UNITED
NATIONS

E

Economic and Social Council

WORKING PAPER NO 4

7 April 2006

ENGLISH ONLY

ECONOMIC COMMISSION FOR EUROPE **STATISTICAL COMMISSION**

CONFERENCE OF EUROPEAN STATISTICIANS

Group of Experts on Consumer Price Indices

Eighth Meeting
Geneva, 10-12 May 2006
Item 5 of the provisional agenda

THE RE-DESIGN OF THE DUTCH CPI*

Invited paper submitted by the Statistics Netherlands

The meeting is organised jointly with the International Labour Office (ILO)

* This paper has been prepared by Mr. Jan de Haan, Statistics Netherlands, at the invitation of the Secretariat. Paper posted on Internet as received from the author.

Statistics Netherlands

Division of Macro-Economic Statistics and Dissemination
Department of Development and Support

P.O.Box 4000
2270 JM Voorburg
The Netherlands

The Re-design of the Dutch CPI

Jan de Haan

Paper prepared for the Joint UNECE/ILO Meeting on Consumer Price Indices, 10-12 May 2006, Geneva, Switzerland. The views expressed in this paper are those of the author and do not necessarily reflect the policies of Statistics Netherlands. Comments from Heymerik van der Grient, Cecile Schut and Wim Vosselman are gratefully acknowledged.

Project number: *MOO-204759*
BPA number: *-MOO*
Date: *31 March 2006*

THE RE-DESIGN OF THE DUTCH CPI

Abstract: Statistics Netherlands has decided to re-design the Consumer Price index (CPI). The aim is to improve its quality and bring the CPI more in line with a cost of living index. This paper provides background information on the (total survey) re-design. It focuses on the bottle-necks in the methodology and the production process of the current Dutch CPI, and discusses the plans for 2007.

Keywords: consumer price index, cost of living index, total survey re-design.

1. Introduction

In the past decade or so much theoretical and empirical research has been devoted to the CPI, both internationally and in the Netherlands. At least some of this work was inspired by the well-known Boskin report (Boskin et al., 1996) which assessed the U.S. CPI. A milestone was the publication of the new international manual on the CPI (ILO, 2004). Late 2003 the management of Statistics Netherlands decided that the CPI should be brought in line with the latest insights as laid down in the (draft) CPI manual. An expert group was asked to outline the future CPI. It reported early 2004 (Balk et al., 2004). One of the questions the authors raised was whether there was a need for a separate national CPI in addition to the E.U. Harmonized Index of Consumer Prices (HICP). If not, a large-scale, total survey re-design of the CPI would not be worth the trouble. In that case it might be better and less costly to try and influence as much as possible the international discussions on the HICP and simply implement the regulations. Among the most important users there seemed to be agreement that there is room for a separate national CPI that, unlike the HICP and the national accounts consumption deflator, is meant to approximate the change in the cost of living. A modular approach was preferred, which should make it possible to compile CPIs for different types of outlets, regions, and household groups. At the end of 2004 a project termed 'Re-design CPI' was set up. In the first phase several pilot studies were carried out to investigate the feasibility of the ideas suggested by Balk et al. (2004). The second phase of the re-design project started late 2005 and aims at implementing new methods and improvements in the production process in a stepwise manner.

Section 2 of this paper broadly outlines the aim and foundations of the future CPI and describes the bottle-necks of the current CPI and their causes. Although the focus is on methodological aspects, the production process will be addressed as well. Sections 3-5 discuss the plans for 2007, in particular the introduction of the annually chained CPI, the implementation of a so-called matrix of transaction categories, and the incorporation of a part of insured medical care into the CPI. Section 6 points to possible future improvements.

2. Aim and foundations of the future CPI

2.1 Concepts

Statistics Netherlands takes the cost of living index for an individual household as the preferred theoretical framework for the CPI. This index describes the changes in the costs a household must incur in order to maintain a given standard of living, or utility, under changing prices. The nation-wide CPI is an aggregate of all individual cost of living indexes. Note that the CPI is a conditional index in which other factors influencing the standard of living are assumed constant. One of those factors could be the supposed increasing insecurity.

The framework of the (conditional) cost of living index is useful for at least three reasons:

- The CPI has a distinct surplus value because it will differ in some respects from the HICP. The latter index is particularly meant for the European Central Bank and measures inflation from a monetary point of view. The CPI is placed in a welfare-theoretical framework.
- Measurement without theory must be avoided. The cost of living index is firmly grounded in mainstream economic theory. This theory provides guidance during the operational decisions needed when compiling the CPI.
- Most people consider the CPI as a short-term measure of changes in purchasing power. In the longer run this must be brought in line with changes in income. The CPI is also more suitable for adjusting wages than the HICP.

The fact that the CPI is an aggregate of individual cost of living indexes also implies that the future CPI – just like the current CPI – should relate to the expenditures of Dutch households, including their expenditures abroad. In this respect too the CPI differs from the HICP. The latter relates to consumer expenditures on Dutch territory (including expenditures by foreigners).

Both the current CPI and the HICP measure price changes of purchases. In case of a cost of living index this is not the preferred approach. The aim here is to measure the cost of consumption. The conceptual difference only plays a role in case of durable goods of course, and most importantly for owner-occupied housing where the CPI should in principle measure user costs.[1]

A special topic is the compilation of the constant tax rate CPI. This index measures (or rather: approximates) what the CPI would have been if the tax rates being levied on products belonging to final household consumption expenditure (VAT, excise

[1] Diewert (2003) notes that "Forming a price index for the user costs of a durable good is not very much more difficult than forming a price index for the purchase price". A number of countries do in fact use (a simple version of) the user-cost approach, e.g. Iceland. One of the problems might be volatility of the user costs index series (Verbrugge, 2004).

duties) had not changed. De Haan (1999) describes the way this index is calculated in practice. The European Central Bank (ECB) has long been in favour of compiling a constant tax rate HICP. It seems that this index will indeed be implemented in 2007, largely following the Dutch method (ECB and Eurostat, 2004).

2.2 Target population and scope

The target population of the current CPI is restricted to all private households, i.e. excluding persons living in so-called institutional households. There is no need to change this. In addition to the CPI for all private households Statistics Netherlands also publishes a CPI for wage earners. Once every four or five years a study will be undertaken into the differences between CPIs of the households groups that are distinguished in the national accounts' Social Accounting Matrix. Earlier research has shown that the variability of the household-specific CPIs within those groups is typically rather large (see Pannekoek and Schut, 2002). In Germany, households are given the opportunity to compute their own specific CPIs on the Internet, given their expenditure patterns. There has been some discussion to offer this service also in the Netherlands, but no concrete plans exist at present. An alternative would be to let the public compute its own CPI, given their household characteristics (level of income, most important source of income, household composition).

The scope of the current CPI, that is the products or product categories of which the price changes are tracked, is limited to out-of-pocket payments (Balk, 1993). There is a relationship with the income side: the scope corresponds to purchases made out of disposable household income, that is gross income minus compulsory payments to the government (direct taxes and social security contributions). A number of local taxes and payments for local government services are included. In this respect the national CPI differs from the HICP and the national accounts consumption deflator. The included local taxes are known as consumption-related taxes which are directly tied to the consumption or purchase of some goods and services. Examples are local property taxes that must be paid when living in a dwelling.

Another, more practical criterion, is that every purchase falling into the scope should correspond to a price which is known to the buyer at the time the transaction actually takes place. 'Prices' which are adjusted with a time lag do not meet this criterion and the expenditure categories are left out. Retrospective tariff changes have frequently occurred in health care. This was one of the reasons – though not the most important one – to exclude health from the national CPI. The HICP, on the other hand, does include part of health care. Another major difference with the HICP is that the CPI includes owner-occupied housing. Statistics Netherlands uses the rental-equivalence approach. The use of 'imputed rents' may seem to conflict with the latter criterion, but excluding the shelter costs of owner-occupied housing would drastically reduce the CPI as a measure of the change in the cost of living. As stated before, changing over to a user-cost approach should be considered as this would fit better into a cost of living framework.

There is no reason to change the starting point of the out-of-pocket expenditures to describe the scope of the CPI. However, there can be some discussion on the exact definition. A few minor expenditure categories which have been excluded so far for practical reasons, like soft drugs, might be included in the future. More importantly, a part of health care will be included in the CPI as from January 2007, following a major reform of the Dutch health care system. The decision to include health will be explained in section 5.

2.3 The population model

The CPI is a weighted average of the price indexes of elementary aggregates. An elementary aggregate is a fairly broadly defined product category belonging to the scope of the CPI, that is the entire set of transactions between buyers (households) and sellers (mainly retail outlets). The grouping into transaction categories is given, say COICOP x type of outlet (x region, possibly). Statistics Netherlands should track the price change of each category as good as possible, given the available resources. This is not new of course; the CPI and the HICP both rely on this idea. What is new is that the future CPI can no longer rest on a single population model describing the all-items index in terms of the prices and quantities of individual goods and services. The various transaction categories differ so much with respect to their composition and the market circumstances that the use of a single model or measurement method becomes untenable.

At the 'upper level', adjusting the system of transaction categories consists of two elements:

- Adjusting the number of categories. For example, new categories may be added, existing ones divided up or removed, etc. Such adjustments can have a number of causes. The domain of the CPI can be extended for conceptual reasons, for instance with medical care. Truly new goods may appear on the market place, like mobile phones in the past. An adjustment of the system might also be useful in practice, especially for reasons of data collection and estimation.
- Revising the weights of the system. A chain index with monthly or quarterly adjusted weights is likely to suffer from drift in case of seasonal effects. A year can be conceived as a natural base period, and the weights should preferably be updated annually. Annual rebasing accounts for changes in expenditure patterns and makes it possible to incorporate truly new goods in a timely manner. The future CPI will be an annually chained Lowe-type price index.[2] This issue will be taken up in section 3.

---

[2] Section 9.135 of the CPI Manual (ILO, 2004) reads: "One way in which to minimize the potential biases from the use of fixed-weight indices is obviously to keep the weights and the base period as up to date as possible by frequent rebasing and chaining. Quite a number of countries have adopted this strategy and revise their weights annually. [….] Annual chaining eliminates the need to choose a base period, as the weight reference period is always the previous year, or possibly the preceding year."

Adjusting the samples of products per transaction category – in other words: dealing with the changing universe within an elementary aggregate – should be a continuous process. Adjustments must be made as often as needed, depending on the prevailing market circumstances. Where the market dynamics are huge, the samples have to be updated or renewed frequently, in some cases perhaps even many times per year, particularly for high model turnover products like PCs. As said before, the idea of a single population model for all transaction categories will be abolished. Just like the sampling procedure, the aggregation of individual price observations at this lower level of aggregation (the elementary index number formula) ought to depend on the market dynamics. A highly dynamic market – characterized by many disappearing and new models and severe substitution between existing models – requires another treatment than a static market. Currently the ratio of unweighted arithmetic average prices (Dutot index) – is used throughout the CPI.[3] A first step towards improvement could be the introduction of a geometric (Jevons) index number formula, at least for a number of elementary aggregates. The new computer system which should be built this year or next year should in any case be flexible in the sense that different index number formulas can be used for different transaction categories.

2.4 Sampling and data collection

The degree of market dynamics has also implications for sampling, data collection and quality adjustments. Not only is it important what kind of data is collected, and how and where this is done, there is an important organisational aspect involved as well. Although improvements have been made recently, the current method can still be described as a kind of wait-and-see policy: actions are not undertaken until some 'problem' occurs, often when the number of price quotations within an elementary aggregate falls below a certain threshold value. A more active approach is obviously necessary. Instead of simply waiting until models or varieties have disappeared from the market, new models should be incorporated into the CPI in a timely fashion. The internal organisation should be tuned to this, possibly by strengthening the position of the branch specialists.

Ideally Statistics Netherlands has at its disposal a matrix or frame in which for each transaction category all outlets are listed in real time. This matrix – COICOP x type of outlet (x region) – could serve as an outlet sampling frame for those situations where samples have to be drawn. Furthermore, the expenditures must be estimated annually for all categories, and distributed among groups of households, if desired. As in the current CPI, national accounts expenditure figures should be used because those data are likely to correct to a considerable extent for things like underreporting which are known to plague the Household Expenditure Survey (see De Haan, 1999).

---

[3] There is one exception, namely for scanner data. The Dutch CPI incorporates scanner data from a number of supermarket chains (Schut et al., 2002). For each chain, the price change at the level of individual products, defined by European Article Numbers (EANs), is calculated as the unit value index. On the use of unit value indexes, see Balk (1998).

The national accounts data should be complemented or disaggregated by data from other sources. In section 4 I will come back to the matrix of transaction categories.

For each elementary aggregate it is necessary to determine the most efficient way to measure the price change, including the index number formula. Based on the costs and the desired accuracy, and given the available resources, a choice must be made between observing the whole population (of both product varieties and outlets) and drawing samples. Of course this choice cannot be seen in isolation from the method by which price changes are measured. On the one hand a certain method can impose restrictions on the data collection procedure. For example, hedonic indexes require relatively many observations, including product characteristics. On the other hand the use of a particular data source can influence the measurement method.

Whether the CPI describes the price change of purchases or of consumption (use), the universe always consists of transactions. Data collection procedures should thus aim at acquiring transaction data as much as possible. The raw data usually have to be cleaned and adapted before they can be used as an input for computing a price index. More and more outlets store their sales data electronically. Retail scanner data is the most famous example of this, and those data are increasingly being used by statistical agencies for CPI purposes, but there are likely to be many more examples. In any case, Statistics Netherlands should expand its efforts to obtain electronic data on actual transactions.[4] This concerns prices but also quantities sold or turnover and product characteristics. Characteristics are needed to correct for quality changes and may help to classify the products into COICOP categories.

It can be expected that the CPI will increasingly be based on electronic data. One of the challenges for the future CPI is to determine the optimal mix between electronic data collection methods and field collection. Meanwhile the outlet sample should be re-designed and brought up-to-date; there are some doubts about its representativity. The current sample design is not flexible enough. In order to incorporate new outlets timely, and also to spread respondent burden, a less static sample design should be considered, for instance by introducing a rotating sampling scheme. Moreover, field collection must be modernised.

At present Statistics Netherlands uses what are called tight product specifications. Branch specialists at the office spend quite some time specifying in detail the items to be priced. Next, a sample of outlets is selected where prices should be observed. The obvious problem is that there does not exist a proper sampling frame of outlets for individual, tightly described products. Consequently, the initial non-response is typically very high. Non-response also occurs when products are (temporarily) out of stock. It would be preferable to use loose product specifications, and to permit the

[4] The Dutch CPI is a monthly statistic, so that the CPI should relate to the entire month. This means that average transaction prices (unit values) should in principle be computed across the whole month. In order to publish timely, however, unit values may be computed which, for example, are limited to the first two weeks of a month. Statistics Netherlands already does that for supermarket scanner data.

price collectors to choose one or more varieties of the loosely specified product in the outlets they visit (for example, the best selling varieties).[5] In that case the data collection or sampling procedure is reversed, so to speak: presently product varieties are selected first and corresponding samples of outlets are chosen next, whereas in the future Statistics Netherlands might first select the outlets in which households actually spend their money and next let the price collectors choose specific varieties within the outlets. Many statistical agencies in and outside Europe, for example the BLS in the U.S., follow this strategy already for a long time now.

2.5 Quality adjustment

The quality adjustment problem is as old as price index compilation itself, but it has probably grown during the past decades. The number of product varieties has been increasing rapidly and model turnover is higher than before. Just like in many other countries the branch specialists at Statistics Netherlands first check if the 'old' item and its replacement can be directly compared. If not, they use a kind of route map to choose a particular quality adjustment method. It turns out, however, that simple methods such as overlap pricing and the use of option prices predominate and that ad hoc choices are sometimes still being made today. More sophisticated procedures such as hedonic regression are not applied.[6] A shortcoming of the present method is that the model specifications or characteristics are only partly known. Further, often a 'new' model is selected that resembles the old one, whereas it would of course be best to select a model that is representative for the current market circumstances; see e.g. Silver and Heravi (2002).

By collecting electronic transaction data on prices, quantities and characteristics we should be able to estimate hedonic indexes in the future, particularly for high-tech and high-turnover products like PCs. Even without the use of hedonics, collecting data on product characteristics will be helpful to decide whether or not two models are directly comparable, and if not, to assess how they actually differ. Changing over to 'loose specifications' is likely to increase the number of unmatched observations since the prices observed in the outlets may relate to different models in different time periods, especially when there is high model turnover. This in turn increases the need for explicit quality adjustments at the level of the individual model-outlet combinations, or product offers as they are sometimes referred to in a HICP context, and hence the collection of product characteristics.

---

[5] To reduce non-response the product specifications are slightly loosened yet in some cases. This is a bit problematic from a theoretical point of view because it conflicts with the use of the Dutot index number formula at the elementary aggregate level. The (geometric) Jevons formula would be better suited. For details on elementary aggregate price indexes and the relationship with probability sampling, see Balk (2003).

[6] At Statistics Netherlands a lot of work was done on the use of hedonic regression, though. For empirical work, see Van Mulligen (2003) and Van der Grient (2004). De Haan (2004a,b) addresses the time dummy variable approach.

3. Introduction of the annually chained CPI

3.1 Background

The CPI currently being compiled by Statistics Netherlands is a Laspeyres index in which the expenditure weights are updated every five years. The index is computed and published monthly, like the CPIs of most other countries. As from January 2007 the weights will be updated annually. The future CPI can be viewed as a Lowe-type price index, based on quantities, or weights, that date back a few years before the price reference period (December of the previous year), which is chained annually. Eurostat has always been in favour of this type of chain linking for the construction of the HICP. This section outlines how Statistics Netherlands intends to implement the annually chained CPI. Although this type of chain linking is well established in practice – France, for example, has been using a similar method for more than two decades now – there are a number of issues that, as far as I know, have not been extensively documented. This is not to say that countries like France are not aware of those issues but rather that no one seems to have taken the opportunity to discuss them in some detail.

Before describing the chaining principle it should be recognized that annual rebasing and updating of the weights does not necessarily imply annual chaining. Chaining is primarily needed for the construction of a long-term time series. De Haan (2005a) suggested distinguishing between a short-term CPI and a long-term chained CPI. The short-term CPI could be a direct, unchained Laspeyres index of which both the weights and the index reference period are updated annually. Statistics Netherlands decided not to follow this suggestion, based on three objections:

- users wish to have one continuous series with a fixed index reference period;
- there should be no difference in methodology between the CPI and the HICP in this respect;
- the CPI should not be revised: once published, the CPI and the measures derived from it, such as headline inflation, should be ‘definitive’.

Different users, having different goals, may need different types of CPIs. The new CPI Manual also recommends publishing a ‘family of indexes’ (ILO, 2004, preface). But it is true that most users indeed seem to desire one continuous series. This rules out almost every other method and automatically leads to a chain index, though the choice of the linking period is still an open question. The second point stresses that unnecessary differences between the national CPI and the HICP must be avoided, so that they should as far as possible be based on identical methods and concepts. Note, however, that the HICP index reference period is not entirely fixed: after a decade it has recently been changed to 2005. The third objection, that the CPI should not be subject to revision, is less straightforward and as such debatable. Many economic statistics, such as real GDP-growth, are revisable. The reason is obvious: when more information becomes available, a better estimate can be made. In case of the CPI this

would for example mean that newly available expenditure data can be used to re-estimate a series for a particular year using more recent expenditure weights.[7] Yet, since the CPI is used for indexation in many contracts, the public will probably have great difficulties with revisions of the CPI.

3.2 The chain linking method

The Lowe price index is the general representation of a fixed-basket (fixed-quantity) index; see Balk and Diewert (2003) and ILO (2004). As a starting point I will take the Lowe price index of month *m* of the current year *y*. December of the preceding year (*y*-1,12) acts as the price reference period. The quantity reference period *r* will not be specified at this stage but it is assumed that $r < y$. In practice *r* will be the most recent year for which expenditure data is available. For convenience I write $r = y - a$ ($a > 0$). The Lowe index is now given by

$$P_{Lo}^{y,m} = \frac{\sum_i p_i^{y,m} q_i^{y-a}}{\sum_i p_i^{y-1,12} q_i^{y-a}}, \tag{1}$$

where $p_i^{y,m}$ denotes the price of product *i* in month *m*, year *y* and q_i^{y-a} the quantity sold of *i* in year $r = y - a$. Monthly index numbers can be constructed according to equation (1) for consecutive years *y*. Since the price and quantity reference period are updated annually, there is a system of annual rebasing. For reasons of simplicity it is assumed that the set of products is constant over time although in practice this will usually not be the case.

Next, a chain index is constructed using December of year *y*-1 as the linking period:

$$P_{Ch}^{y,m} = \frac{\sum_i p_i^{y,m} q_i^{y-a}}{\sum_i p_i^{y-1,12} q_i^{y-a}} \left[\prod_{t=1}^{y-1} \frac{\sum_i p_i^{t,12} q_i^{t-a}}{\sum_i p_i^{t-1,12} q_i^{t-a}} \right]$$

$$= \sum_i \tilde{w}_i^{y-a/y-1,12} \left(\frac{p_i^{y,m}}{p_i^{y-1,12}} \right) \left[\prod_{t=1}^{y-1} \sum_i \tilde{w}_i^{t-a/t-1,12} \left(\frac{p_i^{t,12}}{p_i^{t-1,12}} \right) \right], \tag{2}$$

where $\tilde{w}_i^{s-a/s-1,12} = v_i^{s-a}(p_i^{s-1,12} / p_i^{s-a}) / \sum_i v_i^{s-a}(p_i^{s-1,12} / p_i^{s-a})$; $v_i^{s-a} = p_i^{s-a} q_i^{s-a}$ (*s*= *y*, *t*). Notice that December has a double function: it acts as the price reference

[7] A problem with not revising the chain CPI at all may be the fact that in the Netherlands the national accounts are subject to a major revision every five years or so. This is not the place for a thorough discussion of the national accounts revision policy. It will suffice to mention that, due to newly available data sources or for some other reasons, expenditure figures at the level of individual product groups are sometimes revised considerably. To cope with this problem a revision policy for the chain CPI in line with the national accounts policy seems inevitable.

period in the direct Lowe index given by equation (1) and as the linking period in the chain index (2). December of year 0 is the index reference period, i.e. the starting period of the chain index. If year 0 was chosen as the index reference period, a third factor would have to be added to (2).

Except where scanner data is available, annual rebasing and chaining will generally not be carried out at the level of the individual products but at some upper level. So instead of (2) the following product group equivalent will be used:

$$P_{Ch}^{y,m} = \sum_g \tilde{w}_g^{y-a/y-1,12} \pi_g^{y,m/y-1,12} \left[\prod_{t=1}^{y-1} \sum_g \tilde{w}_g^{t-a/t-1,12} \pi_g^{t,12/t-1,12} \right], \tag{3}$$

where $\tilde{w}_g^{s-a/s-1,12} = v_g^{s-a} \pi_g^{s-1,12/s-a} / \sum_g v_g^{s-a} \pi_g^{s-1,12/s-a}$ (s= y, t) is the price-updated expenditure share of product group g and $\pi_g^{./.}$ a price index of g. Since the weights for the CPI are derived from the national accounts, the product groups are defined as the lowest COICOP level for which such data are available. In the second half of year y the 'definitive' national accounts figures for y-3 become available. Hence, for the CPI of year y the most recent 'definitive' national accounts data relate to y-4, which is not very up-to-date. Statistics Netherlands therefore decided to use the most recently available preliminary national accounts figures, which relate to y-2.[8]

In addition to the publication of a non-revisable continuous CPI series with a fixed index reference period, something which users may find attractive, and the use of up-to-date expenditure data, which is undoubtedly a sensible strategy, one can think of two other advantages annual rebasing and chaining might have. The first has to do with Statistics Netherlands' internal organisation: there is no need to install a project organisation at five year intervals to carry out the revision. Compared to the former major rebasing, the annual rebasing will involve a relatively minor operation, which does not include an extensive re-sampling of products and outlets at the same time. Those activities should now be carried out in a continuous way. Second, chaining might help to reduce upper level substitution bias.[9] However, the advantage of the future chain CPI should perhaps not be exaggerated. Empirical research confirmed that the inflation rate derived from the chain index is indeed only slightly lower than the inflation rate derived from the current fixed-weight index (De Bruijn and Van der Grient, 2006).

---

[8] An empirical exercise showed that the preliminary figures are fit for use in the CPI, despite the fact that they are rough estimates (De Bruijn and Van der Grient, 2006).

[9] A substantial improvement would only be attained by using a superlative index number formula, notably the Fisher. Thus, I would recommend Statistics Netherlands to compute an annually chained Fisher index on an experimental basis to estimate possible upper level bias of the chain CPI. This index can be calculated easily, albeit with a time lag of several years. Upper level substitution bias depends on the level of aggregation: the more product groups are distinguished, the larger the bias tends to be. Using 186 groups, De Haan (2000) found an annual upward bias of the Laspeyres CPI with respect to an annually chained Fisher index of about 0,1 percentage point. This figure coincides with an earlier estimate by Balk (1990).

3.3 Properties of the chain index

The chain CPI given by (2) or (3) has some properties that can easily be overlooked. The current (direct Laspeyres) CPI and the Lowe index given by (4) are consistent in aggregation: they can be both calculated as a weighted average of the price relatives of the individual products but also – using the same formula – as a weighted average of the price indexes of product groups at arbitrary aggregation levels. Chain index (2), on the other hand, is not consistent in aggregation. CPI users as well as price statisticians may find this a disadvantage. This type of inconsistency also means that the future chain CPI will depend on the level of aggregation at which the weights are updated.

There are a number of more fundamental problems one might have with the future chain CPI, especially when looking at headline inflation as measured by the ratio of the index in month *m* of year *y* and the index one year earlier. Obviously, this ratio is based on two different sets of quantities. Although in practice (except for scanner data) expenditure shares and price index numbers are used, for expository reasons it is convenient to use the original formulas in terms of prices and quantities. Using (2) and remembering that in practice the value of *a* in (2) will be equal to 2, the annual change can be written as

$$\frac{P_{Ch}^{y,m}}{P_{Ch}^{y-1,m}} = \frac{\sum_i p_i^{y,m} q_i^{y-2}}{\sum_i p_i^{y-1,12} q_i^{y-2}} \frac{\sum_i p_i^{y-1,12} q_i^{y-3}}{\sum_i p_i^{y-1,m} q_i^{y-3}} = \frac{\sum_i p_i^{y,m} q_i^{y-2}}{\sum_i p_i^{y-1,m} q_i^{y-2}} \lambda^{y,m/y-1,m}, \tag{4}$$

where

$$\lambda^{y,m/y-1,m} = \frac{\sum_i p_i^{y-1,m} q_i^{y-2}}{\sum_i p_i^{y-1,m} q_i^{y-3}} \Bigg/ \frac{\sum_i p_i^{y-1,12} q_i^{y-2}}{\sum_i p_i^{y-1,12} q_i^{y-3}}. \tag{5}$$

In expression (4) the annual price change has been split into two parts.[10] To be more precise, (4) is a chain index itself, consisting of two Lowe price indexes. The first index measures the price change between December of year *y*-1 and month *m* of year *y*, the second index measures the price change between month *m* of year *y*-1 and December of year *y*-1. Headline inflation as measured by (4) not only depends on the prices in month *m* of year *y* and year *y*-1 but also on the prices in December of year *y*-1. Like any chain index – including of course the future chain CPI (2) – (4) is path dependent.

---

[10] At the moment Statistics Netherlands publishes a table in its monthly press release with the contribution of product groups to headline inflation. In Annex 1 of the draft HICP Manual a similar decomposition is presented for the chain index. This solution coincides with the U.K. practice of computing contributions of components to annual changes in the all items RPI, as described in section 8.9 of the Consumer Price Indices Technical Manual 2005. Balk (2006) provides an alternative solution.

This brings us to a related point. The second expression of (4) is the product of two factors: a direct Lowe price index, which compares the prices in month *m* of both years with *y*-2 as the quantity reference period and a factor $\lambda^{y,m/y-1,m}$, given by (5), which is the ratio of two annual Lowe quantity indexes going from year *y*-3 to year *y*-2. In general $\lambda^{y,m/y-1,m}$ will differ from 1 as a result of substitution effects due to relative price changes. There are also other factors influencing the quantity structure, for example changes in consumer tastes, exogenous causes such as rationing due to bad weather conditions, etc. So it is rather difficult to predict whether $\lambda^{y,m/y-1,m}$ will be greater or smaller than 1. Because $\lambda^{y,m/y-1,m}$ generally differs from 1, the annual change given by (4) is not necessarily equal to 1 if the prices in month *m* of year *y* and year *y*-1 were identical. Put in another way: equation (4) fails the identity test.[11] For performing plausibility checks it may be worth while to decompose (4) into both factors, the first factor measuring pure price change and the second factor measuring the effect of changes in the quantity structure between year *y*-3 and year *y*-2. Note that $\lambda^{y,m/y-1,m}$ can be derived implicitly.

The fact that the chain CPI (2) and the derived headline inflation given by (4) do not satisfy the identity test is problematic from a theoretical perspective: such measures can hardly be called true price indexes. However, this failure is less important if the magnitude of the effect is negligible in practice. Using national accounts and price data for 1997-2003, De Bruijn and Van der Grient (2006) found that $\lambda^{y,m/y-1,m}$ has indeed been quite small. The average rate of inflation as measured by the chain CPI (3%) was 0,05%-points lower than the inflation rate as measured by the first factor of the second expression on the right of (4).

4. Implementation of the matrix of transaction categories

4.1 The ideal matrix

In January 2007 a preliminary version of the matrix of transaction categories will be implemented in the production process of the CPI and the HICP. Before describing this version I will briefly repeat the aim and features of the ultimate ideal matrix. The aim is twofold: the matrix serves as a detailed weighting scheme and as a frame for sampling outlets. The rows of the matrix are expenditure categories at the level of products, i.e. detailed COICOP categories, and the columns are types of outlets. Having the first aim in mind, the cells of the matrix may be defined as the lowest level of aggregation for which accurate expenditure data can be found, and will be referred to as elementary aggregates. The second aim requires a listing of all outlets

[11] The identity test stems from the axiomatic or test approach to index number theory; see e.g. Diewert (1992), Balk (1995) and chapter 16 of the CPI manual (ILO, 2004). In the usual bilateral approach only two time periods come into play, but in (4) the quantities and prices relate to different periods. I will nevertheless speak of the identity test.

for each cell. This can be done either by sub-dividing the columns into individual outlets instead of outlet types or by adding a third dimension to the matrix.[12] What is important to understand is that the matrix relates to, and contains data on (whether estimated or measured without any error), the population of outlets and products and not samples thereof. This is the reason why the rows of the matrix cannot be sub-divided into individual varieties or models of the products: except for scanner data, or similar electronic data, for an individual outlet belonging to a certain outlet type the entire set of varieties or models sold is unobservable – although this population does of course exist in reality. In turn this is one of the arguments for using loose instead of tight product specifications.

De Bruijn and Osseforth (2005a,b,c,d) have looked at various issues concerning the matrix of transaction categories, for example which data sources for the weights and the sampling frame of outlets are available within and outside Statistics Netherlands, what the possibilities and bottle-necks will be of compiling the matrix and keeping it up-to-date, and how it can be used in the production process of the CPI. One of their conclusions is that, despite some minor shortcomings, the General Business Register (GBR) of Statistics Netherlands can serve as the basic sampling frame for most of the types of outlets since it is reasonably complete and generally up-to-date. Another advantage is that the use of the GBR for CPI purposes will enhance comparability with related business statistics. Where needed the GBR should be completed with additional information. In areas where the GBR is not helpful at all, alternative sampling frames have to be constructed.

4.2 A preliminary version

The preliminary version of the matrix to be implemented next year will be used as the weighting scheme for the CPI and also to update the sample of products. It will not be used as a sampling frame for outlets, though, since the re-design of the outlet sample has not yet been started. As mentioned earlier, national accounts expenditure data will be the starting point. To simplify matters the four-digit COICOP level is chosen to define the rows of the matrix as this coincides with the publication level. In the future many categories may be disaggregated into more homogeneous strata. An important activity to be carried out in 2006 is distributing the four-digit COICOP national accounts figures for 2005 among various outlet types. As far as possible this will be done using actual expenditure or turnover data, for example data from the Household Expenditure Survey, retail trade statistics, and the available scanner data. Where expenditure information is lacking, the optimal number of price observations – the number of prices that should be collected for all sampled products belonging to a certain four-digit COICOP group (a row of the matrix) in the various outlet types (columns) – will be used as a crude measure.

---

[12] The second option is what Statistics Netherlands will actually be doing, because for most individual outlets reliable turnover data at the product(group) level is lacking. There is one exception, namely where scanner data is available.

Recall that, with the exception of scanner data, the Dutot index number formula is used to estimate the price index of a sampled product. The use of the Dutot formula is problematic for two reasons. First, even if the product has been tightly described (as usual, though not always), it cannot be called a homogeneous item if the services provided by the various outlets differ. Consumers may be willing to pay more for identical items in some outlets than in others, so that there will be sustained price differences, and possibly also differing price changes. Second, there is a practical problem as well. In principle the sample of outlets is a fixed-size panel. As a rule re-sampling should only take place during a base year revision. In practice the panel does not remain entirely fixed in time. This is understandable since the population of outlets changes during time: existing shops close down and new shops open up. To accommodate the population dynamics – to make the sample representative for the current population – the outlet sample is updated on an ad-hoc basis. Such sudden adjustments can have adverse price effects.[13] It would be better to adjust the sample in a smoother way. The use of outlet-type weights that remain fixed throughout the year and can be changed annually, which will be implemented with the matrix of transaction categories, is an important step forward.

Disaggregating the current sample of outlets into sub-samples most likely increases homogeneity and reduces the bias due to the aggregation of heterogeneous product varieties. From sampling survey theory it is well known that such post stratification generally leads to more efficient overall estimators (Särndal et al., 1992). However, post stratification which is carried through too far can lead to unstable results. Given the relatively small overall sample sizes, disaggregation may result in only few price observations on a particular product in certain outlet types. This makes it uncertain whether the standard error of the product price index will indeed be reduced. Thus, the optimal form of stratification needs further investigation. Another issue that will be looked into is the imputation method for temporarily 'missing' prices. Imputation is currently applied at the product level and must be changed to the level of the cells of the matrix. The computer system must be adapted to this.

At this stage the sample of outlets and the sample of products will not be updated drastically. This means that the prices of tightly described products will remain to be collected in the various outlet types. In the future it should be possible to use loose product descriptions and thus to observe the prices of different product varieties in different outlets. In order to aggregate the price changes of the varieties observed in individual outlets the Jevons index number formula seems appropriate for most of the product-outlet type combinations.

---

[13] Using the Dutot formula, the price changes of different outlet types are implicitly weighted by the sum of the base period prices. In practice Statistics Netherlands uses a chained version of the Dutot formula. Hence, when the relative number of price quotes is changed in some month, the implicit weights will change the following month. If the adjustments are made on an ad-hoc basis, the aggregate price index of a product may behave in an unexpected way. Van der Grient and Blijenberg (2004) found an example of this while analysing unpublished material for their study of the 'supermarket war' in the Netherlands during 2003.

5. Extending the scope of the CPI with health care

5.1 Background

In January 2006 health care insurance in the Netherlands was reformed. The reform introduced a fundamental change in the organisation and structure of the health care system. A compulsory basic insurance scheme now covers the largest part of health care for the total population, and approximately 40% of the total population moved from private insurance schemes to the new basic insurance scheme. Furthermore, everyone is free to choose between a range of additional packages offered by several insurance companies, if so desired.

Health care is excluded from the current Dutch CPI. To meet the demands of many of our users, Statistics Netherlands has decided to incorporate the additional health care insurance into the CPI starting from January 2007. This choice raises a number of conceptual and measurement issues, some of which will be addressed in section 5.3. First the reasons for including additional health care insurance premiums will be discussed.

5.2 Reasons for including part of health care

It is instructive to start with explaining why all insured medical care is excluded at present.[14] At the introduction of the CPI with base year 1990 the scope was changed. One of the changes was the removal of insured medical care, which had been part of the CPI for many years. Three reasons were given for this (see also Balk, 1993):

- At that time the majority of the population was insured through the compulsory sick-fund. The corresponding premiums paid were conceived as social insurance contributions instead of consumption expenditure and were therefore left out of the CPI. Although the premiums paid by privately insured households should in principle have been included, since they can best be described as out-of-pocket expenditures, it was decided to exclude them as well to handle both groups of households in the same way.
- It was felt that changes in the structure of the health care system should not affect the scope of the CPI and thus the price index numbers.
- Goods and services of which the prices or tariffs are determined retrospectively were excluded from the CPI, as mentioned earlier. Strictly speaking, a lot of the health care tariffs that were observed before (for instance the hospital room rate, that is the costs of spending a day in hospital) cannot be called market prices but are some sort of ex post accounting instruments.

---

[14] Expenditures on non-insurable medical goods (aspirine, plasters, cough mixtures, and so forth) and expenditures on medical goods and services for which households have chosen to be uninsured do belong to the scope of the current (and future) CPI.

The reform of the health care system in 2006 motivated Statistics Netherlands to look again at the above-mentioned arguments:[15]

- Following the treatment in the HICP and the national accounts the compulsory basic insurance is viewed as social insurance and should therefore be left out of the CPI. However, there is a strong case for including the premiums paid for the additional insurance packages as they clearly are out-of-pocket payments. This part of health care is included in the HICP and the national accounts also, and users will most likely appreciate this kind of comparability. The requirement of treating different types of households in a comparable way is a priori fulfilled since the new health care system holds for the total population: there is a single basic insurance for everyone, and everyone is free to choose between a range of additional insurance packages or not to be additionally insured.
- Future changes in the structure of the health care system, for example changes in the coverage of the insurance, remain an important topic. This problem will be addressed in section 5.3.
- During recent years market incentives have been introduced in (some parts of) the health care system. Also, the way prices are set has become more transparent than before. Information about the premiums and the composition of the various insurance packages can be obtained rather easily, for example via the Internet. Retrospective tariff changes for the parts of health care outside the basic scheme are nowadays an exception. So there seems to be no big problem in collecting price data.

5.3 Measurement issues

Two measurement issues will be discussed in detail here. The first is the concept of price. Should insurance premiums be observed or should preference be given to an approach based on the prices or costs of medical goods and services consumed and the costs associated with the services provided by insurance companies? The second issue is how to deal with changes in the coverage of the additional health insurance scheme and the related question of how to handle quality changes. Before going into those issues, a brief description is presented of how casualty insurance that provides reimbursement on the repair or replacement of damaged or stolen goods is treated in the CPI and the HICP. This will be a useful starting point for a discussion on the treatment of health care insurance (see also Triplett, 2001).

The price concept used in the HICP evolves from the concept of output used in the national accounts. The convention is that the output value of the casualty insurance industry equals premiums collected less claims paid (plus premium supplements, i.e. income from the investment of technical reserves, which will be disregarded here for simplicity). In a model in which premiums are equal to claims plus administrative costs, the national accounts convention implies that the nominal value of output of

[15] Parts of this section and of section 5.3 are borrowed from Gras and Schut (2005).

the industry equals the administrative costs of providing insurance. This convention is consistent with the notion of *pooling risks*. The assumption is that an insurance company is able to offer protection because it has created the facilities for pooling risks. The administrative costs are due to the services provided, such as performing actuarial work and settling claims. The national accounts concept is often referred to as the net premium approach. Claims received are registered as final expenditure on repair and replacement, the prices of which can be directly observed. However, the price index of risk-pooling services cannot be observed, so that some figure must be imputed. In case of the HICP the (gross) premium index is used for this.

An alternative concept of output is based on the idea that the policy holders protect themselves from risk by transferring risk to the insurance company in exchange for the premiums paid. Because the company still has to perform certain administrative activities to assume the risk, this concept of output may be called *assumption of risk*. If this is the preferred concept of output then observing premiums would be the most direct way to measure changes in the price paid for risk protection.[16] This is done in the current Dutch CPI as we believe that the concept of risk assumption fits well into the cost of living index framework.[17] Balk (1993, p. 53) has defended the use of the (gross) premium approach in a slightly different way: "In the category of services we include the rights. For example, a right is acquired when one pays an insurance premium. In exchange for the premium one is entitled to reimbursement of (all or part of) the cost due to fire, theft, car damage etc. Whether and when such rights are to be executed differs between the households." Statistics Netherlands has no plans for changing over to the net premium approach. Hence, the treatment of insurance will remain a conceptual difference with the HICP.

In the future CPI, as from January 2007, the price concept for additional health care packages will be the premium paid. In the context of the CPI we are not so much concerned about the actual use of medical goods and services but merely in the payment for the assumption or transfer of risk, or alternatively in the right to receive a certain treatment in case of illness, etc. It is implicitly assumed that health care insurance may be handled in a similar way as casualty insurance, which is not self-evident. For example, health care costs are often 'forced' as staying ill is usually not a serious option, whereas one may choose not to have his car repaired. Similar to

---

[16] It can be argued that gross premium changes should be adjusted for changes in risk; see De Haan (1999) for some references to the literature. However, so far nobody has come up with an acceptable solution.

[17] Erwin Diewert, who used to be an advocate of the gross premium approach, has recently changed his position. He now feels that "…. when a consumer buys a policy, he or she purchases a joint product. The first product is the premium cost. The second product offsets this cost and is the expected value of the loss in property. Due to transactions costs within the insurance company, the net cost of the purchase of the policy is generally positive and so the question is why would the consumer throw money away? The answer is …. consumers are not indifferent to small certain losses and large losses that have the same expected value" (Diewert, 2005, p. 64).

what is done in the case of casualty insurance, premium changes for the additional health care insurance scheme (at a constant coverage) will not be adjusted for any changes in 'risk' or utilization (the number of claims per insured). Due to the aging of the population the fraction of people having a disease may increase in the future. Not adjusting for this effect is likely to lead to an upward bias of the price index. Note again that we do observe the prices of medical goods and services in the CPI for which households are not insured.

There will probably be more changes in the structure of the health care system in the years to come. One such change might be a reduction in the coverage of the basic health care insurance scheme. This will most likely affect the scope of the CPI by either extending the coverage of the additional insurance scheme or by increasing the range of self-paid medical goods and services. There are basically two options to deal with this:

- The first option states that the prices of the 'new' goods and services are raised from zero to some positive value, and accordingly raises the additional insurance premium. Measured inflation will therefore increase. This approach is followed in the HICP. Apparently it is assumed that the 'new' goods already belonged to the scope of the index in the base period – otherwise it would make no sense to speak of a price increase. This is problematic, though: in the base period there existed an (albeit implicit) positive price, because those goods and services were covered by the basic insurance scheme.
- The 'new' goods are introduced during the next base year revision. In the future chain CPI this will be the year following the introduction. The CPI will thus not be affected by the extension of the coverage of the additional insurance scheme or the consumption of self-paid health care products. Looking at the issue from a national accounts perspective, a reduction of the basic health insurance scheme reduces real collective (government) medical care expenditures and raises real household expenditures. This option is chosen for the CPI.

In practice the premiums of a sample of rather narrowly defined additional health care insurance policies will be observed. Policy conditions change frequently for many reasons, including changes in coverage. To adjust for a change in coverage the approach in case of casualty insurance is to ask insurance companies to provide estimated premiums for the sampled policies of which the premium characteristics are held constant or, what is essentially the same, to ask them to provide estimates of that part of the premium change due to the change in coverage. A similar approach will be adopted to adjust for changes in the coverage of a sample of additional health care insurance policies.[18]

---

[18] At first sight it may seem natural to use hedonic regression instead. However, due to the potentially large number of characteristics this approach would probably be infeasible. More importantly, the medical care market may not satisfy the conditions needed for performing hedonic price analysis (Berndt et al., 2001).

Since it is the right to receive health care of a constant quality that matters when measuring the price index of health care insurance, the premium change should in principle be adjusted for changes in quality of the goods and services (treatments) policy holders may or may not receive. The same holds for the goods and services directly paid by households. But the measurement of quality change in medical care is a notoriously difficult area. Explicit quality adjustments will thus not be carried out.[19] This is another potential source of upward bias in the index.

Because the introduction of insured medical care is a major conceptual change of the CPI, a new index series will be started as from January 2007 instead of linking the new CPI in one way or another to the existing CPI that excludes insured health care. Fortunately this date coincides with the introduction of the chain CPI. This makes it possible to cope with the dynamics of the health care system in a much better way than would have been possible with the current fixed-weight CPI. A 'guesstimate' is that the weight in 2006 will amount to approximately 3.5%.

Note that the scope of the HICP has been reduced as a result of the new health care system since the largest part of the former private insurance scheme is now covered by the compulsory basic scheme and hence falls outside the scope of the HICP. For the HICP a continuous series has been constructed by linking the new series to the old series in such a way that the all-items HICP is not affected.[20]

6. Possible future improvements

The parts of the CPI re-design described in sections 3-5 should be implemented in January 2007. Based on the discussion of the aims and foundations of the future CPI in section 2, several possible further improvements emerge. I will briefly mention some of them below, without being very specific as those activities are not (yet) officially planned.

- Re-designing the sample of outlets, including constructing appropriate sampling frames. This cannot be done in isolation from other improvements since an exact description of the statistical target is an indispensable part of a sampling design.

---

[19] In the U.S., "BLS was unable to produce consistent constant-quality premiums for health insurance policies for use as CPI prices. BLS plans further research to find more appropriate ways to price this index and currently the CPI is again re-testing the direct pricing of health insurance" (BLS, 2006).

[20] At first the idea was to let the prices of the removed medical goods and services 'fall to zero', corresponding to the approach followed in case of a minor change in scope. Inflation as measured by the HICP would then have been reduced considerably, and this effect was deemed undesirable by Eurostat. For more information, see "Commission Recommendation of 08/XII/2005 on the treatment in the Harmonized Indices of Consumer Prices of certain issues concerning health care reforms within the framework of Council Regulation (EC) 2494/95 and specific implementing measures relating hereto".

- Further work on the matrix of transaction categories. The cells of the matrix, i.e. the preferred elementary aggregates, must be specified and joined with the outlet sampling frames where needed. This relates directly to the first point.
- Introduction of loose product specifications and the use of a geometric index (Jevons) number formula at the cell level of the matrix of transaction categories. For which cells would this be the best solution? This has a direct relation with the first two points.
- Extending the use of explicit quality adjustments. The use of hedonic regression should be considered, in particular for high-tech and high-model turnover goods. A Centre and Network of Excellence (CENEX) on quality adjustment, in which Statistics Netherlands participates, has recently been established. With its focus on practical issues the CENEX seems a fruitful point to start from.
- Extending the use of scanner data. Statistics Netherlands is receiving those data for a number of supermarket chains and other types of outlets, e.g. chains selling household appliances etc., which are currently not incorporated into the CPI. In order to facilitate implementation, data processing should be organised such that the amount of extra work will be limited.[21]
- Building a new automated system. This system must be flexible, meaning that it can handle different types of data (including scanner data), supports the use of various index number formulas at the elementary aggregation level, etc.

In addition to the above-mentioned activities, there is a need for research into two areas: health care and user costs. Although some conceptual and measurement issues on the construction of medical care price indexes have been addressed, it should be admitted that many other issues have not been taken into account. As far as I know the most comprehensive overview in this field is Berndt et al. (2001). However, this study discusses the situation in the U.S. of several years ago. Given the institutional differences between the U.S. and the Netherlands, and the changes that have taken place, a study on price measurement for the Dutch medical care sector seems very useful, particularly when placed in a cost of living index framework. As regards user costs, empirical research addressing the feasibility of constructing a price index for the user costs of owner-occupied housing in the Netherlands is unfortunately lacking to date. I suggest performing such research in the nearby future.

---

[21] Van der Grient and Van Mulligen (2005) did some empirical work on scanner data from one chain that sells household appliances and electrical goods. They computed various types of matched-model price indexes, e.g. Törnqvist indexes and unweighted geometric (Jevons) indexes. In De Haan (2005b,c) various suggestions are made to simplify the use of scanner data. In my opinion scanner data should meet at least four criteria in order to be incorporated into the CPI: the products should be easy to classify into COICOP categories; the method to process the data, including the index number formula, should be available; data collection and data storage should not be part of the CPI production process; and the data should be made available to, and be used by, other statistics (notably retail trade statistics).

References

Balk, B.M. (1990), On Calculating Cost-of-Living Index Numbers for Arbitrary Income Levels, *Econometrica*, 58, 75-92.

Balk, B.M. (1993), The New Consumer Price Indices: An Outline, *Netherlands Official Statistics*, 8, winter 1993, pp. 51-54.

Balk, B.M. (1995), Axiomatic Price Index Theory: A Survey, *International Statistical Review*, 63, pp. 69-93.

Balk, B.M. (1998), On the Use of Unit Value Indices as Consumer Price Sub-Indices, in: W. Lane (ed.), *Proceedings of the Fourth Meeting of the International Working Group on Price Indices*, pp. 112-120. Washington, DC: Bureau of Labor Statistics.

Balk, B.M. (2003), Price Indexes for Elementary Aggregates: The Sampling Approach, in: Th. Lacroix (ed.), *Proceedings of the Seventh Meeting of the International Working Group on Price Indices*, pp. 151-174. Paris: INSEE.

Balk, B.M. (2006), Measuring and Decomposing Rates of Inflation Derived from Annually Chained Lowe Indices, *Mimeo*, Erasmus University Rotterdam and Statistics Netherlands, Voorburg.

Balk, B.M. and W.E. Diewert (2003), The Lowe Consumer Price Index and its Substitution Bias, *Mimeo*, Erasmus University Rotterdam and University of British Columbia.

Balk, B.M., J. de Haan and C. Schut (2004), De toekomstige CPI: een schets, *Mimeo*, Statistics Netherlands (Dutch only).

Berndt, E.R., D.M. Cutler, R.G. Frank, Z. Griliches, J.P. Newhouse, and J.E. Triplett (2001), Price Indexes for Medical Care Goods and Services: An Overview of Measurement Issues, in: D.M. Cutler and E.R. Berndt (eds.), *Medical Care Output and Productivity*, pp. 141-198. Chicago and London: The University of Chicago Press.

Boskin, M.J., E. Dulberger, R.J. Gordon, Z. Griliches, and D.W. Jorgenson (1996), Toward a More Accurate Measure of the Cost of Living, *Final Report of the Advisory Commission to Study the Consumer Price Index*. Washington DC: U.S. Government Printing Office.

Bruijn, N. de, and E. Osseforth (2005a), Het kader van transactiecategorieën: is het ABR een geschikte bron?, *Mimeo*, Statistics Netherlands, Voorburg (Dutch only).

Bruijn, N. de, and E. Osseforth (2005b), Het kader van transactiecategorieën: zijn de overige bronnen geschikt?, *Mimeo*, Statistics Netherlands, Voorburg (Dutch only).

Bruijn, N. de, and E. Osseforth (2005c), Het kader van transactiecategorieën: mogelijkheden bij vulling, onderhoud en verfijning, *Mimeo*, Statistics Netherlands, Voorburg (Dutch only).

Bruijn, N. de, and E. Osseforth (2005d), Pilot wit-, bruin- en grijsgoed: gebruik kadermethodiek, *Mimeo*, Statistics Netherlands, Voorburg (Dutch only).

Bruijn, N. de, and H. van der Grient (2006), Jaarlijkse basisverlegging CPI per 1-1-2007; advies over de toe te passen methodiek, *Mimeo*, Statistics Netherlands, Voorburg (Dutch only).

Bureau of Labor Statistics (BLS) (2006), Measuring Price Change for Medical Care in the CPI, *BLS Internet site: www.bls.gov*.

Diewert, W.E. (1992), Fisher Ideal Output, Input and Productivity Indexes Revisited, *Journal of Productivity Analysis*, 3, pp. 211-248.

Diewert, W.E. (2003), The Treatment of Owner Occupied Housing and Other Durables in a Consumer Price Index, *Discussion paper no. 03-08*, Department of Economics, University of British Columbia, Vancouver.

Diewert, W.E. (2005), Progress in Service Sector Productivity Measurement: Review Article of Productivity in the U.S. Services Sector: New Sources of Economic Growth, *International Productivity Monitor*, 11, fall 2005, pp. 57-69.

European Central Bank (ECB) and Eurostat (2004), A Harmonised Constant Tax Rate Index, *Paper no. HCPI 04/504 for the Meeting of the Working Group on Harmonization of Consumer Price Indices*, Luxembourg, 25-26, March 2004.

Gras, A. and C. Schut (2005), Behandeling medische zorg in de consumentenprijsindexcijfers na de stelselwijziging, *Internal memo*, Statistics Netherlands, Voorburg (Dutch only).

Grient, H.A. van der (2004), Scanner Data and Durable Goods: Market Dynamics and Hedonic Time Dummy Indexes, *Discussion paper no. 04011*, Statistics Netherlands, Voorburg.

Grient, H. van der, and H. Blijenberg (2004), Prijzenoorlog tussen supermarkten, in: *De Nederlandse economie 2003*, pp. 36-41. Voorburg/Heerlen: Statistics Netherlands.

Grient, H. van der, and P.H. van Mulligen (2005), Prijsindexcijfers voor wit-, bruin- en grijsgoed op basis van scannerdata, *Mimeo*, Statistics Netherlands, Voorburg (Dutch only).

Haan, J. de (1999), *Empirical Studies on Consumer Price Index Construction*, (Ph.D. thesis, Erasmus University Rotterdam). Voorburg: Statistics Netherlands.

Haan, J. de (2000), Demographic Change and Upper Level Bias in a 'Democratic' CPI, in: M. Silver and D. Fenwick (eds.), *Proceedings of the Measurement of Inflation Conference*, pp. 191-205. Cardiff: University of Cardiff.

Haan, J. de (2004a), Direct and Indirect Time Dummy Approaches to Hedonic Price Measurement, *Journal of Economic and Social Measurement*, 29, pp. 427-443.

Haan, J. de (2004b), Hedonic Regression: The Time Dummy Index As a Special Case of the Generalized Törnqvist Index, *Paper presented at the Eighth Meeting of the International Working Group on Price Indices*, 23-25 August 2004, Helsinki.

Haan, J. de (2005a), Jaarlijkse basisverlegging: minimale variant, *Internal note*, Statistics Netherlands, Voorburg (Dutch only).

Haan, J. de (2005b), Ideeën voor de pilot supermarkten en voor daarna, *Mimeo*, Statistics Netherlands, Voorburg (Dutch only).

Haan, J. de (2005c), Een ongewogen meetkundige index voor scannerdata, *Mimeo*, Statistics Netherlands, Voorburg (Dutch only).

International Labour Office (ILO) (2004), *Consumer Price Index Manual: Theory and Practice.* Geneva: ILO Publications.

Mulligen, P.H. van (2003), *Quality Aspects in Price Indices and International Comparisons: Applications of the Hedonic Method* (Ph.D. Thesis, University of Groningen). Voorburg: Statistics Netherlands.

Pannekoek, J. and C. Schut (2002), De spreiding van huishoudenspecifieke prijs-indexcijfers tussen en binnen groepen van huishoudens, *Research paper no. 0234*, Statistics Netherlands, Voorburg (Dutch only).

Särndal, C.E., B. Swensson, and J. Wretman (1992), *Model Assisted Survey Sampling*. New York: Springer-Verlag.

Schut, C. et al. (2002), Gebruik van scannerdata van supermarkten in de consumentenprijsindex, *Mimeo*, Statistics Netherlands, Voorburg (Dutch only).

Silver, M. and S. Heravi (2002), Why the CPI Matched Models Method May Fail Us: Results from an Hedonic and Matched Experiment Using Scanner Data, *European Central Bank (ECB) Working paper no. 144*, ECB, Frankfurt.

Triplett, J.E. (2001), What's Different about Health? Human Repair and Car Repair in National Accounts and in National Health Accounts, in: D.M. Cutler and E.R. Berndt (eds.), *Medical Care Output and Productivity*, pp. 15-94. Chicago and London: The University of Chicago Press.

Verbrugge, R. (2004), The Puzzling Divergence of Aggregate Rents and User Costs, 1978-2001, *Paper presented at the SSHRC Conference on Price Index Concepts and Measurement*, June 30 – July 3, 2004, Vancouver.