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## Biasing Factors of the Consumer Price Index

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MŰHELYTANULMÁNYOK  
ÚJ SOROZAT

**DISCUSSION PAPERS**  
NEW SERIES

MT-DP. 2003/12

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THE CONSUMER PRICE INDEX**

ILONA KOVÁCS

Institute of Economics  
Hungarian Academy of Sciences

Budapest

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MŰHELYTANULMÁNYOK

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## **Biasing Factors of the Consumer Price Index**

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# BIASING FACTORS OF THE CONSUMER PRICE INDEX

BY ILONA KOVÁCS

## *Abstract*

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*Studies conducted in the United States came to the conclusion that the annual average inflationary rate of 3 percent measured during the interval beginning in the early 1990's through the mid-1990's overestimates by 1.1 percentage points the changes in the cost of living. As a result, throughout the world, not just in the United States, many countries are reconsidering the supposed bias of the Consumer Price Index, its consequences, and consequences related to economic decision making. The purpose of this study is to analyze in detail the biasing factors theoretically occurring during the calculation of the Consumer Price Index, based on international literature, and the possible outcome of such biases. Out of biasing factors substitution effect empirically is investigated on Hungarian data.*

*Journal of Economic Literature (JEL) code: B21, C13, C43, E3.*

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KOVÁCS ILONA

## A FOGYASZTÓI ÁRINDEX TORZÍTÓ TÉNYEZŐI

### *Összefoglalás*

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*A kilencvenes évtizedben az Egyesült Államokban folyó kutatások arra a következtetésre jutottak, hogy az 1990-es évek eleje és közepe közötti időszakot vizsgálva az átlagosan évi 3 százalékos mért inflációs ráta mintegy évi 1,1 százalékponttal felülbecsüli a megélhetési költségek változását. (Lásd Boskin et al., 1998). Hatására nem csupán az Egyesült Államokban, hanem szerte a világban, sok országban foglalkoznak a fogyasztói árindex feltételezett torzításával, ennek következményeivel, valamint a gazdasági döntéshozatalt érintő implikációkkal.*

*A tanulmány célja, hogy a nemzetközi irodalom alapján részletesen elemezze a fogyasztói árindex-számítás körül elvileg fellépő torzító tényezőket és magának a torzításnak lehetséges következményeit. Végül kísérletet tesz a magyar fogyasztói árindex helyettesítési hatásból származó torzításának kimutatására. A magyar adatok nem mutatnak lényegi eltérést a Laspeyres módon számított és Paasche indexek között.*

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Perhaps there is no other key element of economics that could intertwine, influence, determine every single area of the economy to the extent that price and changes in price do. The Consumer Price Index is the best known and most frequently used index for the measurement of the changes in the cost of living and inflation. As a consequence of the key role price plays in the economy, it is very important that statistical institutions of individual countries calculate its changes with adequate precision.

We may calculate the macroeconomic indicators of the economy at real values (growth rate of GDP, real consumption, real wages, size of real income, real value of pensions, various real returns) by deflating, with the help of price indices. Assessment of the performance of any national economy is based primarily on the stability of prices and the extent of economic growth, and both of these require the precise measurement of changes in prices. At the same time the experience of statistical institutions confirms that the calculation of Consumer Price Indices is not without problems. The purpose of this study is to analyze in detail the factors of bias arising during the calculation of the Consumer Price Index, based on international literature, and its consequences. Finally, the study attempts to show the biases caused in the Hungarian Consumer Price Index by the effect of substitution.

## **THE REPORT OF THE BOSKIN COMMITTEE**

The Senate Finance Committee of the United States appointed a five-member consulting body in 1995, the so-called Boskin Committee, consisting of leading economists representing both parties, with the mission to analyze the measured errors and biases of the Consumer Price Index published by the Bureau of Labor Statistics. The committee<sup>1</sup> came to the conclusion that upon examination of the interval between the early and mid-1990's, the average annual rate of inflation measured at 3 percent for this period overestimated the changes in the cost of living by 1.1 percentage points. (*Boskin and co-authors, 1998*).

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<sup>1</sup> Members: Michael J. Boskin (Chairman of the Committee), Ellen R. Dulberger, Robert J. Gordon, Zvi Griliches and Dale W. Jorgenson.



The debate concerning the measurement of the Consumer Price Index, naturally, has been running for decades, sometimes with less, sometimes with more intensity. In the U. S., as early as 1961, the famous Stigler Committee was formed with the objective of preparing a report for the Budget Committee about possibilities of improving national price statistics (*Stigler, 1961*). They drew up statements saying that the Consumer Price Index calculated by the traditional Laspeyres-type method considerably biases upwards the index of the cost of living.

However the Boskin report elaborates unprecedented, intense and effective criticism concerning the measurement errors of the Consumer Price Index. The report drew attention to such an extent that as a result widespread research work emerged about this topic. Consequently, not only in the United States, but in many countries throughout the world, the supposed biases of the Consumer Price Index, its consequences, and its implications in economic decision making have become an issue.<sup>2</sup>

What are the changes that were able to put biases related to the measurement of Consumer Price Indices in the center of attention with such renewed intensity?

In the United States, just as in the most developed industrialized countries, the rate of inflation decreased considerably during the nineties and at times approached zero. Hence it follows that if bias appears in such low rates of inflation, it may make the entire rate of inflation disappear. A considerable proportion of government expenditures is made up of welfare spending, and these are index-linked to the Consumer Price Index. The Boskin report notes if the Consumer Price Index overestimates by 1 percentage point the cost of living during the period of 1997-2006, then merely this error of measurement will cause the budget deficit of the United States to increase by 135 billion dollars by 2006 (*Boskin and co-authors, 1998*).

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<sup>2</sup> A selection from the most important publications: *Moulton (1996)*, *Abraham-Greenlees-Moulton (1998)*, *Jorgenson (1995)*, *Diewert (1998)*, *Hill (1997)*.. In 1997 the conference of European statisticians organized in Geneva was dedicated to the Consumer Price Index. (Joint ECE/ILO Meeting on Consumer Price Indices, Geneva, November 24-27, 1997.) In 1999 two members of the National Bureau of Economic Research, Ernst Berndt and Zwi Griliches, invited price statisticians to a conference, and the somewhat eclectic opinions expressed at this forum were published in the September 2000 issue of the *Monthly Labor Review*.

While the Stigler Committee dealt on a separate basis with the consumer, production and agricultural price indices, it did not come up with a concrete index number concerning the degree of bias in any of these cases, whereas the task of the Boskin Committee was to determine the concrete bias of the Consumer Price Index, and as a final result of their work they published for the first time a single figure denoting the extent of the bias.

In the meantime newer and newer studies have been published, which have urged the improvement of national statistics. Naturally many initiatives from within (Bureau of Labor Statistics) have seen the light of day (*Gordon, 1995, Griliches, 1995, Reinsdorf, 1998, Moulton, 1996, Triplett, 1999*). In 1994 university professors and statisticians created the Ottawa group in order to coordinate work concerning the Consumer Price Index.

In the past decade the enormous changes in the market structures of national economies have also increased the pressure on national statistical institutions for more precise calculations of the price indices. We may highlight two characteristic fields: on the one hand the increase in popularity of discount and wholesale store chains, and on the other hand the mass of newly appearing products and services of improved quality due to fast paced technological developments.

One of the most important activities of central banks is to keep inflation that is measured by Consumer Price Indices under control. But the question arises whether the Consumer Price Index is the best suited to measure inflation?

## **THE CONSUMER PRICE INDEX AND HOW IT IS CALCULATED**

The Consumer Price Index was primarily created out of the necessity that changes in the cost of living had to be measured in some way, therefore it is accepted and declared that we measure the changes in the cost of living and the extent of the depreciation of money with it. The Consumer Price Index, beyond its uses in the calculation of various real indices, serves a multifunctional role in the economy. The study of *Ferenczi-Valkovszky-Vince (2000)* lists five important functions of the Consumer Price Index: 1. index of the cost of living, 2. index of the cost of keeping money, 3. index serving as a base for the calculation of real interest and 4. of the real exchange rate, 5. the means of calculating core inflation; the study showed through a multifaceted examination that the Consumer Price Index does

not wholly fulfill any of these functions and made recommendations as to what kind of indices would be necessary for fulfilling which functions.

In our study we will examine whether the Consumer Price Index is a Cost of Living Index or not. The Cost of Living Index expresses the minimum change in cost for a given consumer that is necessary for the consumer to enjoy the same utility in the current period as in the base period.

According to the definitions in the publications of KSH (1992), (2000) (Central Statistical Office), the Consumer Price Index measures the price changes of the consumption purchased at actual prices by the population. In the applied consumer basket purchased products and services figure *per definicionem*, goods that may not be purchased directly for money, such as consumption from own production within a household, welfare benefits, and expenditures for the purpose of investment and production, are not included. An exception is made for the ownership of apartments, which are included in the basket with a so-called imputed rent, but – aside from an automobile in use – the articles used are missing. The imputed rent included in the basket serving as a base for the Consumer Price Index is questionable (*Ferenczi-Valkovszky-Vince* (2000), since no transaction that would involve spending money takes place. Inclusion of the price of durable consumer goods in the basket deserves special mention, but this would take us too far, and the measurement of the price of the “consumption” of durable goods is not resolved in other fields either.

The Consumer Price Index, which is a Laspeyres-type index, is the base period weighted average of the individual price indices of *representatives* observed at selected outlets.<sup>3</sup> Calculation of the Consumer Price Index is a multilevel aggregational activity. In the first phase, the Bureau calculates a single average price or price index from the observed heterogeneous prices for each representative at the lowest, basic level. The calculated individual price indices of the representatives are used in later phases of the price index calculation.

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<sup>3</sup> I took the information concerning the methodology used for the calculation of the Consumer Price Index between 1992-1999 from a KSH publication published in 1992 (KSH [1992]). The methodology was somewhat changed beginning in 1999 in accordance with European harmonization requirements and efforts: previously 1600, and 1400 *representatives* were listed in the basket, beginning in 1999, 1100 *representatives* were listed, and some items related to insurance, financial services were included in the basket. These changes do not affect my analyses.

“Every representative has a weight, the sum of which is a global 100%. In this way the calculation of the price index, from the representatives through detailed and aggregate groupings, to the global index, is a continuous, concise process, and from the representatives not only the price index following the consumption structure, but any price index with any groupings may be constructed.” (See *KSH*, 1992 pp. 28) The weights of the representatives were developed through the estimations of experts. At higher aggregate levels the household statistical data served as a base for the methodology that was in effect from 1992 to 2000, which harmonized these figures with the figures of macro-level purchased consumption data measured by the System of National Accounts. For every year the weights correspond to a consumption structure from two years earlier, because consumer expenditure shares from household statistics are not available for the given year or even the year preceding the current year. The starting point for developing the weights of the representatives is that the representative products and services should completely fill each and every group that they belong to, and that are made up of approximately 160 items, at a higher aggregate level. In this phase it is of course necessary to be familiar with the weight and expenditure shares measured for the 160 groups of commodities within the expenditures of the population. These expenditure shares must be allocated among the representatives that belong to the given group of commodities. “The weight of the representative is a representative weight, which is the sum of the actual weight of the representative and the weight of the products and services that it represents.” In this phase the estimation of experts plays a major role. The weights of the representatives are changed every year, these weights are reworked annually (see *KSH*, 1992 pp. 28).

Through the use of the Lasperyes-type individual price indices of the representatives, subsequent price indices are calculated for the group of 160, then at an even higher level of aggregation, for the 34 subgroups and finally for the 7 main groups of commodities.

Eurostat, the statistical institution of the European Union, directs and coordinates the harmonization of the Consumer Price Indices of the Member States and the countries wishing to accede, in cooperation with the national statistical institutions. The Harmonized Index of Consumer Prices (HICP) is mandatory for both EU Member States and acceding countries; at this point it is not substitutable for the Hungarian Consumer Price Index, but it exists in parallel with it. The use of the international nomenclature of the COICOP – classification according to the purpose of consumption – is, however, mandatory. In order to calculate the

harmonized price index, the weights must be taken into consideration according to the structure of domestic macro-consumption.

Depending on the weights of which period we wish to use for the calculation of the Consumer Price Index, we may calculate two types of indices.<sup>4</sup> Basically both indices give an answer in their own way to how much the level of prices has changed. *Diewert*, 1976, 1995, 1996 has shown that the true Cost of Living Index (COLI) is best approximated through the Fisher index.<sup>5</sup>

Statistical institutions do not have the means of calculating either the Paasche, or the Fisher index for the current year, because the necessary consumer expenditure shares of household statistics, that are to be used as weights, are simply not yet available. The KSH – as the statistical institutions of many other countries – in theory calculates the Laspeyres-type price index, however, in practice makes the modification of using weights linked to a consumer basket created by a representative method not from the preceding year, but from the year two years before the current year, as even the weights of the year preceding the current year are not available at the time of the calculation of the index.

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<sup>4</sup> The Laspeyres price index ( $P_L$ ) is the arithmetic mean weighted with the expenditure shares fixed at the *base period* for individual price indices, where we use the proportion of expenditures spent on individual goods during the base period within total expenditures as weights. The Paasche price index ( $P_P$ ) is the harmonious average of the individual price indices calculated with *current period* weights. The Fisher index ( $P_F$ ) may be attained by the *geometric mean* of the two indices (see *Köves-Párnitzky* (1981) and *Kovács* (2003)).

<sup>5</sup> The problems of the theory of indexation are not new. Bowley, an English statistician, already at the end of the 19<sup>th</sup> century brought up the idea that “the budget of an earlier and later year must be evaluated at the prices of both years, and the geometric mean must be calculated for the figures thus obtained”. Although this supposition put into words the idea of the “Fisher index”, the index itself is linked with the name of Fisher (see Fisher [1927]). The theory of indexation has enormous and complicated literature, both in the international and domestic technical literature. As an example see: *Fisher*, 1927, *Frisch*, 1936, *Adelman*, 1958, *Eichorn-Voeller*, 1976, *Forsyth-Fowler*, 1981. Many researchers have extensively dealt with this question in Hungary as well (*Köves*, 1981, *Drechsler*, 1958, 1962, 1973, *Laczó*, 1972, 1976).

## BIASING FACTORS OF THE CONSUMER PRICE INDEX

When measuring by the traditional, Laspeyres-type Consumer Price Index, we may find that the biases and their sources may be summarized in five points:

1. substitution of one product for another,
2. substitutions among stores,
3. improvements in the quality of products and services, the effect of substitutions.<sup>6</sup>
4. biases arising from new goods, and
5. sources of error arising during the calculation of basic indices.

The official Consumer Price Index does not take into account compare the cost of the consumer basket representing the base period with the cost of the same basket for the current period, then, in the case of a price raise, the traditional Laspeyres price index overestimates the changes in the cost of living because the spending structure changes because of the different changes in the relative prices during the current period. The Laspeyres index is not capable of taking this into account and thus eliminates from the outset the consideration of the effect of substitution on consumer behavior.<sup>7</sup>

The assumption in the definition of the Laspeyres-type price index that substitution among goods and among stores in the case of consumers is zero, is an economic absurdity, since substitution is one of the cornerstones in the theory of demand. It is a general assumption in the technical literature: if variance in the relative price indices is high, then according to rational consumer behavior substitution appears, the effect of which the

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<sup>6</sup> In the course of our shopping we may buy the same product in different stores and at different prices. Substitution among products and services occurs because in the case of a price raise the prices of these products and services change to a different extent. The consumer, sensing the different relative price changes of individual products and services, may fend off in part the negative effects of the products whose prices were raised to a larger extent on his consumption expenses by switching to buying relatively less expensive products and services, thus demand shifts towards consumption of the relatively less expensive goods.

<sup>7</sup> The Paasche index prompts a bias of the opposite direction, in other words, it underestimates the changes in the cost of living. This is why many suggest the use of the true Cost of Living Index.

Laspeyres-type Consumer Price Index is unable to convey and for this reason it is strongly questionable whether the Consumer Price Index is a Cost of Living Index.

The effect of substitution may be proven through theoretical, logical and empirical means, and it is no accident that technical literature has dealt with the issue for decades. (See: *Aizcorbe-Johnson*, 1993, *Podpiera*, 2002, *Filer-Hanousek*, 2000).<sup>8</sup>

*Diewert*, 1998 gives the bias arising from the substitutability of goods among each other with the following estimation:

$$P_L - P_F \sim 0.5(1+i)\text{Var}(\mathbf{R}),$$

where  $i$  is the rate of inflation measured by the Laspeyres index, and  $\text{Var}(\mathbf{R})$  is the variance of relative price changes. It follows from the formula that the higher the variance of relative price changes is, the higher the bias. Some consider, in the technical literature, that it may appear obvious, that bias arising from substitution increases in line with the level of inflation, because as the rate of inflation increases, so does the variance of relative price changes (*Hanousek-Filer*, 2001). In this regard we do not, however, have exact proof. However, the Paasche and the Fisher indices may only be calculated in retrospect because we do not have data available concerning the amounts sold for the entire population for the current year at the time of the calculation of the index.

The rate of inflation in America was very low during the nineties, yet considerable bias was shown here. In Hungary an inflation of 460 percent was measured from 1990 to 1997. During this period, in the other Eastern and Central European transition countries inflations from 200 percent (Czech and Slovakian Republic) to 24,000 percent (Ukraine) were measured. Many researchers came to the conclusion that in these countries a similar sized bias could be shown in the measured Consumer Price

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<sup>8</sup> We may find examples where changes in consumption, because of the behavior of the consumer, or her inner decision, change in the direction of the price change. Let's consider an event relatively in the recent past, where because of mad cow disease consumers decreased their consumption of beef even though its prices were going down. There are studies concerning the fact that fear of high cholesterol, which is considered a risk factor in cardio-vascular disease, has decreased the demand for eggs, even though the relative price of eggs in time is decreasing (see *Brown and Schrader*, 1990).

Indices (see *Brada-King-Kutan*, (2000), *Filer-Hanousek*, 2000, *Koen-de Masi*, 1997, *Duchene-Gros*, 1994). Nevertheless, if such a bias did exist, it would have serious consequences affecting the Hungarian economy and economic policy decisions.

The other form of the effect of substitution, besides substitution among products, is *substitution among stores*. This occurs when new, less expensive distribution channels appear, such as discount stores, supermarkets, hypermarkets, in addition to the traditional chain stores. These are necessarily left out of the statistical data compilation in the year they are opened because it follows from the principles of the calculation of the index that a store that did not figure in the sampling of the base period cannot figure in the current period. It is markedly characteristic of the transition countries that in the interval of the last 10–12 years the number of stores of this type has increased considerably, and in addition, the importance of stores with lower price ranges has increased in the economy.

Bias resulting from an *improvement in quality* occurs because it is very difficult to show and separate in the price of goods whose quality has changed the price raise that is due to inflation from the price raise that is due to an improvement in quality, therefore statistical institutions attribute a part of the price raise due to an improvement in quality to increased inflation. We know from the methodological description of price statistics (*KSH*, 1992), that the Bureau did not perform corrections relevant to the improvement of quality in the interval between 1992 and 1999.

It is of course difficult to measure an improvement in quality, but improvements in quality – in masses in the case of the most basic goods - have manifested themselves the most forcefully precisely in the countries of transition. Solving this problem also poses a great challenge to statisticians.<sup>9</sup>

*Bias arising from the introduction of new goods* occurs because these goods appear in the consumer basket considerably later than their appearance on the market. The goods introduced in the current period cannot appear in the basket because they did not figure in the base period. Furthermore the new goods gain ground gradually among consumers, and

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<sup>9</sup> In truth only the producing companies may be able to give some essential facts, information as to what weight the inflationary price change and the price change due to the improvement of quality represent in the price raise.



their prices usually decrease drastically in the first few years following their introduction.

From 1999 onwards Eurostat has prescribed a quality correction for the calculation of the Consumer Price Index. There have been attempts made at measuring improvements in quality by the use of hedonic functions (see *Fisher-Shell*, 1971, *Deaton-Muellbauer*, 1980, *Shapiro-Wilcox*, 1996).

Beyond the heated debates concerning the present practice of formulating price indices, the Boskin Committee and researchers working independently from the committee have drafted a research program for the long term, for the upcoming two decades. They suggest the use of the Fisher index for measuring the cost of living and in addition to this the use of the system of demand functions. Demand functions proved sufficiently successful in earlier analyses, even at relatively high aggregate levels (*Hoch-Kovács-Ördög*, 1982, *Szakolczai and co-authors*, 1978, 1979, *Muszély*, 1979, 1980).

In recent years the idea has emerged more frequently in developed countries that the spread of scanning prices with barcodes provides opportunities for collecting data on the whole of goods (products and services) belonging to a specific group of goods. This served at the same time as a stimulant for elaborating procedures related to handling disappearing and then freshly reappearing goods. The Dutch statistical institution, for instance, plans to use the data scanned from barcodes at nationwide commercial chain stores (*de Haan*, 2002). The basic idea is to collect data for all products and services, at the level of the groups of goods, instead of working with representatives, and thus they may switch to the use of the Fisher formula.

## **CONSEQUENCES OF THE BIASES OF THE CONSUMER PRICE INDEX**

It is extremely important that economic policy advisers and experts see clearly the consequences of the possible upwards bias or measurement errors of the Consumer Price Index. Although these are general assertions, there are consequences that may appear more intensely in the economies of transition, to a different extent in different countries.

1. If the Consumer Price Index biases upwards the changes in the cost of living, or in other words, the former is less than what the measurement shows, then, as a result, macro-indicators deflated with the Consumer

Price Index are greater than the measured values.<sup>10</sup> In order to give concrete answers to these questions, however, we have to perform concrete calculations.

2. If inflation differs from what is planned, it causes surpluses or deficits in the budget. If the government underestimates in its plans the rate of inflation, the budget will pocket inflationary gains; if the inflation stays below what was projected, then these gains will be lost. If the Consumer Price Index is biased upwards, then this inflationary gain is even larger.
3. The upwards bias of the Consumer Price Index may have dramatic effects on the balance of the budget, and also on the expenses of employers.<sup>11</sup>
4. The exact measurement of the changes in price also plays an important role in measuring productivity.<sup>12</sup>
5. Beyond the theoretical problems of index calculation the transition from a shortage economy to a market economy brought considerable changes in the increase of selection, improvement of quality, elimination of shortages, and changes in the relative prices of different products and services. In theory the economies of the countries of transition would really be the ideal environment for grasping the measurement problems of the Consumer Price Index because the possible causes of bias were

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<sup>10</sup> Some say that the overestimation of the Consumer Price Index based on the Boskin report projects a better picture of not only inflation, but retrospectively of the entire performance of the national economy of the United States: during the past 25 years average real wages rose, rather than diminished, the median real wage increased, rather than stagnated, and the rate of poverty was probably lower than what was calculated (*Boskin and co-authors*, 1998).

<sup>11</sup> It is a fact that a considerable portion of the budget of the United States is spent on different social programs – Medicare, Medicaid, welfare programs. These expenditures must be revaluated, as wages and other incomes of the population, based on the price index. This is why the statement made by the Boskin report caused such astonishment, whereas, if the calculated Consumer Price Index overestimates the cost of living by an average of 1 percentage point annually in the period from 1997 to 2006, then in 2006 the budget deficit of the United States will increase by 135 billion dollars merely as a consequence of the bias.

<sup>12</sup> The Boskin Committee also indicated that the slowing down of the increase in productivity measured during the 1980's in the United States is partially also attributable to the overestimated rate of inflation during the period.

present to a much greater degree and on a greater scale than in developed capitalist countries.

6. Keeping an eye on the realities of the economic situation, governments must face the unavoidable economic policy decision that in order to encourage economic growth taxes should be decreased, but at the same time political realities demand the realization of extensive social programs to lessen the negative consequences of the transition affecting large segments of the population. In order to be able to make these serious decisions following rational deliberation it is a basic necessity to measure relatively precisely the Consumer Price Index in every country.

#### **ATTEMPTS AT THE MEASUREMENT OF THE BIAS OF THE CONSUMER PRICE INDEX ARISING FROM THE EFFECT OF SUBSTITUTION**

From the biasing factors listed we will only examine bias arising from substitution: we will calculate a Paasche Consumer Price Index retrospectively, then with this and with the help of the Laspeyres index already at our disposal we will calculate the Fisher index – to approximate the Cost of Living Index.<sup>13</sup>

##### ***Weight data and the Consumer Price Index***

A database from 1992 to 2002, received from the KSH, is at our disposal; it contains the individual price indices calculated by the Laspeyres method for 160 purchased product and service groups, plus the weights belonging to the groups. The individual Laspeyres price indices and weights

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<sup>13</sup> Aside from the *Ferenczi-Valkovszky-Vincze*, 2000 study and a few foreign technical literature articles (*Éltető*, 2001) published in *Statisztikai Szemle* (Statistical Review), I have not found material dealing with the expression in figures of biasing factors of the Consumer Price Index in domestic literature. In 2000-2001 I participated in a PHARE ACE program where we studied the proposed problem in relation to three former socialist countries – Bulgaria, Czech Republic and Hungary. Concerning Hungary however, we were not able to get any appreciable results from our calculations, while this experience contradicts the theoretical hypotheses. The study, already mentioned, prepared under the auspices of MNB (Hungarian National Bank) came to the same conclusion. Only in the Czech Republic were they able to show that the Laspeyres index surpassed the Paasche index between 1993 and 1999 by an average of approximately 1 percentage point (*Hanousek-Filer*, 2001).

calculated from the above individual price indices by further aggregation into 34 subgroups and finally 7 main groups are also at our disposal. In the calculations we will refer to these groups by the code numbers given based on triple-digit (160 groups), double-digit (34 groups) and single-digit (7 main groups) aggregation level labels.

Three-quarters of the weights of the 160 product and service groups which form the basis of the price index calculation show, as a tendency, a three year constancy (*Table 1*).

*Table 1*

**Consumer expenditure shares used for the calculation  
of the price indices of some goods (1992–2002)**

Item		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Pork	<i>A</i>	1,970	1,739	1,739	1,739	1,765	1,765	1,765	1,765	1,226	1,215	1,321
	<i>B</i>						1,960	1,950	1,690	1,800	1,880	
Beef and veal	<i>A</i>	0,265	0,231	0,231	0,231	0,245	0,245	0,245	0,245	0,170	0,168	0,162
	<i>B</i>						0,190	0,200	0,200	0,190	0,160	
Fish	<i>A</i>	0,068	0,070	0,070	0,070	0,109	0,109	0,109	0,129	0,115	0,122	0,100
	<i>B</i>						0,170	0,160	0,150	0,140	0,150	
Egg	<i>A</i>	0,436	0,408	0,408	0,408	0,442	0,442	0,442	0,442	0,407	0,378	0,416
	<i>B</i>						0,570	0,480	0,370	0,430	0,440	
Bread	<i>A</i>	1,536	1,864	1,864	1,864	1,856	1,856	1,856	1,806	1,492	1,451	1,497
	<i>B</i>						2,770	2,400	2,000	1,910	1,950	
Books	<i>A</i>	0,557	0,529	0,529	0,529	0,535	0,535	0,535	0,525	0,636	0,610	0,560
	<i>B</i>						0,300	0,300	0,290	0,330	0,340	
Repairs and maintenance of dwellings	<i>A</i>	1,594	1,090	1,081	1,500	1,500	1,500	1,500	1,510	1,530	1,559	1,564
	<i>B</i>						0,460	0,460	0,520	0,700	0,660	

*A* weights, used by Consumer Price Index Department

*B* weights, used by Household Statistics Department

In 1991, 1994 and 1998 the weights of almost all the items changed, whereas three-quarters of them remained the same in the years falling in between. This circumstance naturally justifies that the index calculated by the Laspeyres method is essentially identical to the Paasche index, because Although the weights are taken from household statistical samples according to the methodological description of price statistics, this is contradicted by the fact that the actual household statistical weights, aside from not showing the tendency visible in *Table 1*, do not even correspond to these numbers.

*Table 2* shows with respect to the 7 main groups of commodities how the weights actually used in the course of the price index calculation and those taken from household statistics differ.<sup>14</sup> (For an explanation of the marked difference between the two systems of weights see: *KSH*, 1992).

*Table 2***Consumer expenditure shares, 1997–2001**

Main groups		1997	1998	1999	2000	2001
Food	<i>A</i>	27,16	24,72	24,56	24,43	n. a.
	<i>B</i>	30,15	29,59	27,07	25,84	26,91
Spirits, and tobacco	<i>A</i>	8,91	9,37	9,07	9,05	n. a.
	<i>B</i>	3,67	3,89	3,74	3,66	3,76
Clothing	<i>A</i>	6,17	5,86	5,85	5,79	n. a.
	<i>B</i>	6,37	6,54	6,34	5,89	5,89
Durables	<i>A</i>	5,50	7,12	7,40	7,04	n. a.
	<i>B</i>	4,27	4,40	4,51	5,65	5,11
Household energy	<i>A</i>	8,89	8,63	8,39	8,33	n. a.
	<i>B</i>	13,31	12,41	12,58	11,62	10,89
Others, motor fuel and lubricants	<i>A</i>	16,96	17,04	17,09	17,34	n. a.
	<i>B</i>	15,89	15,54	16,45	17,34	17,25
Services	<i>A</i>	26,41	27,25	27,63	28,02	n. a.
	<i>B</i>	26,35	27,62	29,28	29,99	30,19

*A* weights, used by Consumer Price Index Department

*B* weights, used by Household Statistics Department

The publication describing the methodology of consumer price statistics states that “the data from household statistics do not express the whole of consumption and its actual structure without further work. The reason for this, on the one hand, is that household-statistics do not represent certain segments in correspondence with their actual proportion, and on the other

<sup>14</sup> Naturally weights from two years earlier, that is those from between 1990 and 2000, belong to the price indices calculated by the Consumer Price Index Department between 1992 and 2002. The weights received from the Household Statistics Department are from 1997 to 2001 since I was unable to receive the weights for household statistics from before 1997 due to a lack of time. For this reason we will compare the two systems of weights for the period between 1997 and 2000.

hand, that the data is incomplete because of forgetfulness or denial” (*KSH*, 1992 pp.28). 39 percent of the households figuring in the random sample used for household statistics did not supply information (this is data from 1998), within this figure well-to-do households refused the survey in a considerably larger proportion than those with low incomes, the elderly and pensioners, consequently the former are under-, and the latter are over-represented in the sample.<sup>15</sup>

In view of what has just been said, the Price Department works over the data of household statistics, “so that they may show the actual structure of consumption” (*KSH*, 1992 pp. 29). They correct, adjust the items involved with, on the one hand, an approximation of actual income ranges and, on the other hand, the discrepancy caused by denial and forgetfulness. They increase the total sum with the discrepancy, while they change the value sums of individual consumption items according to their income elasticity.

The following questions concerning the corrections of expenditure weights related to purchased consumption originating from the Household Statistics Department may arise.

1. The Household Statistics Department corrects bias originating from representation by so-called calibration. If the same happens again at the Price Department, the correction will be double.
2. It is true that when a consumer purchases, the size of his income is of determining importance, income elasticity plays a great role in this aspect, but price elasticity plays a role at least as great. Denial and forgetfulness do not necessarily occur according to income elasticity.
3. The greatest difference occurs with respect to two types of consumer expenditure shares: in the case of alcoholic beverages, tobacco, household energy supplies, and foodstuffs spending groups; but the difference is not negligible in the case of durable consumer goods either.

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<sup>15</sup> Because of the mentioned factors a deficiency of 15-20 percent is noticeable in household statistics compared to macro-consumption figures. Deficiency owing to denial and forgetfulness is estimated at 10 percent. Denial is especially striking in the case of alcohol consumption, where only a quarter to a third of actual consumption appears in household statistics, but there are items with larger income elasticity such as restaurant meals, vacations abroad, personal hygiene services, vehicles and fuel, where the discrepancy may reach 30-40 percent.

The proportion of alcoholic beverages was considerably raised, that of foodstuffs diminished, in order to approach macro-consumption figures.

4. It is visible that among the groups of commodities the expenditure shares of energy items were changed the most drastically, downwards with respect to household statistics data. This step is not clear in light of the principle that with the corrections they wish to approach the actual consumption structure, since at the Household Statistics Department the deficiency arising from the under-representation of well-to-do households in the sample has been corrected. Correcting downwards to such an extent does not lead to the correct consumption structure, because the well-to-do consume larger quantities of energy in such a way that this represents a higher proportion in their spending than in the case of less well-to-do households. In addition, diminishing drastically the consumer expenditure share of energy consumption is dubious, since precisely the price of this group of commodities has increased the most. If energy figures with a weight below its actual weight in the consumer basket, then this will depress the official Consumer Price Index.

*Table 3* shows how the annual changes of the consumer expenditure shares of the two different systems of weights, those corrected by the Price Statistics Department and those used by the Household Statistics Department, relate to each other. The period of comparison is short, but it is sufficient for a picture of the tendencies of change in the interval between 1997 and 2000.

*Table 3*

**Correlation between the annual changes in corrected  
and non-corrected consumer expenditure shares**

Year	One-digit	Two-digit	Three-digit
	Aggregation level		
1998/1997	0,37	0,12	0,22
1999/1998	0,44	0,28	-0,03
2000/1999	-0,60	0,03	-0,06

If the consumers included in the sample behave rationally, that is they systematically forget and/or deny their purchases in the same way, and assuming the Price Department systematically changes the household statistics data according to this, then we also have to assume that there

should be a close positive correlation between the annual changes in the two systems of consumer expenditure shares. This is however contradicted by the correlation coefficients visible in *Table 3*. This loose and mostly negative correlation indicates that the principle of modifying the household statistics data is accompanied by an *ad hoc* practice.

*Table 4* contains the price indices of the main groups of commodities and the changes in the general Consumer Price Index. The Consumer Price Index increased over fivefold in the period from 1991 to 2002, at an annual average rate of 18 percent. The largest increase in prices occurred in the first half of the decade, but even in 1997 the rate of inflation was 17 percent. Compared to the general Consumer Price Index the relative price indices of individual groups of commodities changed to very diverse degrees. The prices of durable consumer goods increased the least, they decreased by nearly 50 percent in relation to the general Consumer Price Index. The indices of foodstuffs, alcoholic beverages, tobacco and clothing increased 4-17 percent below the average, while the largest price increase, nearly 50 percent above the average, occurred in the case of household energy. The price increase in miscellaneous articles, fuel and services was also above the average. At a lower aggregate level, we may list a few striking examples: the prices of medication increased 29 times, that of textbooks, books and most cultural services 8-10 times.

*Table 4*

**Changes in the price indices of the main groups of commodities  
and in the general Consumer Price Index, 1992–2002**

Description	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2002/ 1991
Food	119,4	129,2	123,4	131,1	117,3	117,4	114,4	102,9	109,2	113,8	105,4	529,90
Spirits and tobacco	119,6	118,6	116,4	120,1	126,6	118,9	115,3	111,5	111,0	111,2	109,7	519,60
Clothing	123,0	116,7	116,1	120,2	125,6	118,7	114,1	110,0	105,8	105,3	104,0	434,29
Durable	114,3	111,0	111,8	124,0	119,2	108,4	108,1	106,6	101,7	101,0	98,4	264,70
Household energy	143,2	120,3	111,6	150,0	132,5	129,9	117,9	109,4	109,0	110,3	105,5	812,03
Others, motor fuel and lubricants	127,1	121,6	119,0	127,3	125,8	116,0	110,7	114,7	115,0	104,9	104,1	544,79
Services	126,0	124,1	120,3	126,0	126,4	119,2	116,2	114,8	109,7	109,8	106,4	610,52
Consumer Price Index	123,0	122,5	118,8	128,2	123,6	118,3	114,3	110,0	109,8	109,2	105,3	532,65

*Source: KSH, 2002*



From the changes in the variance of the individual price indices (*Table 5*) two tendencies may be read. On the one hand, the higher the aggregate level, the lower the variance in the individual price indices. This is natural because substitution among goods occurs the least between larger consumer groups of commodities, rather, it occurs at the level of product selection. On the other hand, the degree of aggregation essentially and unambiguously influences the relationship between the size of inflation and that of variance: the greater the inflation at a lower aggregate level, the higher the variance of the individual price indices. The latter is also natural because in the course of the decade the drastic changes in the price structure were precisely partially responsible for the high inflation. At higher aggregate levels higher variance of individual price indices due to higher inflation only show in the average, while there were years when inflation was high, yet variance was lower than in a year when inflation was also lower.

*Table 5*

**Variance of the relative price indices at different aggregate levels**

Description	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2002/ 1991
Food	119,4	129,2	123,4	131,1	117,3	117,4	114,4	102,9	109,2	113,8	105,4	529,90
Spirits and tobacco	119,6	118,6	116,4	120,1	126,6	118,9	115,3	111,5	111,0	111,2	109,7	519,60
Clothing	123,0	116,7	116,1	120,2	125,6	118,7	114,1	110,0	105,8	105,3	104,0	434,29
Durable	114,3	111,0	111,8	124,0	119,2	108,4	108,1	106,6	101,7	101,0	98,4	264,70
Household energy	143,2	120,3	111,6	150,0	132,5	129,9	117,9	109,4	109,0	110,3	105,5	812,03
Others, motor fuel and lubricants	127,1	121,6	119,0	127,3	125,8	116,0	110,7	114,7	115,0	104,9	104,1	544,79
Services	126,0	124,1	120,3	126,0	126,4	119,2	116,2	114,8	109,7	109,8	106,4	610,52
Consumer Price Index	123,0	122,5	118,8	128,2	123,6	118,3	114,3	110,0	109,8	109,2	105,3	532,65

The author's own computations

***Calculating the Paasche index at different aggregate levels***

Calculating the Paasche index took place in two steps.

1. Starting with the three-digit aggregation of 160 groups we calculated the Paasche indices for 34 groups of goods for every year within the period between 1991 and 2000 with the weights adjusted for the current period by the Price Department.

2. In the next phase, after working over the weights of the expenditure shares of the 34 product and service groups, we calculated the 7 main groups of commodities and finally – with the use of the weights of these – a single main Paasche index per year.<sup>16</sup>

The lowest aggregate level of our analysis is the level of the groups of commodities with double-digit codes, where each of the 160 groups of the lowest aggregate level at our disposal may be assigned to a double-digit group above it. At this aggregate level we compared the calculated Paasche and Laspeyres indices. As an illustration we show the price indices of a few double-digit product and service groups in *Table 6*.

*Table 6*

**Comparison of the Paasche and Laspeyres indices 1991–2000**

Code	Description	Index	1992	1993	1994	1995	1996	1997	1998	1999	2000
10	Meat and fish	Laspeyres	124,90	126,40	123,70	134,20	108,60	119,30	113,30	92,70	111,60
		Paasche	124,36	125,76	124,23	133,21	108,24	119,35	113,41	92,55	110,90
11	Milk, dairy products, egg	Laspeyres	124,90	132,90	125,90	125,00	118,30	126,30	113,10	105,50	114,80
		Paasche	124,67	132,32	126,44	123,89	118,94	126,25	112,67	105,29	114,49
12	Oils and fats	Laspeyres	117,40	135,60	120,10	138,30	123,60	115,80	121,90	99,80	97,80
		Paasche	114,34	135,95	120,21	139,54	122,79	115,85	119,59	98,10	98,31
14	Vegetables, fruit, potatoes	Laspeyres	110,60	124,70	121,50	144,40	110,10	114,10	123,00	101,70	106,50
		Paasche	109,53	123,24	121,28	145,60	105,47	112,24	118,30	102,88	106,36
18	Alcoholic beverages	Laspeyres	117,50	116,60	114,80	121,50	125,30	118,70	113,40	109,60	109,50
		Paasche	117,06	116,57	114,81	121,46	125,33	118,59	113,45	109,55	109,54
50	Household energy	Laspeyres	143,20	120,30	111,60	150,00	132,50	129,90	117,90	109,40	109,10
		Paasche	145,02	120,42	110,58	145,27	131,59	129,76	118,59	109,08	108,81
64	Transport services	Laspeyres	134,60	129,80	119,60	127,50	128,00	125,90	115,40	115,40	109,60
		Paasche	135,16	128,17	118,35	126,46	127,55	125,70	115,37	115,31	109,69

The shown annual Paasche indices are no more than 1-2 percentage points less than the Laspeyres indices, therefore the effect of substitution is visible in these cases, but there are years where the situation is exactly the

<sup>16</sup> For the examined period 2000 was the last year where we were able to calculate the Paasche index based on adjusted weights, since for the purpose of calculating the 2002/2001 Consumer Price Indices the Price Department was able to use the weights of 2000 in an adjusted form.

opposite, the Paasche index is higher than the Laspeyres index.<sup>17</sup> Based on the calculations we may state that at higher aggregate levels (7 groups of commodities) the effect of substitution essentially disappears, there is no difference between the Laspeyres and Paasche indices.

The hypothesis of international research that bias would be greater in the transition countries that lived through very high levels of inflation is not supported by the Hungarian data at this stage of analysis.

Based on experience it may be stated that in all probability the consumer reacts to changes in relative price by substituting at the relevant product and service levels, and the Laspeyres index eliminates precisely this effect. We have noticed in the publication of *KSH*, 2002 published annually, that the number of representatives included for *foodstuffs and alcoholic beverages, tobacco and clothing* show conspicuous disproportion. The first group that makes up almost 40 percent of total expenditures has essentially the same number of representatives as clothing that makes up 6-7 percent.

We calculated the Paasche index with weights received from and calibrated by the Household Statistics Department between 1997 and 2000, and not adjusted by the Price Department. To our surprise the results we thus received showed differences measured merely in decimal fractions from the Laspeyres index calculated with the adjusted weights. From this we came to the conclusion that the extent of the Consumer Price Index is formed at the level of the representatives, when the weights of the representatives are estimated by experts.

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<sup>17</sup> We may observe that the difference with which, at the beginning of the period, the Paasche index may be credited gradually changes into a difference that the Laspeyres index may be credited with as we draw closer to the year of the current period.

The purpose of this study is to prove or refute that the Laspeyres-type Consumer Price Index overestimates the Cost of Living Index.<sup>18</sup> Starting with the certainty that every factor producing the effect of substitution in the behavior of consumers is also present in the Hungarian economy, moreover, that these processes have intensified precisely during the period of transition, we expected a larger difference between the Laspeyres and Paasche indices.

Since the Consumer Price Statistics Department of the KSH works over every year the weight system of the representatives, it is natural that the two types of indices do not differ considerably. In other words, the reworking of the Laspeyres-type price index changes the index itself, and lowers it.

The fact that the established effect of substitution in Hungary does not reach what was expected suggests that on the one hand the efforts of substitution of the consumers are greatly compensated by other factors.

- Prior to the change in regime the economy of the country was characterized by scarcity and considerable unsatisfied demand. The prices were substantially lower than market regulating equilibrium prices. Parallel to the price liberalization taking place early in the decade of the nineties, supply expanded to great extent, modern, new products and services known in the Western world overflowed the market, scarcity was eliminated. In many instances consumers increased their demand in spite of increasing prices. Under such

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<sup>18</sup> We must note that many see the Boskin report as an examination prompted by political motives, saying that the Boskin report could well support the reduction of the budget deficit accumulated during the Clinton administration. We do not see this opinion as well founded because on the one hand the invited experts represented equally the two parties, and on the other hand if the objectives of the examination were really prompted by political motives, then the report would not have generated such an extent of research worldwide related to the theory of the Consumer Price Index, the likes of which we have not experienced in any other field of research during the second half of the 20<sup>th</sup> century. In my opinion it would be an exaggeration to think that the world's statisticians have lined up just to help the United States reduce its budget deficit. We cannot assume in any country that the Consumer Price Index is so perfect in itself that we should not ponder or experiment with its improvement. If the American price index really biases upwards, then this basically has severe consequences on the economy.

circumstances it is possible that the Laspeyres index that uses the weights of the base period might underestimate the growth of the cost of living.

- The methodological process of forming the Consumer Price Index, the observance of the suggestions of Eurostat is excellent. In my opinion only one step is questionable: at the lowest level, the level of representatives, consumer expenditure shares of household statistics are reworked. Understanding and accepting some of the arguments in favor of the adjustment of consumer expenditure shares, the principles described do not appear in practice as well. The annual changes of the expenditure shares adjusted by the Price Department should follow the changes of the weights provided by household statistics, this, however, is contradicted by the absolute looseness of the correlation measured between the changes. This is especially disquieting at the lowest aggregate levels closest to the level of representatives. From this we may conclude that the structure of expenditures depicted by the consumption basket is in almost no relationship with the structure of expenditures derived from household statistical surveys which, if not in a perfect manner, does at least depict the structure of purchased consumption of the Hungarian population.
- It may be stated with great probability that the determining moment of the calculation of the Consumer Price Index takes place at a phase not entirely visible and traceable by the researcher, that is, at the level where representatives are classified in higher level, three-digit aggregate groups, and the expenditure weights of these groups are distributed among the representatives. This moment determines the extent of the general Consumer Price Index. The size of the expenditure weights distributed among the representatives is not irrelevant for precisely this reason, whether they are larger or smaller than what would correspond to the actual consumption structure. What is especially relevant is how the individual price indices of the representatives change in this phase. The individual price indices of the representatives are a given at the level of the representatives, but subjective decisions also play a role for example in how much less of a weight the representatives of household energy, the prices of which are increasing the most, should receive in the consumer basket than they have received in the household statistical surveys. The effects of this spiral through the individual price indices calculated for the triple-digit and higher aggregate levels as well. What kind of subjective element,

and to what extent, the “expert estimation” brings to this phase of the development of weights, is something we cannot form a picture of.

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