so-called regions model in order to improve the spatial coverage of the consumer price index.

The next section introduces some terminology related to sampling and weighting. Section 2 provides details on the outlet-type weighting in Germany whereas in section 3 the regional sample is described. Section 4 addresses the combination of outlet-type and regional weighting. In section 5, some empirical results are presented and section 6 concludes.

1.2 *Weighting in price statistics*

Price statistics is a sample survey. In the terminology of the Harmonised Index of Consumer Prices, the set of product-offers initially selected by the price statistician in order to observe prices is called “target sample”.⁷ In constructing a target sample, not only the issue of which goods to choose plays a role but also which outlets and which regions are relevant. In practice, mixtures of different sampling approaches (such as purposive or cut-off sampling) are used often. These mixtures do in many cases include a stratification, where the target universe is first divided into several strata and the units are then selected within each or within the most important strata.

When stratifying, the stratum results are extrapolated to the universe for the calculation of the overall result. This is done with the help of **weighting** – by multiplying each stratum result with a stratum weight. The weighting factors are proportional to the size of the stratum in order to achieve a good representation of the universe. In general, the weighted overall result in the sampling theory is calculated as follows:⁸

⁷ For the terminology of the Harmonised Index of Consumer Prices, see Handbook on the Application of Quality Adjustment Methods in the Harmonised Index of Consumer Prices, Destatis, Wiesbaden 2009 (forthcoming).

⁸ For an overview of sampling methods see Kreienbrock, Lothar: Einführung in die Stichprobenverfahren, Oldenbourg Verlag, München, Wien 1993.

The overall result is calculated as the weighted mean of the partial results of the strata:

$$(f1) \quad y = \sum^h (x_h \cdot G_h), \text{ with}$$

y ... overall result (e.g. overall price index)

x ... stratum result in stratum h (e.g. price index for a type of good)

G ... stratum weight (or weighting factor)

h ... numbering of strata ($h=1, \dots, L$)

The weight of stratum h is proportional to the size of the stratum:

$$(f2) \quad G_h := \frac{N_h}{N}, \text{ with}$$

N ... size of the universe (e.g. overall consumption expenditure)

N_h ... size of the stratum (e.g. consumption expenditure for one group of goods)

In German price statistics, strata results are calculated as (unweighted) Dutot-Indexes:

$$(f3) \quad x = \frac{\sum^i p_{it}}{\sum^i p_{io}}, \text{ with}$$

i ... numbering of price observations in stratum h ($i=1, \dots, k$)

p_{it} ...observed price for good i within stratum h in the current month

p_{io} ...comparable price for good i within stratum h in the base period

A sample can be designed more efficiently with the help of stratification. When constructing random samples, a given random error can be achieved with a smaller sample size by using stratification. The efficiency improvement of the sample resulting from the application of stratification is referred to as **stratification effect**.⁹ A further important advantage of stratification lies in the fact that certain elements are unavoidably included into the sample. The given strata provide for an inclusion of these elements in any case.

Samples in consumer price statistics are usually not random samples. The principle of stratification can nevertheless be applied and with that, an increase in efficiency via the stratification effect can be expected. Furthermore, by stratifying the consumer price sample an inclusion of certain outlet-types or regions into the sample in any case can be achieved. To reach this aim, strata should be built in which the development of prices is relatively homogeneous whereas the price development between the strata should be heterogeneous. In other words, the stratification variables should be correlated with the target variable, which is the development of consumer prices.

⁹ See Kreienbrock, Lothar: Einführung in die Stichprobenverfahren, Oldenbourg Verlag, München, Wien 1993.

In price statistics, weighting according to types of goods is the normal case. In Germany, the overall result of consumer price statistics has always been calculated as a weighted mean of strata results, according to the Laspeyres-formula:

$$(f4) \quad y = \sum_h \left(\frac{\sum_i p_{it}}{\sum_i p_{io}} \cdot G_{ho} \right)$$

The weights G_{ho} are established according to shares in private consumption for types of goods in the base year (following an adapted COICOP¹⁰ classification). Moreover, the consumer price index of Germany was stratified according to the Federal Länder already before 2008.¹¹ A weighting of outlet-types is, however, not a standard element of consumer price indexes and was introduced in Germany with the adjustment of the national consumer price index to the base year 2005, which took place in January 2008 – as described in the next section.

2. Weighting of outlet-types

2.1 Classification of outlet-types

For the implementation of the outlet-type weighting, a “classification” of outlet-types had first to be developed. Following the principle of stratification, the retail outlets belonging to the same stratum should exhibit a similar price development whereas the price development between strata should preferably be different.

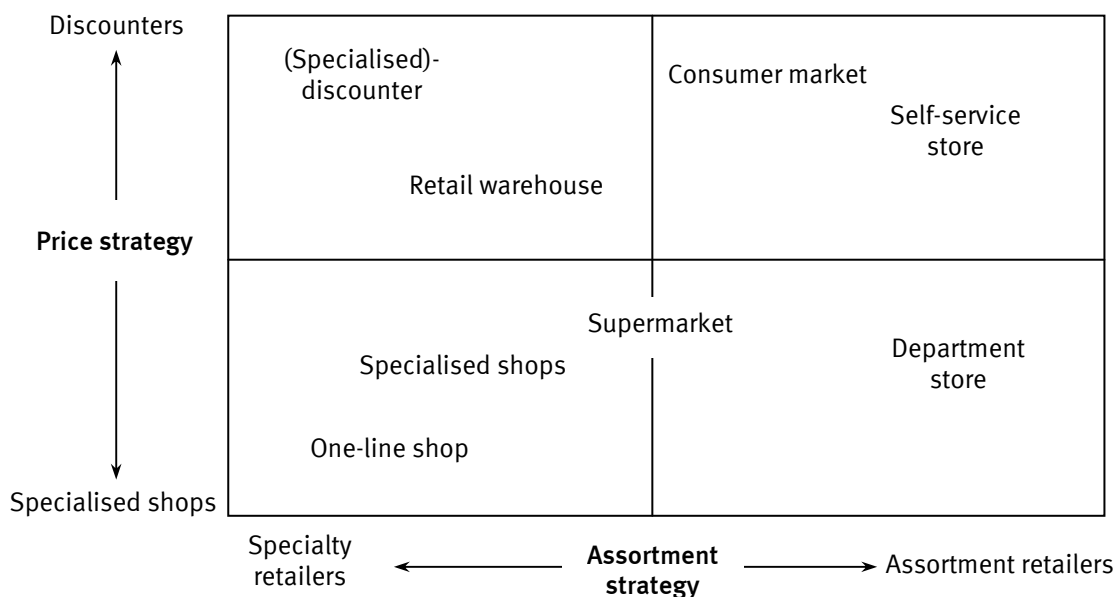
A differentiation according to the pricing strategy of the retailers seemed sensible, which yielded a first differentiation between “discounters” on the one hand and “specialised shops” on the other hand. Discounters concentrate on the physical distribution of fast moving consumer goods in a small assortment at low calculated prices. Specialised shops, on the other hand, offer a deep, often specialised assortment at different qualities and price levels, usually combined with consulting services.

Furthermore, retail outlets can be differentiated according to the scope of their assortment: Speciality retailers such as specialised shops, specialised discounters, and retail warehouses are rather specialised on a narrow assortment. On the other hand, department stores and self-service stores offer a rather broad assortment without emphasis on any product type. Retail outlets with a broad assortment have better options for mixed calculations and therefore more price setting options for a particular product group. For this reason, a differentiation between these outlet-types seemed sensible. The result would be a classification encompassing the price and the assortment strategy. The chart below serves as a simplified illustration by means of examples.

¹⁰ Abbr. for Classification of Individual Consumption by Purpose.

¹¹ See box “Gewichtung im Verbraucherpreisindex”, in: Behrmann, Timm: Preise im August 2003, Wirtschaft und Statistik 09/2003, Destatis, Wiesbaden 2003, p. 862.

Chart 1: Differentiation of retail strategies



However, the differentiation characteristics, which can be used in a theoretical framework, are not always transferable into praxis on a one-to-one basis. In practise, it was important to rely on objective, distinctive features, which could be used to classify the different outlet-types. Furthermore, it was desirable that the classification was largely consistent with the division of the retail statistics in order to allow for the use of the turnover information for the calculation of the respective weights, as discussed below. Finally, eight outlet categories were established which were largely based on an existing classification in price statistics (see chart 2).

Chart 2: Outlet categories of consumer price statistics

Outlet-type	Key
Large store / department store	1
Consumer market / self-service store	2
Supermarket	3
Discounter / retail warehouse (big box formats)	4
Specialised shop	5
Remaining retail	6
Public and private service centres, renting	7
Mail order, online shopping	8

Further research is needed in order to improve this classification of outlet-types. A contribution could be gained from an analysis of the microdata of the “annual retail survey”.¹² The annual retail survey includes data on the number of enterprises and local units, persons employed, turn-

¹² See Faber, Cathleen: Geschäftstypengewichtungen für den Verbraucherpreisindex aus amtlichen Mikrodaten des Einzelhandels, in: Messung der Preise, Tagungsband, Frankfurt am Main 2007, pp. 111-121.

over, cost, investments and the like.¹³ The issue would be to define clusters of outlets which show similar price developments, whereas the clusters have to be defined by measurable characteristics – such as number of employees or cost structures – relying on the data available in the microdata set.

The next step was to assign the outlets that are selected for price observation in Germany to the above listed outlet-types. This task comprises that all outlet-types, which are included in the price observation process, are categorised by using a consistent key (see second column in chart 2). Every price that is collected for consumer price statistics is assigned to the outlet-type in which it is collected following this key.

The correct and consistent assignment of reporting units is an important pre-condition for the introduction of an outlet-type weighting system. It constitutes the connection between a price series and its weighting factor. However, important is not the absolutely exact definition of what constitutes a discounter or a supermarket, etc. It is more important that the assignment of outlet-types to the outlet classification is consistent with the way in which the weights are calculated.

2.2 Calculation of weighting factors for outlet-types

For the calculation of weighting factors, information on the market shares of the above mentioned outlet-types is needed for every type of good and theoretically also for every region. This information can be used to weight prices that were collected in the outlets belonging to a certain outlet-type.

The most important source of information is the official retail trade statistics, which provides comprehensive data on the sales structures in the German retail industry. The general structure of the German annual retail survey is outlined in chart 3. The result of this survey is, in principle, a table, which distinguishes between economic sectors in the columns and between product types in the rows. The retail companies are assigned to economic sectors according to the focus of their sales, following the Classification of Economic Activities, Edition 2003 (WZ 2003), which is closely related to the Statistical Classification of Economic Activities in the European Community (NACE)¹⁴.

Chart 3: Structure of results of the German annual retail survey

	Economic sectors →			
Product types ↓	Total sales of the assigned companies with the referring product type	...		
	...			

¹³ See the annual series “Binnenhandel, Gastgewerbe, Tourismus: Beschäftigte, Umsatz, Aufwendungen, Lagerbestände, Investitionen und Warensortiment im Handel – Fachserie 6 Reihe 4”, Destatis, Wiesbaden, diverse volumes.

¹⁴ WZ is the abbreviation of “Wirtschaftszweig”, which means branch of economic activity. The WZ classification was recently adapted to WZ 2008. For the NACE codes see Eurostat: NACE Rev. 2 Statistical classification of economic activities in the European Union, Luxembourg 2008.

There are in principle three issues connected to using this survey for the calculation of weights for outlet-types:

(1) Assigning retail companies to outlet-types

The annual retail survey does in general not assign companies to specific outlet-types but to branches of economic activity. However, following the assortment structures as described in the classification of economic activities, the outlet-type is in some cases relatively obvious. For example, companies belonging to the WZ class “retail sale of non-specialised stores (non-food)” are mainly retailers operating with the outlet-type “large stores and department stores” (key no 1 in chart 2).

Nevertheless, the distinction between specialised shops and retail warehouses on the one hand and between supermarkets and food discounters on the other hand remains difficult. Furthermore, the position covering mail order and online shopping in the retail statistics does not take account of all channels which are relevant in consumer price statistics.

Therefore, for the compilation of market shares of outlet-types, information from market research institutes and associations were used besides official data. Furthermore, an evaluation of data from trade journals, newspapers, and from the internet helped to improve the available data. In some cases, when detailed information was not available, the existing allocation of price observations in consumer price statistics was used for calculating the weights assuming that the existing allocation provides indication of the actual market shares.

(2) Breakdown of sales volumes by product types

The product types of the retail survey do in many cases comprise different COICOP 10-digit headlines, which are the lowest level of the breakdown in product categories in German price statistics. The product type “consumer electronics and accessories (including audio-visual storage media)” in the retail survey, for example, contains TV sets but also blank DVDs. These products are often bought in completely different outlet-types. In order to determine the weights for different outlet-types, market share information is needed on a more detailed level as every price development on the COICOP 10-digit level finally had to be assigned with a respective weight.

In some cases, the market shares on the 10-digit level were identified by means of additional information obtained from market research institutes. In other cases, it was simply assumed that the market shares of outlet-types on the lower level are proportional to the market shares for the headline product type specified in the retail survey.

(3) Regional breakdown of sales volumes

A regional breakdown of the results from the annual retail survey is not possible. The annual survey does contain regional data but this refers to companies rather than to outlets. However, the turnover of a company is assigned to the region in which the company has its domicile and not to the location of its outlets. For example, when an enterprise is located in Lower Saxony the whole turnover of all its outlet stores, which may be located throughout Germany, is assigned to the Land Lower Saxony.

The monthly surveys in trade, restaurant and hotel industry provide auxiliary information here.¹⁵ These surveys also collect information on outlet sales at least for each Federal Land. The disadvantage of the monthly surveys is that they do not contain a classification according to product types. Thus, the total sales of the outlets can be connected to regions, but it cannot be observed from which product types these sales resulted. The chart below outlines the structure of the monthly surveys, as prepared for the purpose of this project.

Chart 4: Monthly surveys in trade, restaurant and hotel industry

	Economic sector →			
Federal Land ↓	Total sales of the assigned outlets	...		
	...			

The information from the monthly surveys could be used to calculate region-specific weights for the outlet-types. The weighting information could thus be differentiated for the German Federal Länder. However, some simplifying assumptions had to be made. For example, it had to be assumed that the sales share of shoes in the outlet-type ‘department store’ is the same in all Federal Länder – whereas the market shares of “department stores” are different between the Länder. This constitutes simplification which is however necessary. It is needed as for many product types no exact sales data were available for the Federal Länder neither from official statistics nor from market research institutes (at acceptable prices).

In addition, several Land Statistical Offices provided information that was specifically relevant for their respective Federal Land. The compilation of weights was a stepwise process as described in section 1.1. The Federal Statistical Office proposed benchmarks and then jointly determined the weights together with the Land Statistical Offices that were finally used. In this way, the Land Offices could contribute their specific knowledge of the retail structures in their respective Land. Less than one percent of the weighting volume proposed in the benchmarks was adjusted in this alignment process.

The advantage of an outlet-type weighting scheme is that additional information on the market shares of outlet-types is included into price statistics. Prior to its implementation, solely the practical experience of the Land Statistical Offices was relevant for the representation of outlet-types. Furthermore, there was no possibility to check the quality of the sample with regard to the coverage of outlet-types by using market data. In this respect, the new system is in any case an improvement – even considering the fact that weighting factors cannot completely be calculated based on survey data.

The Information on market shares are used for two purposes: For the determination of relevant outlet-types and for weighting the observed price development. Regarding the relevance of a specific outlet-type, all outlet-types with market shares over a defined threshold (e.g. 5% market share) should be considered whereas outlet-types exhibiting smaller market shares can be ne-

¹⁵ See Destatis, monthly series: “Beschäftigte und Umsatz im Einzelhandel – Fachserie 6 Reihe 3.1”, Wiesbaden, diverse volumes. For the purpose of outlet weighting the regional data were restructured.

glected. As the retail landscape is subject to an ongoing change, the additional information has to be updated every five years analogously to the regular revision intervals.

2.3 Calculating outlet-type-weighted price indexes

For the calculation of outlet-type-weighted price indexes, the observed price developments are weighted according to the estimated sales share of the referring outlet-type. The number of price series that are collected for each outlet-type does thereby not have to correspond to the weight of this outlet-type. Weighting explicitly leaves several possibilities of distributing the sample size to the strata. In general, the following possibilities exist concerning the distribution of the sample size to the strata: ¹⁶

(f5) **even distribution** $a_h = \frac{1}{L}$, with:

L ... number of strata
 a ... sampling fraction in stratum h

When distributing evenly, the same amount of sample units is selected for each stratum. This distribution considers neither the stratum weight nor the stratum variance. It is therefore not suitable to maximise the desired stratification effect. However, opposed to un-stratified samples, such stratification may already improve the results.

(f6) **proportional distribution** $a_h = \frac{n_h}{n} = \frac{N_h}{N}$, with:

a_h ... sampling fraction in stratum h
 n_h ... number of sample units selected in this stratum
 n ... overall sample size
 N_h ... size of stratum h
 N ... size of the universe

When stratifying with a proportional distribution of the sample size, the sampling fraction per stratum is proportional to the size of the stratum. The results correspond to those of a “self-weighted” sample.

(f7) **optimal distribution** $a_h = \frac{N_h \cdot V_h}{\sum_h (N_h \cdot V_h)}$, with:

a_h ... sampling fraction in stratum h
 N_h ... size of stratum h
 V_h ... variance in stratum h

When using the optimal distribution, the sample size per stratum is proportional to the size and to the variance within the stratum. This kind of distribution is especially efficient as it maximises the stratification effect. Following the principle of the optimal distribution, the number of avail-

¹⁶ Siehe Kreienbrock, Lothar, Einführung in die Stichprobenverfahren, Oldenbourg Verlag, München, Wien 1993.

able price series per outlet-type should be geared to the difference in price development between the outlets of this outlet-type. If, for example, there is a widely consistent price development for food discounters in Germany due to an oligopolistic market structure, only relatively few price series need to be collected for this outlet-type. The high relevance of food discounters in Germany will then be considered by the explicit weight of this outlet-type. However, in practice these aspects can at this stage only be used as a rough guideline since the exact price variance within the strata is unknown. If the outlet-type weighting scheme is in use for some years it might be possible to estimate the variance of the price development within segments of outlet-types by means of empirical data. By using this information, the efficiency of the sample could be further improved. For the time being, only minimum amounts of price observations as well as benchmarks were defined for each relevant outlet-type per Federal Land. The Land Statistical Offices adapt the number of price series per outlet-type based on their experience in collaboration with the Federal Statistical Office.

3. The “Regions Model”

3.1 The hitherto existing spatial sample

Until 2008, prices for consumer price statistics were collected in a fixed selection of 188 municipalities, which had mainly been established several decades ago. In the first step, an unweighted mean of the price developments in the municipality was calculated. In the second step, the elementary indexes for each type of good and Federal Land were calculated as unweighted arithmetic means of the price developments within the selected municipalities. By proceeding this way, the price developments of small municipalities entered the overall index of the respective Federal Land with the same weight as the price development of big municipalities. Additionally, not all types of goods were collected in all municipalities: 50% of the basket of goods was only observed in selected big cities or covered by central data collection, 10% of the basket was collected in 153 reporting municipalities, and only 40% of the basket was priced in all 188 reporting municipalities. The system was relatively inflexible as a price collection beyond the municipality borders was nearly impossible. Thus, a reaction on changes in the consumer behaviour – such as a trend towards buying in shops on a greenfield site – was hardly possible.

3.2 The basic concept of the regions model

The idea of the regions model is to stratify the territory of Germany into approximately 100 regions. This equals a division on a level between NUTS 2 and NUTS 3.¹⁷ The stratification is geared to the so-called “regional planning areas” of the Federal Institute for Research on Building, Urban Affairs and Spatial Development (see box on page 12). In principle, prices for all goods of the basket of goods shall be collected in all 100 regions. However, also in the regions model there are exceptions:

For some goods, the effort of price observation is higher. Especially, for electronic goods, which often exhibit a high rate of technical progress, quality characteristics have to be observed in addition to prices. To lower the burden of data collection the number of regions selected for price observation is decreased in these cases. A similar reasoning and additionally the problem of seasonal fluctuations in the case of clothes also led to a reduction of regions for price observation for this type of good.

¹⁷ ‘Nomenclature des unités territoriales statistiques’, which means ‘classification of territorial units’.

Regional Planning Areas

The Federal Institute for Research on Building, Urban Affairs and Spatial Development defined 97 regional planning areas, which delimit functionally connected regions within Germany (see map below). The criteria for defining the regional planning areas are:

- existence of a well reachable centre
- consideration of settlement linkages as well as natural conditions
- consideration of social, historical and economical linkages
- division into approximately equally-sized areas
- consideration of administrative divisions to alleviate planning tasks and to allow for data aggregation

Source: Bundesforschungsanstalt für Landeskunde und Raumordnung: Raumentwicklung in den alten und neuen Bundesländern, Bonn 1991, pp. 1-2. See also www.bbsr.bund.de.

Karte Raumordnungsregionen 1.1.2004



On the other hand, a higher regional variance in price developments can be observed for rents; therefore, more than 100 regions should be included in the sample for this part of the consumer price index: Within the 100 regions there are sub-regions on a narrower level (NUTS 3), which can be assigned to certain sub-region types. There are several sub-region types, such as urban areas, rural areas, and the like. The idea for rents is to combine the two variables, ‘region’ and ‘sub-region type’, for stratification in the following way: Within one region, each sub-region type should be represented once. In this way, the number of sample units within one region relies on the heterogeneity of the region with respect to the sub-region types.

Within each region, the data collection is carried out in one reporting municipality at least. Nowadays, most consumers are very mobile. Thus, one can speak of close connections within one regional planning area and expect more or less homogeneous price developments within one region. As a rule, one municipality per region may therefore suffice.

In many regions, one of the previous 188 municipalities can be taken over for price observation in the new system. In these cases, there is no need for changes in the selection of municipalities. Some regions are currently covered by price observations in more than one municipality. In these regions, some municipalities could be closed for most types of goods. Furthermore, there are some regions that are currently not covered by price observation. In these regions, additional municipalities have to be included for price observation.

3.3 Weighting in the regions model

In the language use of consumer price statistics, the terms “explicit weighting” and “implicit weighting” have become common. When transferring these terms to the principle of stratification, implicit weighting is the special case of stratification with a proportional distribution of the sample size (see formula f6 above) while explicit weighting describes stratification with any other kind of distribution of the sample size.

The weighting of regions is carried out implicitly, i.e. by the number of collected price series within each region. The higher the number of price series in one region, the higher will be the impact of the price development of this region on the overall index. As described above, in the former system an unweighted mean of the price developments in the municipalities was calculated. In the new system, sub indexes for one type of good in one outlet-type are calculated as unweighted means of the respective price developments observed within all regions of a Federal Land. This yields an implicit weighting of the regions within the Federal Land.

The weight of the region, i.e. the number of price series should reflect the sales relevancy of the region, which is identified by good-specific key figures. Depending on the COICOP-class, different key figures are reasonable. For example, the sales relevancy concerning hotels can be determined by the number of employees in the hotel sector. Regarding different kinds of services, the disposable income of the residents of the region might be more appropriate.

3.4 Implementing the regions model

Having started in 2008, the implementation of the regions model will successively be completed until 2014. The first step in January 2008 was to stop the calculation of average price developments for municipalities. However, the adjustment of the number of price observations within the regions to their economic relevancy has to be improved for some regions. This requires a rela-

tively extensive re-allocation of the sample and therefore the adaptation will be performed stepwise until 2014, each at the turn of the year.

4. The German weighting system

4.1 Combining the weighting of outlet-types and regions

How can the weighting of outlet-types be combined with the regions model? Ideally, complete information would be available on the distribution of all retail sales across the regions of one Federal Land. In this case, the exact market shares of the different outlet-types would be known for each region of the respective Federal Land.

In the following, the ideal case is illustrated by using a simple example: Let us assume that one type of good (chocolate) is sold in four relevant outlet-types. The exemplary Federal Land consists of three regions (see chart 7). In each region, prices would have to be collected for all relevant outlet-types in order to reflect the price development of the respective type of good for the complete Federal Land. In the next step, the collected prices would have to be weighted with the respective market shares.

Chart 7: Market shares of chocolate within one Federal Land (example)

	Discounter/retail warehouse	Supermarket	Department store/large store	Consumer market/self-service store
Region A Agglomeration	30%	35%	10%	25%
Region B Urbanised	40%	30%	5%	25%
Region C Rural	45%	25%	0%	30%

In practice, the information in the table above is usually not completely available. But information is available for the marginal distributions:

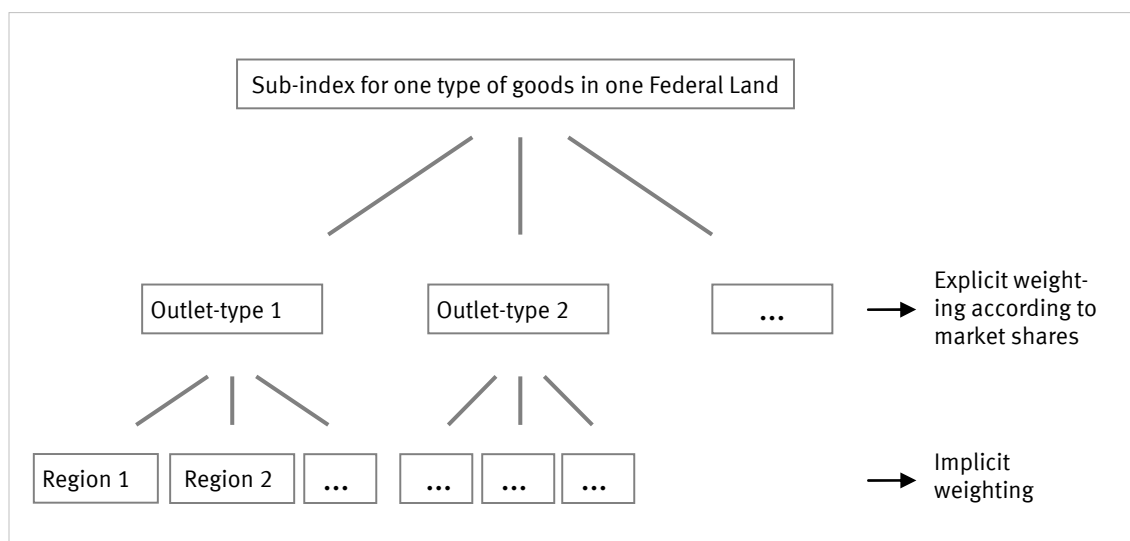
- The market shares of the outlet-types can be estimated for the whole Federal Land (for example the sum of market shares for discounters in all three regions).
- The sales relevancy of the regions can be roughly gained from indicators for the economic activity within the regions. The figures do however not relate to specific types of goods.

In order to introduce a weighting system according to outlet-types *and* regions in spite of these data gaps, a stepwise procedure for the calculation of the price development of *one type of good in one Federal Land* was developed (see chart 8):

- (1) All price series in one Federal Land are summarised for one type of good and one outlet-type and in a next step stratified according to outlet-types. The price series of one stratum do then represent the respective sales within the *complete Federal Land* for one type of good and one outlet-type. The results for one stratum are then explicitly weighted according to the market shares of the outlet-types.

- (2) Within one stratum the price series are gathered from different regions. The application of explicit weights is thereby impossible, as weighting factors cannot be calculated. The regions however are implicitly weighted by adapting the number of price series.

Chart 8: Calculation of Land-indexes for one type of good



In the regions model not every outlet-type has to be covered by means of price observations in each region. It is sufficient to consider the different outlet-types on the Land level. There are, for example, regions where department stores do not exist. In these cases, the respective price series can be collected in another region. Price observations for department stores would then only be gained from specific regions. However, if the number of price series is reduced for one outlet-type within one region, it should be increased accordingly in the other outlet-types in the same region. This is to keep the minimum number of price series for the respective COICOP 10-digit headline constant for one region and to keep the implicit weighting of regions unbiased.

4.2 Why to apply implicit weighting of regions?

Implicit weighting is applied for the representation of regions for the following reason: The distribution of market shares of outlet-types is only known on the level of the Federal Länder but not on the level of regions. The offices of the Federal Länder must therefore be able to react on the availability of outlets of certain types and if necessary to concentrate the price observation for certain outlet-types on certain regions.

As mentioned in the example above, there are not many department stores in rural areas – even if the market share of department stores is significant on the level of the Federal Land as a whole. In order to construct the sample, e.g. for clothing, price series may only be obtained from urban areas while prices for other outlet-types could also be collected in other regions.

For programming purposes, this kind of flexibility can only be implemented with an implicit weighting. Implicit weighting has the advantage that individual strata may remain empty – the weight is then automatically allocated to other, filled strata.

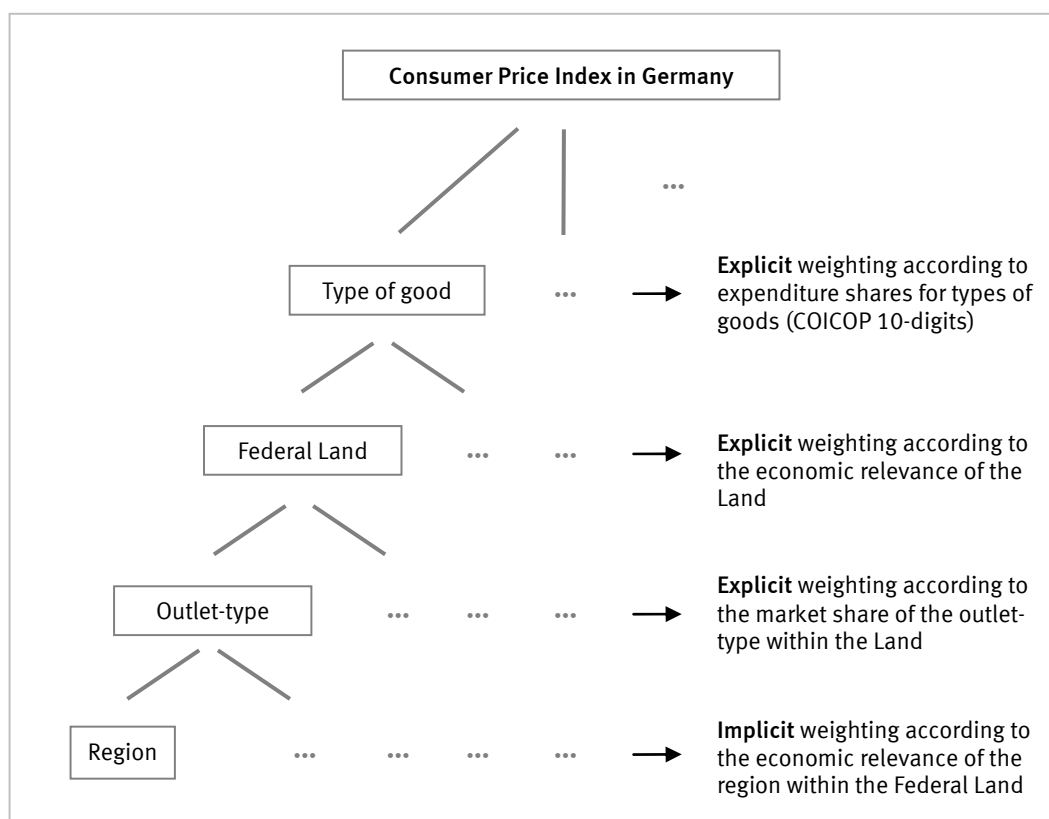
Even if the distribution of market shares of outlet-types would be known on the level of regions, this information is only updated every five years within the index system. Within the period of five

years, the availability of outlets within certain regions can change and it may become problematic to fill the respective stratum with price observations from the requested outlets.

4.3 The overall weighting system

In the new system, average prices and elementary indexes are calculated for each type of goods, each outlet category, and each Federal Land. By using Länder weights, which are determined by their share of private consumption, these sub-indexes from each Federal Land are combined to sub-indexes for Germany. Finally, these sub-indexes are aggregated – under consideration of the weighting scheme for types of goods at the federal level – to the consumer price index.¹⁸

Chart 9: The overall weighting system in German consumer price statistics



5. Empirical results

5.1 Overall revision differences

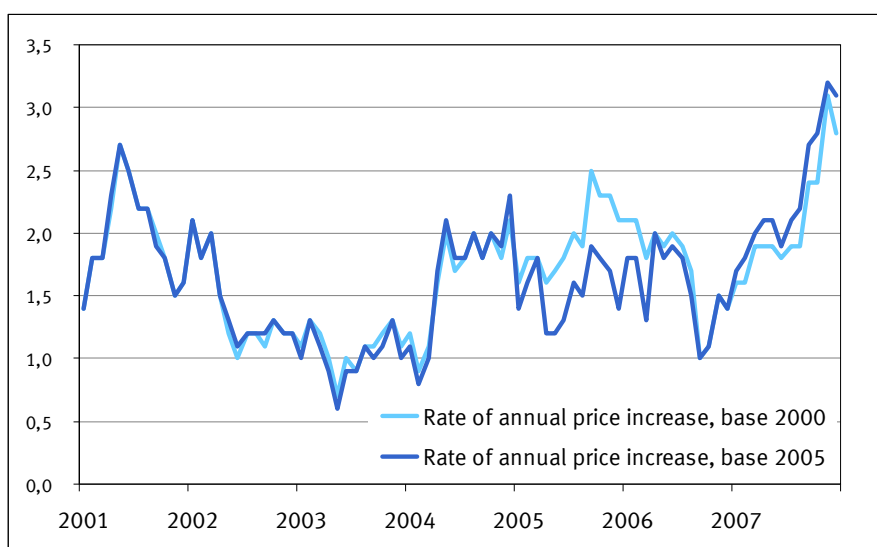
In Germany, the national CPI is revised at regular intervals every five years. The most recent revision took place in 2008, including the introduction of the new base year 2005. The most important methodical modifications were – besides the introduction of the explicit weighting of outlet-

¹⁸ For a detailed description of the overall index calculation and the technical framework in the German consumer price statistics, see Burg, Florian and Seeger, Daniel: “Das neue Verbundprogramm der Verbraucherpreisstatistik”, *Wirtschaft und Statistik* 2/2009, Wiesbaden 2009.

types and the regions model – to update the weighting scheme for types of goods (according to COICOP), and to extend the price collection periods.¹⁹

Chart 10 exhibits the rates of annual price increases before and after the revision. Two periods can be distinguished: (1) Up to December 2004, the new index was linked with the previous CPI. That is why in this period there are only marginal differences regarding the measured price development. These differences were completely caused by rounding. (2) For the period between January 2005 and December 2007 a calculation in retrospect is available. This way, it is possible to quantify the impact of the methodological improvements on the CPI for this period.

Chart 10: Rates of annual price increases of the CPI



The differences between the annual price increases show the greatest magnitude in 2005. This is due to the fact that the values of the new index are directly compared to the chained values of the old index. Inevitably, this leads to biased results for 2005 on the new basis. In 2006 and 2007, smaller differences between the different bases can be noticed.

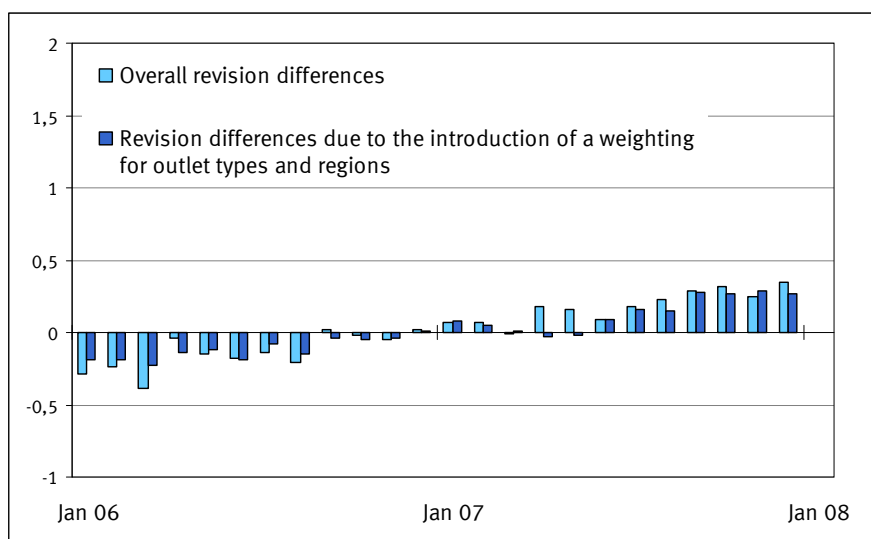
5.2 Revision differences due to the introduction of outlet-type and implicit regional weighting

Chart 11 shows the so called “revision differences” – the difference between the growth rates of the original and the revised index. The revision differences indicate the impact of the changes in the index calculation on the results coming with the index revision.

The impact of introducing the outlet-type and the regional weighting on the results could not be directly observed. However, a quantification of the impact of the main other methodical modifications on the index results is available: the impact of updating the weighting scheme by product types and the extension of survey periods. Therefore, the effect of introducing an outlet-type and regional weighting can be interpreted as being the residual amount of the revision-related differences.

¹⁹ See Elbel, Günther and Egner, Ute: “Verbraucherpreisstatistik auf neuer Basis 2005”, Wirtschaft und Statistik 4/2008, Wiesbaden 2008.

Chart 11: Revision differences

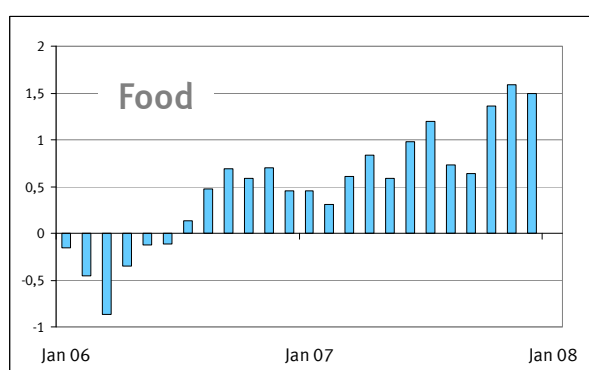


The isolated impact of introducing the outlet-type and the regional weighting amounts in many months from 0.1 to 0.2 percentage points, while in the end of 2007 the impact increases up to 0.3 percentage points per month. Chart 11 shows that the revision differences due to weighting for outlet-types and regions are almost as high as the overall revision differences. Overall, it can be assumed that the biggest amount of the revision differences could be attributed to the introduction of an outlet-type weighting. The remaining methodical modifications only had a marginal influence on the measured price development. A further analysis of the revision differences shows that especially for the groups “food”, “non-alcoholic beverages”, and “alcoholic beverages”, a systematic increase of the revision differences occurred.

5.3 Revision differences in the food sector

In the food sector, a pattern of increasing revision differences can be observed (see chart 12), which reflects structural changes in the German economy. Due to the implementation of the explicit weighting of outlet-types, the weights of the respective outlet-types changed in many cases. (Based on the number of price series entering the index calculation, artificial “implicit weights” for outlet-types could be calculated in order to simulate an outlet-type weighting before the year 2008. These artificial weights can be compared to the explicit weights implemented in 2008.)

Chart 12: Overall revision differences for food prices



In the domain of food, the changes of outlet-type weights were especially considerable. In this field, the weight for the price-oriented outlet-types consumer market and discounter increased by trend. In contrast, the weights of the rather service-oriented outlet-types such as supermarkets or department stores decreased. This reflects the considerable shifting of market shares in the German food retail during the last decades.

Chart 13: Weights for different outlet-types for food in Bavaria

Outlet-type	Base year 2000	Base year 2005
Large store / department store	1%	0%
Consumer market / self-service store	21%	26%
Supermarket	35%	26%
Discounter / retail warehouse (big box formats)	23%	39%
Specialised shop	18%	8%
Remaining retail	2%	1%

During the second half of 2007, exactly those outlet-types suddenly increased the prices whose weights had been enlarged with the introduction of the new weighting system in price statistics. This happened in connection with the overall rise of food prices in 2007. For example, the price development for bread and cereals in food discounters was especially remarkable. Having showed an even price development in 2005 and 2006, a considerable upward movement started. In the following charts, the price developments for noodles, flour, butter, and cream between February 2007 and March 2009 are displayed for different outlet-types. The price increases during the second half of 2007 were in some cases significantly lower in other outlet-types, especially in supermarkets.

Chart 14: Price developments for types of goods and outlet-types

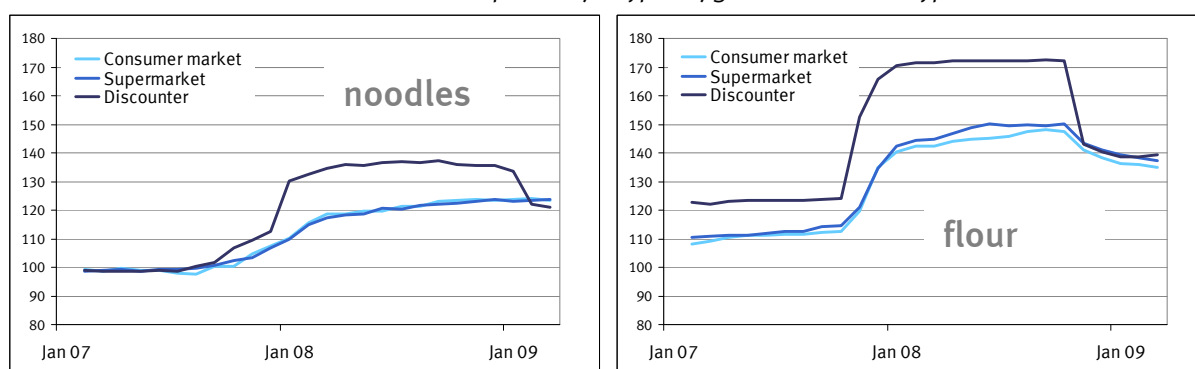
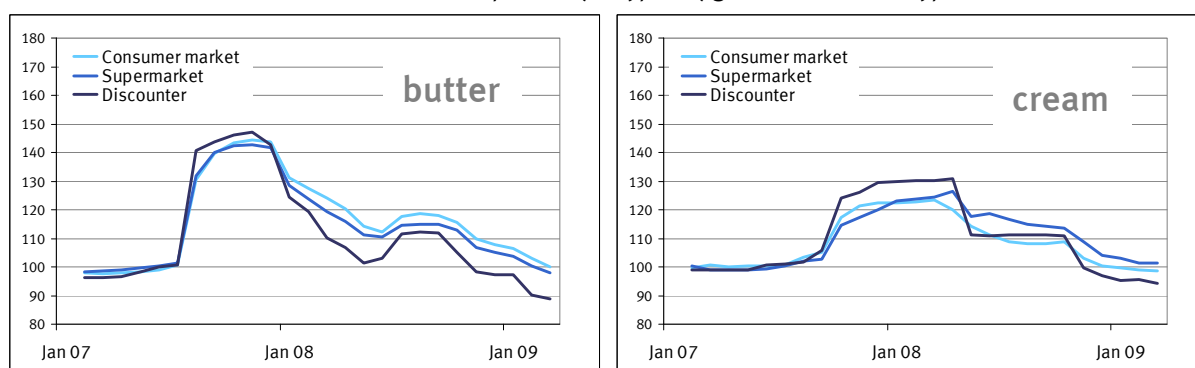


Chart 15: Price developments for types of goods and outlet-types



The structure of increasing revision differences and the high values in the second half of 2007 can to a considerable extent be assigned to the above displayed price increases of food in price-oriented outlet-types (such as food discounters). To these types of outlets, higher weights were allocated with the introduction of the explicit weighting of outlet-types.

6. Conclusion and Outlook

The main reasons for the introduction of the new system were to improve and to assure the quality of the sample by agreeing on common standards throughout Germany and to enhance the clarity of the system. An explicit weighting of outlet-types allows for an incorporation of additional information on market shares of outlet-types into the weighting system. This further leads to an improvement of results. Moreover, it is guaranteed that all relevant outlet-types are covered.

A further advantage of the outlet-type weighting is that the offices of the Federal Länder have to care less about the distribution of the number of price series between the outlet-types. It is sufficient that they roughly consider certain benchmarks, which can be established in advance. The correct representation of the consumption relevance of outlet-types is guaranteed by means of weighting. If the outlet-type weighting scheme is in use for some years it might be possible to estimate the variance of the price development within segments of outlet-types by means of empirical data. By using this information, the efficiency of the sample could be further improved.

The regions model guarantees that all German regions are covered. It creates a more systematic regional sample as prices of all types of goods are collected in all regions, except for some specific durable goods and clothing. Furthermore, it allows for a higher flexibility of price collection, as prices can now also be collected outside the borders of a municipality (e.g. on a greenfield site). Finally, the implicit weighting guarantees that regions enter the index according to their consumption relevance.

In the following months and years, several steps are planned to complete and improve the outlet-type and regions weighting system. Concerning the outlet-type weighting, the current classification of outlet-types will be verified, the coverage of the sample will be improved, and the weights will be screened. Furthermore, the feasibility of weighting different types of service providers (for example different types of restaurants or hairdressers) will be analysed. Furthermore, the sample of rented dwellings will be analysed with respect to segments and regional coverage. With regard to the regions model, the regional coverage will be improved stepwise until 2014.