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WHAT ARE CONSUMER PRICE STATISTICS GOOD FOR?

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Abstract

This paper studies five different aspects of inflation. Undoubtedly, there are manifold requirements made on the consumer price index. It is designed to measure changes in the cost of living and the cost of holding money, to serve as the basis for calculating real interest rate and real exchange rates and to fulfil the co-ordinating role of a core inflation index. The authors of this paper believe that seeking to capture inflation in terms of a single "universal" indicator may lead to an oversimplification of the concept. In its current form, the Hungarian consumer price index does not "purely" suit any one of the theoretical concepts of inflation.

The objective of this paper is to draw up a number of proposals related to the methodology of consumer price statistics, which appear to be one of the best data sources. In an attempt to make full use of this quality and illustrate the problems noted above, we will propose a set of indicators, for analytical purposes, designed to be appropriate for the various "areas of application".

Contents

1. Introduction

Today, changes in consumer prices are a closely monitored indicator of macroeconomic developments. The performance of central banks is, sometimes almost solely, evaluated in terms of inflation reflected by changes in the level of consumer prices. This paper focuses on the problems faced by the current Hungarian system of consumer price statistics from the viewpoint of the central bank and macroeconomic analysis. We will propose a few expedient changes to the current system, and also look into the possibility of a recombination of existing information as a means for assisting macroeconomic analysis.

Inflation means change in the general price level, as distinct from changes in the price of individual goods and services. Measurement starts with the observation of individual price changes, which are then aggregated, in plain terms, averaged, by means of some sort of mathematical formula. The first question to resolve is what type of individual prices should any given aggregated price index cover. The prices of consumer goods and services are normally of special interest, and the observation of such prices seems to be relatively simple (needing nothing else but walking into a shop and making note of the prices). This is why it is consumer price indices (CPI) that have come into prominence out of the potential price indices. However, the method of observation raises a number of difficulties. (How many outlets should be visited, how many prices and how often should be collected; what happens if a shop closes down, etc.) Another problem is the selection of an appropriate aggregating formula. If the price of every good changed at the same rate, aggregation would pose no difficulty whatsoever. Unfortunately, this is not the case over either the short or the long term. The existence of (long-term) relative price change poses the question of what weight to assign to component indices in the course of aggregation. A plausible, but as will turn out, not necessarily correct choice, seems to be the introduction of weights according to the proportion of individual goods (services) within total expenditures. Here the problem is that these proportions are also changing in real life and, to make things worse, statistical systems can only observe them with a time lag. Moreover, there are some issues of principle involved. One such issue to resolve is what consideration should be given to the quality of goods when compiling the price index, in other words, what to do with the fact that the quality of a commodity with an unchanged brand-name may fluctuate or change over time. A special case of quality change arises with the appearance of new goods. How should one measure change in the price of a previously non-existent commodity, and what to do with goods disappearing from the market?

Statistical agencies all over the world are required to address each and every one of the above issues. Non-statistician outsiders may think that they can remain in happy ignorance of the technicalities of operationalisation, and they can place their trust in experts seeking to minimise this uncertainty. They should at least trust that the mistakes are not major or are in fact random, in other words, that the bias can be both positive and negative.

Unfortunately this upbeat approach is not sustainable. Alan Greenspan, chairman of the *Federal Reserve Board (Fed),* was quoted as telling the Budget Committees of Congress in 1995 that calculations undertaken at the Fed found that the official CPI in

the USA might be overstating the increase in the cost of living by perhaps 0.5-1.5% per year. This statement was made even more dramatic when Mr Greenspan added that making the necessary downward adjustment would reduce the annual level of the deficit by about USD 55 billion in five years (Moulton, 1996). The valorization of welfare payments in the USA is based on the Consumer Price Index in an effort to keep the real value of nominal transfers at a fixed level. Thus, even adjustment of such a small size, not exceeding 2% a year, would have had tremendous impact on the redistribution of income at a time when headline inflation was in the range of 3%. A report by an *ad hoc* commission of experts set up following the hearing did indeed reinforce what Mr Greenspan said, putting the overestimation rate in the range of 0.8 and 1.6% (see Boskin et al, 1998)[1]. This, as pointed out in the article written by members of the commission, should drastically alter the perception of the performance of the American economy, also in retrospect. As economic statistics often draws on interrelated observations, biases in the CPI impinge on the measures of consumption, GDP and productivity. The implication of overstating inflation is that the American economy has performed much better over the past few decades than had been earlier thought, not only in terms of the rate of inflation but also in terms of real growth (Boskin et al., 1998).

Despite all these difficulties, the CPI is one of the best data sources of economic statistics, thanks to the nature and frequency of data collection. The calculation of the Hungarian CPI also has an established routine, ranging from the collection of information by means of set methods to the publication of statistical indicators produced by the application of various computing procedures. However, numerous courses can be taken in order to obtain "working" aggregate indices. The proper use of weights remains an unresolved issue in many respects. Clearly, different objectives require the use of different weights, and expenditure weights may, and occasionally should, be abandoned. The selection of the appropriate weights needs a certain amount of research. The above-cited American example gives further evidence for the importance of improving the fundamental statistical method as well, a view often supported by direct "political" arguments.

Section 2 will briefly describe the prevailing Hungarian CPI, while the subsequent five chapters will look into five possible areas of application of consumer price statistics. In section 3 CPI is examined in its role as a cost-of-living index, in section 4 as the measure of the cost of holding money. Section 5 deals with the calculation of real rates of interest, and section 6 and 7 discuss real exchange rate indicators and core inflation, respectively. The conclusions are summed up in the final chapter, alongside an analysis of certain practical aspects of CPI methodology.

2. The Hungarian consumer price index as it is

How did the Hungarian Central Statistical Office (CSO) define the CPI on introduction? Related documents[2] define it as the price index *of household consumption purchased at actual prices*. It is in effect designed to measure the change

1 Documents relating to the CPI or Advisory Commission can be downloaded from the website of the Bureau of Labor Statistics (BLS, (http://stats/bls.gov/cpihome.htm). See also the articles of the symposium in the 1998 winter issue of the *Journal of Economic Perspectives*.

2 Statements in this section are based on the official publications of the Statistical Office: CSO (1992) and (1998).

in the cost of purchasing a fixed market basket *of consumer goods* and *services*, redefined every year, representing average consumption patterns during some base period (i.e. of two years ago). This basket only includes *purchased* goods and services, thus goods for investment and production purposes, as well as those obtained not by the direct spending of money, such as goods and services produced within the household and public services, are excluded. (There is one exception, the item of owner-occupied housing, or *OOH*.) When designing the CPI, it was an important consideration that it should be consistent with the category of purchased household consumption used in *GDP statistics*. This accounts for the exclusion of the prices of *second-hand goods* (with the only exception being second-hand cars) from the CPI.

What specific items does the Hungarian CPI consist of? The 160 strata of items making up the CPI include goods and services of *current* consumption by average households, *durables*, purchased less frequently, and a specially constructed – *imputed* – item. Consumer durables comprise household goods (furniture, appliances, etc), vehicles (new and second-hand cars, motorcycles, etc.) and durables for entertainment (such as televisions, video recorders, etc.), as well as jewellery. It is the actual retail price of such goods that are included in the Hungarian CPI. There are two interesting items that are regarded by the CSO as exceptions in view of the proposed definition of the CPI. One is OOH (item 611), which is unrelated to any concrete purchase transaction, and the other is *second-hand cars* (item 411), as it is not in compliance with the single entry accounting concept of the SNA system used by the CSO as one their principles in designing the CPI. Let us examine the reasons for these two exceptions in the price index. As for the first item, represented in the CPI with the largest single weight, the consensus concluding the social and professional debate on the issue in autumn 1991 was that the price index of *real estate investment* should be left out of the CPI. The reason is that it is not part of consumption and "affects only a negligible portion of households" [sic!]. On the other hand, "expenses related to OOH should be taken account of *in some way* (italicized by authors): in the form of imputed rent[3]". The argument in support of the other exception sounds equally interesting. While second-hand goods, which have already been taken account of as items of consumption at the time of the original purchase, are excluded from the CPI, exception is taken with second-hand cars, "owing to the significance and special character" of the item.[4]

At the stage of index aggregation, i.e. the construction of the weighted average, individual prices in the sample are aggregated into the all-items CPI in the form of a *fixed-weighted Laspeyres index*, using the *arithmetic mean* at each stage of

3 The accounting of housing-related prices appears to be somewhat peculiar. While the price index includes the rent paid for flats *owned by the local authorities*, it excludes *private sector rents*. It is unclear why statisticians objected to the exclusion of owner-occupiers' expenses, when the price index already includes the communal costs incurred by building-community members, as well as the index for housing maintenance and repair. Measuring the price (more precisely, cost) index related to the use of OOH seems to be out-of-place with respect to the definition of *purchased* consumption. This is because there are no transactions involving the spending of money. It is therefore impossible to observe the price or cost paid for the service of housing. When imputing this item, the CSO calculates the pertaining price index in an indirect way i.e. relying on other type of observable information, such as the cost of housing maintenance, which has already been taken account of once.

4 The arguments cited in support of taking the noted exceptions are based on the *presumed* behaviour of the *average* consumer. This recalls the issue raised by Varian (1989): when evaluating economic phenomena, starting from the "representative " individual is misleading because of ignoring those people crucial for the problem, that is, those in "marginal" positions.

aggregation. The weights derived from the survey of consumer expenditures of *two years before* are fixed within the year. Interestingly enough, not every one of the 160 items constituting the CPI changes its weight *every year*. The expenditures-based weights for certain foodstuffs (such as eggs, beef and veal, ready-made meals), industrial goods (such as motorcycles, home improvements & maintenance articles) and services (such as car and garage rental) have only changed on *three* occasions over the past eight years. (In other words, while in 1993, 1996 and 2000, the weights of nearly each item changed relative to a year earlier, in the years 1995, 1997 and 1998, the weights of two-thirds to four-fifth of the items remained *unchanged*!) The relative frequency of the changes might give the impression that they depend on the relative costliness of price collection: the weights of regulated prices and energy, items inexpensive to keep track of, are adjusted almost every year. This seems to be in contrast with the idea that the weights are supposed to be derived from the data collected in the framework of the *household expenditure survey*. The logical inference is that the Statistical Office does not exclusively derive its CPI weights from the survey of consumer expenditures. We have, however, no knowledge of other possible sources.

3. The CPI as a measure of the cost of living

Although seen by most users as a cost-of-living index, the Hungarian CPI does not fully answer the theoretical description. Moreover, within the current framework of price statistics it cannot even be turned into such an index. The reasons are associated with consumer price indices *in general*, such as the ignoring of the substitution effect and the treatment of consumer durables price measurement, quality change and the new goods problem, in addition to *Hungary-specific factors*, such as the exclusion of imputed consumption and public services from the CPI. These problems are related to the two questions associated with the construction of the CPI, and noted at the beginning of the *Introduction*: what prices and how should be aggregated (see illustration below):

		Which stage does the problem occur at?	
		Sample selection	Method of aggregation
How much is the problem Hungary-specific?	General	Durables	- Substitution effect - Quality change - New goods
	Specific	Non-purchased consumption	

The transformation of the Hungarian CPI into a cost-of-living index would require such large-scale changes that the extra costs incurred on a *regular* basis would not be likely to allow *monthly* publication. *This, however, is not expected from a "true" cost-of-living index*. The purpose of computing cost-of-living indices from a macroeconomic point of view is the study of *consumers' real wages*, and hence the relationship between labour markets and inflation. As contracts for shorter or longer periods are fixed *in nominal terms*, it is not monthly fluctuations in the price level that need to be accounted for, but a kind of *permanent* component, more precisely, the *expectations* associated with one. Therefore, it is all right if a cost-of-living index is

not available on a monthly basis as long as this makes the calculations required by the definition of such an index possible and the significance of *noise* is reduced.

Like in many countries of the world, the Hungarian CPI is constructed by means of the *modified Laspeyres formula*. The *original* Laspeyres index uses the weights from the base period for each and every period of time; in contrast, the modified formulae use weights fixed for a longer interval – one year in Hungary and five years in the USA.[5] In consequence, the use of the modified formula tends to magnify the well-known upward bias in the Laspeyres index caused by the use of a fixed market basket of goods and services, i.e. ignoring the *substitution effect* of relative price change. In contrast with the theoretical definition of the cost-of-living index as a measure of changes in the minimum cost of obtaining a (historically) fixed *level of utility*, the Laspeyres index calculates the change in the cost of obtaining a fixed *level of consumption*. However, price changes may cause the former consumer basket to become less than optimal, with relative price change perhaps even prompting consumers to shift their spending towards cheaper goods. If such is the case, the use of the old basket may *overstate* the increase in the cost of living.

The *Boskin commission*, set up in 1995 to review the American CPI *from the aspect of economic theory* (see above), distinguished between three sub-categories of substitution. First, there is *bias caused by substitution between goods (what* bias): at a low stage of aggregation relative price change may encourage consumers to switch from, say, one kind of beef to another; at a higher stage they may even substitute meat for other foodstuffs. Naturally, over the short term, it is typically at the disaggregated stage that substitution is more significant. At the same time, permanent change in relative prices may also lead to substitution at the aggregated stage (consider the impact of the 1970s oil price explosion on the relative price of, and later demand for, energy-intensive goods). Second, the prices collected and compared always come from the same retail outlets (lacking thus comparison of prices from a variety of outlets). Thus a shift in buying preferences towards *cheaper shop types*, such as discount stores or large shopping centres, is not recognised as a price reduction that boosts well-being. At the same time, observable consumer behaviour suggests that the below-normal retail prices of discount stores amply compensate for poorer service or less convenient accessibility. According to the calculations of the Boskin commission, the bias due to ignoring such substitution (*where* or outlet substitution bias) is significant: accounting for one-fifth of the total upward bias in the American CPI. The third type of bias (*when* bias) is due to the *timing* of purchases. The price level is not necessarily identical on every day of the month, with sales regularly held at the beginning or end of the month or at weekends, adjusted to consumers' purchasing rhythm. This may encourage consumers to substitute between different dates over time. If this is not reflected in the rhythm of price collection[6], a systematic upward bias may be introduced into the estimation of the cost-of-living index.

5 For more on this, see the section dealing with the real interest rate.

6 In America, prices are normally checked on weekdays, so the source of some bias there can be the popularity of major weekend purchases and linked sales events (Boskin et al. 1998). In Hungary price collecting visits are in principle evenly distributed between the 4th and 24th days of each month, but there is no information available on the real state of affairs. For example, as certain employee groups (e.g. civil servants) get paid at the start of the month, retailers may schedule special sales offers for the first few days of the month (i.e. before 4th).

The *general problems* associated with the consumer price indices also discussed in the Boskin report include the treatment of new goods and quality change. The problem is that new goods and services are only brought into the price index after a considerable time lag. A typical example cited in the Boskin commission's report is that VCRs, microwave ovens and computers were included in the CPI more than a decade after becoming widespread, and cellular phones as late as 1998. In Hungary, mobile communication fees were first included in the CPI in 2000[7], while computers and communication appliances (wire and cellular phones, fax machines, etc) have not even been included in 2000. To gauge the bias caused by delayed introduction, one could conceive of demand for new goods following Hicks (Diewert, 1998): goods had even before their introduction an imaginary (i.e. imputable) price which was so high compared with the reservation price that there was zero demand for them. The price after introduction is lower than the imputed price, resulting in a positive surplus of well-being for the consumer, relative to the given reservation price. This appears in reality as a considerable reduction in the price of new goods during the period after their introduction. The delayed introduction of new goods into the CPI ignores this initial period, thereby underestimating the increase in well-being or overestimating that in the cost of living.

The problem of *quality change* is also related to the introduction of new goods, given that most new goods and services undergo continuous improvement in quality after introduction. This will lead to a flaw in the price index if the improvement in quality fails to be fully reflected in the price (in the form of a price increase). This is because consumer well-being is enhanced and the minimum cost of maintaining a fixed level of utility is reduced. This effect is ignored by the simple measures of price change, which thus tend to overestimate the change in the cost of living. The technical source of the difficulty lies in the way *prices are collected*. Although each and every price constituting a price index must relate to the same commodity month after month, it is by no means uncommon that the collectors cannot find the same article the next month. When this happens, they will try, in compliance with the rules of price collection, to find an article which is "to a large extent" similar and fit it to the series of the old commodity. They do so on the assumption that there has been *no* quality *change*. As far as we know in the mid-nineties the Hungarian Statistical Office replaced this procedure with the *"automatic linking"* technique, which means that the old price of the "changed" commodity is linked to the old price of the missing commodity. This is based on the assumption that the quality difference is *fully* reflected in the price difference. Empirical studies on which the relevant section of the Boskin report is also based suggest that the bias arising from ignoring quality change is particularly strong in respect of health services and pharmaceuticals as well as consumer durables (3-4% a year on average!), see Nordhaus (1998). This bias can be eliminated by explicitly calculating the effect of quality improvement. *"Hedonic regression"* breaks down a product into its key features – say the memory and speed of a computer – and then assigns prices to those features rather than to the product as a whole. The increasing use of this pricing technique in the USA for clothes, home computers, cars, televisions, etc. allows price rises due only to higher quality to be knocked out of the index (see Reed-Stewart, 1999). In cases when the service supplied by a particular commodity is some measurable physical quantity (such as

7 The weight attached to mobile communication in the Hungarian CPI as of January 2000 – on the basis of the survey of household expenditures in 1998– is 0.36%, one- tenth of the total weight of telephoning, which has risen to 3.6%.

emission of light, heat, etc, during the lifetime of the commodity), the price of one unit of service can be directly defined (see Nordhaus, 1998 on the "true" price of light).

To date, no microeconomic data based calculations, similar to those presented in the Boskin report, have been prepared on the bias in the Hungarian CPI. It is not possible to directly adopt the *magnitude* of the American estimates either, as it is not known how much the magnitude of bias is influenced by the current rate of inflation[8]. Yet ignoring the three types of substitution is certain to put a systematic upward bias into the Hungarian CPI as a measure of the cost of living. This is because all the factors that trigger the substitution mechanisms in more advanced economies are also present in Hungary. What is more, these developments (such as relative price change, quality change, the emergence of new goods and outlets, shift in spending habits) have been taking place at a fairly fast pace in the course of *transition.* Thus, if anything, the substitution bias in the price index is likely to be *higher* than lower compared with the USA (see more on this in Section 8 on the Maastricht criteria).

To this point we have dealt with the *general* problems associated with the construction of cost-of-living indices. Let us now consider two specific items that the Hungarian CPI does not take account of, namely *self-consumption*[9] and *benefits in kind* provided by employers and the government. They are of special significance because economic progress and the restructuring of public institutions are likely to bring about changes that might be easily mistaken for increases in the cost of living by a flawed CPI. The source of the problem is that although self-consumption and benefits in kind are crucial to economic well-being they are excluded from the CPI. Moreover, as prices and quantities of such *non-purchased items of consumption* cannot be monitored directly, their inclusion in a cost-of-living index raises major technical difficulties.

Self-consumption comprises all non-market goods (such as home-produced crops, meat, etc.) and services (such as cleaning, cookery, mending, gardening, etc.) produced by households. Its significance is in reverse proportion to the stage of economic development, with a larger amount of goods and services taken to market in the advanced economies than in less developed agricultural countries, which typically rely on household production. Although it is difficult to find convincing data in support of the argument, in the wake of the dramatic fall in female employment in the first half of the nineties, there was, in all likelihood, a steady upsurge in self-consumption in Hungary. According to our rough calculations, self-consumption accounted for about one-twentieth of household consumption in 1995-96 [8]. Using the concept of *opportunity cost*, the *price* of self-consumption is derived from the amount of time and work devoted to it since it is paid work and/or time of leisure that is given up when engaging in the above activities. Ignoring self-consumption will introduce a

8 While in the 1990s annual headline inflation was around 3% in the USA, it ranged between 9% - 35% in Hungary.

9 I.e. consumption of goods and services produced within the household, e.g. subsistence farming, childcare, maintenance and repair activities.

8 Based on Tables 6.2 and 6.5.1 of the Central Statistical Office publication "*National Accounts Hungary, 1995-1996*". Imputed housing consumption was removed from our data by subtracting the non-market production of the Real estate, renting…(ISIC code K) sector from the household sector's non-market production. The result was then related to households' consumption of their (similarly corrected) disposable income; all at current prices.

special bias into international (or inter-regional) comparisons of living standards. As self-consumption holds greater significance in low-income countries, expressing relative welfare simply in terms of money income or wages will put a downward bias into the relative situation of less developed regions or countries. In other words, thanks to a larger proportion of self-consumption, poorer countries can, *ceteris paribus*, obtain a higher level of well-being at *identical money wages*, i.e. living costs are lower there.

Benefits in kind, representing the other main type of non-purchased consumption, consist of *fringe benefits*, provided by employers, and state-provided *public services*, such as health, education, etc, and *public goods*, such as the infrastructure, safety, a clean environment, etc. The former is to be paid for in the form of lower net wages, reduced by the value of employer-provided benefits. The latter are financed via both indirect (such as consumer and excise) taxes and direct (such as income) taxes, which are deducted from the net wage level. It is this lopsided consideration of the phenomenon which gives rise to some difficulty. Standard income or earnings indices and the CPI reflect the effect of *financing* exclusively. Consider the situation when, as a result of tax changes, employees start to be given pay rises instead of the "free" use of company cars. In connection with public services, it is *indirect taxation* that may be a problem. Newly marketed services may trigger a drop in indirect taxes and consequently prices, which the CPI would reflect as a fall in prices with a welfare-boosting effect.[9] At the same time, the financing of higher standard (better quality) public goods may also take place via indirect tax hikes. New motorway construction, for instance, may be funded via levying higher taxes on petrol, which will be registered as a price increase. The above are all represented by traditional statistics as changes affecting price or income levels even if there has not necessarily been a change in well-being.[10] What makes the issue of benefits in kind unique in Hungary is that the tax system is expected to be modified via cuts in the direct costs of employment and a *systematic* decline in state involvement. The potential reduction in the employment-related tax burden might shift compensation from benefits in kind towards wage-type payments, making the previously implicit cost of the goods provided by firms explicit in the process. The withdrawal of the state, as long as it entails indirect tax cuts, may imply a decrease in gross prices.

Benefits in kind are problematic even at the theoretical level since it is difficult to determine the output of a number of state-provided services and public goods. (For example, in health, should output be measured in terms of the number of hospital days or the improvement in life expectancy?) It is also difficult to give the quantity of output. (How many *units* of public safety?) Clearly, correct measurement poses serious difficulties.[11] Thus, even an ideal cost-of-living index could only be an imperfect measure bound by constraints. If, for example, following Nordhaus, the level of indirect taxes is assumed to move in conjunction with the level of public

9This is linked also to the *new goods* bias as new market services had not been in the index either.
10Tax cuts and wage rises, *ceteris paribus*, cause *no drop* in the level of well-being, since, in a market environment, employees can spend the increase in their wages on the same item (e.g. a car) that they used to receive as a benefit in kind. However, this will not necessarily be the case if the employer has been able to buy the commodity in question at a cheaper price thanks to large-quantity buying.
11 Commenting on the relationship between public services and the measurement of the stage of economic development, Hüttl et al. (1998) have showed that the cost-based accounting of non-market production has kept *dollar* GDP at a high level in transitional countries, despite the decline in volume indices.

goods, then it will be possible to calculate a cost-of-living index based on *net* consumer prices.[12] Since there is no single price index that could by itself gauge the impact on well-being of direct taxation and employers' benefits, it would be vital to create consistency between income, consumer and price statistics.

The inference to be drawn from our analysis is that failing to measure the cost of a fixed level of *utility* (or well-being), the current Hungarian CPI is not a cost-of-living index. Published every month and lacking subsequent revision, it would be worthwhile to transform it into a measure *of the cost of inflation* (i.e. of holding money) (see Section 4). At the same time, attempts should be made to introduce a cost-of-living index published less frequently (say, on quarterly or annual basis). This index would differ from the current CPI in several respects:

- To reduce the *substitution* bias, it would be expedient to use the combined and geometrically weighted Fisher or Tornquist indices. As this assumes the estimation of current expenditures, these combined index formulae could serve as the basis for *revising* the cost-of-living index, initially published as a Laspeyres index. The system of price collection should also tackle the problem of *substitution* across outlets and times of purchase, for example, via the direct comparison of prices from different shops and across different times of purchase.
- It would also be important to bring *new goods* into the sample as fast as possible. This requires the monitoring of *current* consumer habits via additional sources of statistical information (such as *scanner data*, widely used in large shops or other "unconventional" *real time* techniques).
- *Quality change* should be treated by hedonic regressions or should be recalculated into physical quantities. Should this be possible in a continuous manner only to a limited extent, then the price index could be subsequently adjusted for the effect of the quality change.
- It seems worthwhile to either strip out consumer durables from the price index or impute their prices on the basis of *rental equivalence*. The latter could probably be done only with the item of housing. Where there is a viable second-hand market, (like for cars) the *user cost* approach might also be tried. However, as we are rather sceptical about the above alternatives, we would recommend the exclusion of consumer durables from the cost-of-living index.
- The concept of cost-of-living index in our view would be a *theoretical approximation of the level of well-being (utility) available at given prices and incomes rather than of purchased consumption*. This would require the harmonisation of the categories of income, consumption and price level. This could create a framework for including certain non-purchased items of consumption in the price index and for defining the prices of such.

4. The CPI as the index of the cost of holding money

12 In a technical sense, this index would resemble the British central bank's RPIY, excluding indirect taxes. In the British case, however, the objective was not a cost-of-living index but a price index free from *noise*, i.e. the *direct* effect of changes in indirect taxes. See Beaton-Fisher (1995).

Can it be said that although flawed as a cost-of-living index, the Hungarian CPI can be used as a measure of households' *monetary expenditures*? It cannot, unfortunately. The reason is that the CPI includes an item with a significant weight (namely, OOH, 5.9%) that is not associated with actual monetary expenditure. At the same time, it excludes a couple of items that involve monetary expenditure (such as second-hand goods and capital goods). Furthermore, the use of consumer expenditure weights does not necessarily reflect the relative needs for holding cash.

With a view to our forthcoming inferences it is worth noting that the above interpretation of the CPI is close to the definition of the harmonised index of consumer prices (HICP), used by the Eurostat, the statistical agency of the European Union. A European Commission report (EC, 1998) states that the HICP is partly an index of households' "final monetary consumption expenditure" (p. 10), and partly an indicator of the effects of inflation on economic agents, including households, with regard to holding money (p. 8)[12].

Our starting point in constructing a consumer price index that measures the cost of holding money is the direct costs of stable inflation and those associated with *holding cash balances*. In this way, not all the above-listed costs of inflation are taken account of: costs not related to holding cash, such as indexation costs due to unstable inflation, or those related to taxation and manageable by changing taxation rules, are excluded. Our theoretical starting point is in fact the *loss in well-being known as the shoe-leather cost* of predictable-rate inflation, due to households' transactions-based demand for money.

Let us take a look at the practical aspect, i.e. what prices and in what index form should be aggregated in order to satisfy the theoretical requirements. The question of *"what prices"* seems easier to answer. According to the quantity theory of money a price index should comprise all the prices, but only those, that can be linked to monetary (cash-based) transactions.[9] In addition to purchased *consumption*, this index may comprise household and company *investment* expenditures as well as firms' spending on *raw materials and factors of production*, i.e. wages and interest payments, in addition to producer prices. Moreover, unlike cost-of-living indices, this price index would comprise the prices of investment goods themselves rather than the imputed price index of the services such capital goods provide.[10] Even though constructing a price index comprising any other prices than those derived from household consumer expenditures sounds a daring project that falls beyond the scope of the present study confined to domestic consumer price statistics, it is by no means unprecedented in international experience.[11] In terms of the Brussels document which lays down the basic principles of the *HICP*, the European Commission would *in*

12 This definition accounts for excluding such imputed items from the HICP that represent no actual expenditure, such as the price index of OHO by the Eurostat.

9 Naturally, this depends on the definition of "money".

10 In contrast with the cost-of-living index, under the notion of microeconomic profit maximization discussed earlier the monetary price index does not generally require the consideration (i.e. imputation) of any implicit (more precisely, shadow) prices. Only monetary transactions are of interest here as they are the source of the loss in well-being caused by inflation.

11 A real-life example of such a universal price index is given by the British Statistical Office's experimental price index called Final Expenditure Prices Index (FEPI), which covers the monetary expenditures of all aggregate economic agents.

principle approve of the existence of a price index that covers *all* types of market (monetary) transactions (EC, 1998).

In addition to determining what prices should constitute the monetary expenditure price index, the principles of aggregating these prices into an *average* should also be laid down. The difficulty here arises from the fact that depending on the different statistical assumptions, the aforementioned theoretical considerations lead to a variety of indexing formulae, which makes *a priori* choice difficult. Of course, one can stick to the use of weights derived from the *household expenditure structure*. Our theoretical considerations, however, allow this only subject to major restrictions as it is not at all certain that the expenditure-based weights will reflect the relative cash requirements of individual goods. Therefore there are no grounds for giving preference to expenditure-based weights. Let us consider the literal interpretation of the *cost of stable inflation*. As here the loss in well-being, defined as "shoe-leather cost", stems from the existence of cash transactions, the logical way of obtaining the *average of the individual prices is by giving them weights according to their relative needs for cash*. Accordingly, larger weights would be given to day-to-day consumer purchases, frequently and typically settled in cash (or one of its close substitutes e.g. the debit card) and to investment goods and durables (such as houses, cars), still often paid for in cash in Hungary, than to goods paid for with bank transfer or credit. *Non-purchased* items of *consumption* would be automatically given zero weights, as they involve no cash transaction whatsoever. *This is the reasoning behind the exclusion of non-cash transactions – the imputed items of non-purchased consumption - from the HICP, the Eurostat's price index.* However, as the operationalisation and empirical measurement of the relative cash requirements of transactions seem to be rather cumbersome, devising a weight system based specifically on the literal interpretation of the cost of holding money is not feasible.

Under the transactional definition of monetary theory, pioneered by Irving Fisher and Jevons, the deterioration in the purchasing power of money caused by an increase in the money supply affects *each* price and to an *equal extent*. Wynne (1999) cites Jevons' expressive description which suggests that individual price changes always have one single common factor at work, notably changes in the price of *gold*. Accordingly, the price changes here can be traced back to one common monetary factor, namely a change in the money supply. It is possible to construct a model in which *inflation is given as the common and universal component of the individual price changes*. With reference to the menu costs of inflation and to the work of Cecchetti – Groshen (2000) there are *two kinds of price* setters assumed to be active in the economy. One controls the prices that can be changed flexibly, i.e. at any time and only at negligible cost (such as food and petrol). The other group can only change its prices at infrequent intervals because of the high costs incurred. As the first group can frequently modify their prices, which implies that pricing errors are easy to correct, it is not in their interest to capture or take account of the universal or permanent component of the price changes perceived. It is the prices determined by this group which make aggregate price indices noisy. By contrast, the other group would incur losses by "misinterpreting" the underlying trend of inflation, so prices controlled by them tend to change much more "smoothly", i.e. in closer conjunction with the general trend. The analyst's task with regard to this model is to filter out the common

and universal component of individual price changes.[12] The quantity theory of money leads to the same conclusion. It claims that entailing a *universal* deterioration in the purchasing power of money, inflation is present in every price in an identical measure. "Monetary" inflation is, thus, the common component of each unique price change.

These conclusions can be effectively asserted in the framework of *stochastic index theory*.[13] Our general model is based on the assumption that each observed price index, $p_{t,,}$ contains a "signal" component, P_t , which cannot be observed directly, and a "noise" component, x_t, with the latter two being the indicators of local idiosyncrasies in relative price changes and price movements:

$$p_t^i = \Pi_t + x_t^i \ .$$

In the above equation i denotes the index of goods and each variable is written as a *logarithmic difference*. The various "monetary" inflation indices proposed in the literature are obtained from this in accordance with the different assumptions for the idiosyncratic and common components (Wynne 1997 and 1999). The purpose of this paper is the study of price indices derived from the established system of consumer price statistics and meaningful for statistical publishing and monetary analysis. Therefore, we intend to focus only on two of the inflation indices that could be derived from the above model, namely the unweighted Jevons index and the relative (inverse) variances weighted price index.

The Jevonsian simple unweighted geometric mean formula,

$$\hat{\Pi}_t = \frac{1}{n} \lambda_{i=1}^{n} p_t^i \ ,$$

is based on the concept that an increase in the money supply will cause "identical changes in every price". Statistically, this formula is based on the assumption that relative price changes follow trends with zero expected value and of normal distribution, trends that are independent of one another and the common component. However, this is not a valid assumption for Hungary or the transitional countries in general, where, as will be remembered, relative price changes have trends (Valkovszky-Vincze 2000). This fact will render most formulae proposed for practical application unsuitable. Even *trimmed mean* indices, which do not assume normality, are based on the absence of such trends, i.e. the assumption of one single common component P_t.[14] In the light of the fact that the price index based on the monetary theory provides no theoretical support for the use of the traditional expenditure-based weights either, we have no reason to reject this simple solution either.

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12 One possibility is to directly survey companies' pricing habits using questionnaires to separate these two groups, see Tóth – Vincze (1998). Still it would be rather difficult to match up the individual companies (sectors) with their respective price index groups.

13 See Diewert (1997). In fact, the reasoning frequently works the other way round: the use of stochastic index calculation is justified, as it were, "subsequently" by the assumptions of the early theory of money or the models based on the two kinds of price setters.

14 It is only *Dynamic Factor Indices* (DFI), which can only be calculated by econometric techniques, that make no use of this assumption, also taking account of the stochastic trends in relative price changes, see Wynne (1999). The disadvantage of this method in practice is the revision of the estimates.

From a different aspect it may be a problem that every price change in the Jevons-index is assumed to convey the same amount of information on the general trend. But the notion of the two kinds of price makers, discussed in connection with the menu costs, implies that less noisy individual price indices are capable of conveying a larger amount of information.15 This is what motivates the use of weights based on *the strength of the "inflation signal"* in individual price changes (*variance-weighted* or *neo-Edgeworthian* price index, Wynne 1997). In the simpler formula, the individual price indices are given *relative inverse variance weights.* In the more complex formula, the individual variances themselves are defined in relation to the estimated universal component within the framework of non-linear simultaneous equations.

$$\hat{\Pi}_t = \frac{1}{n}\sum_{i=1}^{n} w^i p_t^i \quad , \quad w^i = \frac{1/\hat{s}_i^2}{\sum_{i=1}^{N}\left[\chi/\hat{s}_i^2\right]^{\rho}} \quad \text{, where}$$

the weights in the simpler formula are obtained directly:

$$\hat{s}_i^2 = \frac{1}{T-1}\sum_{t=1}^{T}\left(p_t^i - \overline{p^i}\right)^2 \quad .$$

In the more complex formula, the weights are constructed by an *iterative* technique based on the common component, Π_t :

$$\hat{s}_i^2 = \frac{1}{T-1}\sum_{t=1}^{T}\left(p_t^i - \hat{\Pi}_t\right)^2 \quad .$$

The period *t =(1,…,T)*, on which the weights of the formulae are based, is arbitrarily *fixed*.

Summing up the above, three strategies may be adopted for the aggregation of the component price indices into the monetary expenditure index. First, one can use the *weights from household expenditures* as in the Laspeyres formula. Although there are no conceptual arguments for this approach, there are none against it either. The biases described in the section on *cost-of-living indices have no relevance* here as our focus is not an indirect level of utility. *Weighting* individual price changes *with relative variances* is based on the need for identifying the universal component. Using the *unweighted Jevons index* would be an admission of the ad hoc nature of expenditure weights, and the unreliability of weights based on the strength of the inflation "signal".

As far as the selection of the *weights* is concerned, it seems difficult to rank the three methods (see Tables 4.1 and 4.2 in the Appendix). From an empirical aspect, relative price trends appear to "cancel" one another out to the extent that the *unweighted Jevons index* is not far removed from the 12-month rate of the CPI. Simple *variance-based weights* can be equally applied to month-on-month and 12-month price

15 It is the simplified version of this concept that is represented by the "*ex Food and Energy*" core inflation indices, including the two Hungarian "official" core inflation indices. These indices give zero weights, for *all periods of time,* to groups (such as raw and seasonal food, certain energy and regulated prices) *a priori* deemed too noisy.

indices.[16] What recommends the choice of *12-month indices* is that they are the standard seasonal adjustment filter of inflationary developments. Thus, it is traditionally the prices which appear "excessively" hectic (i.e. have unstable or no seasonality) even after the twelve-month filter that are considered problematic. The table also shows that using weights proportional to the variability of *month-on-month indices* will typically result in large weights for consumer durables, which have a permanently below-average rate of inflation, relative to the expenditure. The price index based on month-on-month indices thus systematically diverges from the trend of the CPI (remaining constantly below). Furthermore, there appears to be no marked difference between the use of simple weights and iterative variance-based weights. Descriptive statistics also suggest that it is inverse variance-based weights based on twelve-month indices that are the "smoothest", with their standard error and range indicators far smaller than those of the others. Before choosing between the various types of weights one should first define what statistical requirement is a "correct" inflation indicator to meet. This involves determining the relevant *loss function* that is to be minimised when selecting between the alternative solutions. This, however, is not the purpose of this section; relevant examples, in different contexts, are given in Section 7 on core inflation and by Valkovszky – Vincze (2000).

In sum, constructing a monetary expenditure price index on the basis of the social cost of inflation needs above all co-ordinating of the sample of the price index with its definition. This would require knowing household spending habits from the point of view of holding money. In the absence of this, the *"second best solution"* would be:

- To omit the imputed item of *OOH*, which represents no monetary expenditure
- To consider the direct inclusion in the price index of housing-related monetary expenditure, i.e. *market rents paid for flats and houses as well as selling prices of housing units,* in addition to rents paid to local authorities [17];
- To bring into the sample the widest possible range of goods purchased via monetary transactions. This should at the very least cover *second-hand goods* (as such a price index would not be expected to comply with the SNA principles). The inclusion of *capital goods and certain types of investments* (such as bond or share subscriptions, insurance, etc) relevant to household expenditures could also be considered;
- And, naturally, to incorporate into the price statistics new (?), so far excluded, goods (such as computers, modern communication devices, etc.)

Most of the above proposals would require only minor or one-off changes in the current consumer price statistics. The CPI published monthly by the Central Statistical Office bears marks of both a cost-of-living index and a monetary expenditure price index. It would only require a relatively small investment to turn it into a fully monetary expenditure price index defined on the basis of the cost of inflation. Analysts and statisticians would both benefit by the transformation of the prevailing "mixed" definition into such a single-aspect one. The former would be assisted in devising and developing the system of price statistics and the latter in obtaining an economic indicator which, constructed in a consistent manner, would allow direct

16 Variance-based weights are given as the arithmetic mean of logarithmic price changes, which is equivalent to geometrical weighting of the original data.

17 The most likely reason for the CSO's apparent reluctance to collect data on rent incomes, often not obtained in a fully legal manner in terms of tax rules, may be the fear that this might discourage *respondents* to *other* types of questions as well.

interpretation. Not least, as we have noted above, redefining the Hungarian CPI, which is published on a regular basis, as a monetary expenditure price index would also be consistent with the concept of the HICP, the official price index of the European Union. In this sense the existence of such a price index would take the system of Hungarian institutions a step closer towards meeting the harmonisation obligations. [18]

5. Real interest rates

Traditional macromodels contain one aggregate good, and international macromodels sometimes contain two. In the latter case too, the two goods are aggregated via some linearly homogenous function into one intratemporal utility function. This way it is possible to define the exact price index of the aggregate, treated as one single good, and hence, to determine the real interest rate (see Obstfeld.-Rogoff, 1996). Provided that relative price changes follow a trend and are predictable, which is a plausible assumption in respect of Hungary, then the individual goods will vary in their "*respective"* expected real interest rates. Even if the assumption of linear homogeneity is adhered to, the "correct" rate of interest will not be identical to that calculated on the basis of the CPI aggregate defined with expenditure weights. The deviation would not be large if a constant elasticity of substitution (CES) aggregate would closely approximate the utility function. Nevertheless, "introspection" tells us that this would not be the case as the elasticity of intertemporal substitution is not likely to be homogenous across individual goods. (Will a change in the price of next month's hot water have the same effect on today's demand for hot showers as an increase in air fare with the same time frame will have on the demand for holiday abroad?) Thus, the joint emergence of two reasons (may) justify the need for defining a separate CPI relevant to the calculation of real interest rates: 1. differentiation of intertemporal substitutability and 2. foreseeable relative price changes.

The question is if it is possible to construct a price index that adequately reflects the different elasticities of intertemporal substitution. Valkovszky-Vincze (2000) propose such an index, in which the weights are derived assuming preferences that correspond to a generalisation of the utility functions most common in the literature. The reasoning is retraced here in more detail and in a slightly different form.

The starting point is Houthakker's addilog utility function[19]:

$$u(C_{1t},...C_{nt}) = \sum_{i=1}^{n} \frac{C_{it}^{1-s_i}}{1-s_i}, \qquad (1)$$

where C_{it} is the consumption of the ith good at period t, and the s_i–s are positive parameters. The assumption is that the consumer will maximise the utility functional

$$U(\underline{C}_1,..\underline{C}_t,...) = \sum_{t=1}^{A} \mathrm{B}^{t-1} u(\underline{C}_t). \qquad (2)$$

18 On differences between the Hungarian consumer price index and the HICP from the aspect of harmonisation, see the articles of the symposium in *Statisztikai Szemle*, 7/1999.

19 Clarida (1996), for instance, used this utility function to estimate demand for imported durables.

The (intratemporal) first order conditions relating to the individual goods are given as:

$$\forall i: \quad \frac{C_{it}^{-s_i}}{P_{it}} = \Lambda_t \qquad (3)$$

where P_{it} is the price of the good i at t, and the Λ_t Lagrange multiplier, i.e. the marginal utility of nominal wealth.

The following difference equation describes the evolution of the Lagrange multiplier:

$$\Lambda_t = I_t \mathrm{B} \mathrm{E}_t(\Lambda_{t+1}) \qquad (4)$$

where I_t is the gross nominal interest rate ($I_t = e^{i_t \Delta t}$), and B is the subjective discount factor.

Switching to natural logarithms in the following section (denoting logarithms with lower case letters) and taking time (for the period $\tau := \Delta t = t_e - t_b$) differences, the following can be derived

$$\Delta l = -s_i \Delta c_i - \Delta p_i \qquad (5)$$

$$\Delta l = -tb - \log(\bigcirc_{j=t_b}^{t_e-1} I_j) = -tb - i(t_b, t_e) \qquad (6)$$

where $\Delta l_i = l_{it_e} - l_{it_b}; \Delta c_i = c_{it_e} - c_{it_b}; \Delta p_i = p_{it_e} - p_{it_b}$

(In (6) the (stochastic) terms included in (4) have been ignored.)

The linearized Euler equation relating to the individual goods is given by

$$\Delta c_i = \frac{1}{s_i}(i(t_b, t_e) + tb - \Delta p_i). \qquad (7)$$

Assuming the existence of a g factor for each good, giving in a linear way the impact of the change in the consumption of the given good on total demand, the aggregate effect can be written as

$$\lambda_i g_i \Delta c_i = \lambda_i \frac{g_i}{s_i}(i(t_b, t_e) + tb - \Delta p_i). \qquad (8)$$

The price index we wished to determine is given by

$$p = \lambda_i \frac{g_i}{s_i} \Delta p_i \qquad (9)$$

The above equations allow one to *„calibrate"* the parameters $1/\sigma_i$. Take 0 as the base year, with each individual price index assuming the value of 1. Choose the unit of measurement so that the base-period consumption of each good equals one unit. Expenditure weights W_i are known for both the base and the current periods.

$$W_i = \frac{P_i C_i}{S}, \qquad (10)$$

where *S* denotes total household consumer expenditure.

Taking the logarithmic difference of equation (10) and using (6) and (7), the required parameters are as follows:

$$\frac{1}{s_i} = \frac{\Delta w_i - \Delta p_i + s}{\Delta l - \Delta p_i}. \quad (11)$$

In the right-hand side w_i and p_i are known from consumer price statistics. The value of *s* can be calculated from National Accounts statistics. The calculation of $\Delta\lambda$ would require a rate of interest with a suitable maturity, which, however, can be approximated with the realised values of short-term interest rates. Time preference is a free parameter, which can take various values in the range of 0.95 and 0.90 at an annual rate. (The upper bound is being regarded as normal in developed countries.) The formulae derived in the aforementioned manner were applied to a division of clusters obtained by slightly modifying the classification defined by Valkovszky-Vincze (2000) and to different base and current years, with various subjective discount rate parameters. The CPI data series belonging to the individual clusters are listed in the Appendix.[20]

Chart 5.1 shows the weights derived for the individual groups varying according to the different periods and values for parameter b. It is clear from the Chart that the cluster of the series we *a priori* regarded as "disturbing" (first of all, the imputed rent for OOH, as well as gambling, donations, etc.) *"is misbehaving"* (the model is generating negative weights). Therefore, the subsequent exclusion of these series – within the framework of this model – is also justified on empirical grounds.

Unfortunately, but by no means surprisingly, durable goods also have to be stripped out as not only is their weight fluctuating but it is also changing signs.[21] As already noted in connection with the cost-of-living index, when consumers time their purchases of durable goods they are not merely making a decision of intertemporal substitution but also of investment. If there is a substantial change in the expected (relative) price trend of a durable good, this will not only change the real rate of interest on that good in relation to a particular time period, but also the return on investment in that particular good seen as an asset providing future utility in the form of a yield. The underlying difficulty is that "demand" for the *consumption* of durable goods may behave very differently from demand for *buying* such goods. While

20 The relative price trends of the individual component aggregates relative to the CPI are shown in Fig 5.6.

21 Owing to the assumption of separable preferences, the exclusion does not affect, in principle, the estimates for the parameters of the remaining groups. This is because, as shown by formula (2), marginal utilities are independent of the consumption of the excluded goods.

experience shows non-durable consumption to be smooth (strongly autocorrelated), the pattern of durables purchases tends to be much more hectic. This is also reflected in the Hungarian data in the abrupt change in the weight of durables. It is perhaps by no accident that the weights in the US CPI are not replaced every year, and five-year average weights are used instead. The real price of the consumption of a durable good is rent (or user cost), which is found by deducting from the purchase price the present value of the future price less depreciation. However, in addition to giving rise to a number of new and serious difficulties relating to operationalization, this rent would also require special treatment that is theoretically incompatible with the current framework. The reason is that at any given date the price of consumption (the rent) is not independent of the prevailing rate of interest.

Finally, the cluster of administered prices has also been excluded on practical grounds as it has only a small weight (mostly a (small) negative value) across a broad range of parameters and seems to be almost completely independent of the time period. The demand for such services (see Table 5.1), with the only possible exception of 650-TELEPHONE, has rather low price elasticity, and there is hardly any possibility of their intertemporal *"substitution"*. Thus the impact of movements in such prices on the real interest rate defined in the above sense is indeed small.

The exclusions are based on good reasons. We have *a priori* arguments in favour of stripping out the data series also deemed for exclusion under the original classification (see Table 5.1 and comments in Sections 2 and 3). Stripping out administered prices will not change the results in effect and can be simply seen as *"algebraic rounding"*. The only decision that carries special significance is the exclusion of durable goods. It is based on the fact that the available data contain an effect that cannot be made compatible with the assumptions of the model we wish to calibrate. Since this effect, namely the demand generated by *"investment"* in durable goods, is of paramount importance, in our analysis of consumption versus saving, there seems to be no other choice than that of excluding this cluster.
It may be misleading that the "in" categories in Chart 5.1 also show significant volatility. This is partly the result of normalising (i.e. the other clusters *"must"* somehow follow the substantial volatility seen in the cluster of durable goods, but with the opposite sign). Furthermore, calibration is admittedly less robust in respect of the selection of the different time periods, which is partly due to the aforementioned problem with the quality of the available weights. It is important to note that the (relative) weights of the included items have only minor sensitivity to the parameter b. The issue of selecting the time period will be discussed later.
In the range of b =0.90-0.95, regarded as plausible, the model has generated the weights shown in Chart 5.2 for the remaining clusters. Using these weights to aggregate the price indices of the individual clusters, obtained using the original CSO weights, will produce a price index somewhat different from the CPI. The difference between the (logarithmic) calculated price for the period 1992-98 and the CPI is shown in Chart 5.3 as a function of parameter b.

Clearly, the divergence from the CPI is hardly affected in a qualitative sense by the choice of the time-preference parameter b, as is also proved by the relatively stable weights in Chart 5.2. Thus the result can be regarded as robust in this respect. Accordingly, we have proceeded with our calculations using the parameter b =0.95, a standard choice in the literature.

Another question associated with robustness is how dependent the result is on the choice of the time period. The situation here is less favourable, as illustrated by Chart 5.4. As noted above, the Statistical Office varies the weights in the consumer basket – data we have also relied on - in terms of an algorithm that has not been published in detail. So much is clear, however, that there are some years when nearly all the weights are replaced, while at other times the majority of the weights remain unchanged. This leads to the selection criterion that the best start and finish to the period are the years following such an *"overhaul"* of the weights.[22] Driven by such considerations our choice has fallen on the period 1992-1998, which is the longest period presumed to have correct weights. The weights obtained in this way for aggregating the price indices of the relevant clusters are listed in the final column of Table 5.1.

Changing the weights of the various component series that have strong seasonality (for instance, giving 15% larger weight to foodstuffs at the expense of the series with smaller/different seasonality) will change the original seasonality of the CPI. Consequently, comparison with the original CPI series in Chart 5.4 will reveal stronger seasonality.

Chart 5.5 shows the results of our investigation of real interest rate calculation. Two versions of real interest rates have been calculated using the yields on three-month government securities: one with the original CPI and the other with the price index re-weighted via the proposed procedure. (Perfect foresight is assumed in both cases.) Both the CPI and the price index of our construction have strong seasonality, a property not assumed of interest rates. Therefore, we started out with adjusting (separately) seasonally the series of both the CPI and the price index considered as being relevant to the real rate of interest. It is these seasonally adjusted indices that were then related to the interest rate data. One peculiarity appearing from the Chart is that the modified real interest rates are nearly always lower than those calculated with the CPI and that they have, very often in the past, been in the negative range. Another intriguing feature is that over the last two years these modified real rates have been nearly always positive and most recently showed but slight deviation from the real rates calculated with the CPI. To prevent anyone drawing hasty conclusions about the effect of monetary policy on aggregate demand, it should be noted that the modified real rates are intended to measure the effect on consumption and not on purchases. As investment is a major component in the fluctuation of household spending, establishing the relationship between real interest rates and aggregate demand requires some insight into investment developments as well as the relevant price (yield) indices.

Clearly, correct appreciation of the durables price index and the question of weights call for further research. Our calculations have made it clear that the traditional utility functions are less than satisfactory, but the more general form we have proposed may also prove to be too simple. The model of our choice is apparently incapable of handling the *"dual nature"* of consumer durables. Excluding them, however, may lead to significant bias. Chart 5.6 shows that their relative price follows a considerable negative trend. This would not be a problem by itself as the permanent trend leads to

22 Note, of course, that the weights used by the Statistical Office should in fact be seen as estimates relating to the consumption structure of two years before.

only one constant error in the *absolute* level of the real interest rate, which will hardly hinder the evaluation. The real limitation to the method is that – apart from the demand for investment goods not involved in direct consumption – it is exactly through its effect on the *timing of the acquisition* of durable goods that the real rates of interest govern the output gap. Consequently, assuming *"pure"* consumption only – i.e. such that takes no account of the (different) depreciation of goods in any way – the macromodel based on traditional intertemporal optimalisation neglects a highly important, if not *crucial* factor even if the addilog utility function is being used.

This section and the method outlined herein serves the primary purpose of highlighting the problems associated with real interest rates. The by-product of this investigation is the notion that it might be worthwhile for the Central Statistical Office to consider a switch from the current system of annually changing the weights in the CPI to one in which the weights are smoothed with some method.

6. Real exchange rates and the CPI

The domestic *nontradable/tradable relative price,* i.e. the *"internal real exchange rate"* - (see Kovács-Simon (1998)) - plays an important role not only in theoretical but also in empirical research. The *internal real exchange rate* is not a real exchange rate in the usual sense of the term since it is not the relative price of a product made in two different countries that it measures. If every real exchange rate is only an indicator of an unobservable variable of the economy, then one could say that the internal real exchange rate is the indicator of the indicator. This is so because under certain assumptions changes in the internal real exchange rate, calculated exclusively from domestic prices, provide useful information on the fluctuations in other real exchange rate indicators. Standard methods for calculating the internal real exchange rate *a priori* divide domestic prices into tradable and non-tradable prices. In the section below we will propose an alternative method for the calculation of the *internal real exchange rate.* Under the proposed method, which relies exclusively on consumer prices, division is not dichotomous and is endogenously determined.

Valkovszky-Vincze (2000) estimated dynamic regressions for the 160 strata price indices of the Hungarian CPI and calculated the long-term coefficients of the exchange rate and the wage cost. The aforementioned paper makes use of the regression results only to the extent that the long-term coefficient of the exchange rate for nearly all consumer durables is around 1, and that of wages is practically 0. This criterion is labelled as the *"tradability"* criterion. In the following, we will attempt to define a continuous *tradability – non-tradability* scale, using heuristic methods, with (in the long term) exclusively exchange rate dependent prices on one endpoint and exclusively wage dependent prices on the other endpoint. This is hoped also to facilitate the construction of a RER-relevant price index in which the weights increase according to the degree of *non-tradability.*

We can formally argue as follows. By definition, the price of the *i*th commodity is the product of the marginal cost and the *mark-up*. Written in logarithms:

$$p_i = m_i + mc_i . \qquad (1)$$

The *mark-up* parameter (*m*) is the function of *"perceived"* demand. Under perfect competition, it is equal to 0, otherwise it normally takes a positive value. Provided that the supply of a product is fixed, such as that of fresh vegetables, the price is determined by demand regardless of production costs (of some past date). Here it is the *mark-up* that assumes all fluctuations in demand.

The marginal cost function depends on our assumptions relating to the production function. The log-linear approximation to be used in the paragraphs below is given as

$$mc_i = q_i + e_i e + w_i w \qquad (2)$$

where e is the nominal exchange rate, w the logarithm of the nominal wage and q_i comprises other effects. (The formula is based on the assumption that there are no sectoral wage differences.) Other effects may include technological change, the effect of capital accumulation on marginal productivity or even foreign prices. This formula is often used to describe closed economies,including either the wage only or the wage as well as the capital cost. The latter, however, is not a component of the marginal cost, insofar as the capital stock is assumed to be predetermined in the short run.

If a producer also produces for exports and thus sets prices on the foreign markets, then e =1 and w =0 in the above equation. Such a producer can be regarded as the ideal *tradable* producer. By contrast, in the case of the *"producer"* of services employing exclusively domestic labour e =0 and w =1 would be relevant, and the *"good"* produced could be called the ideal *non-tradable* good. Naturally, consumer goods and services can almost never be regarded as purely tradable if for no other reason than simply because transportation costs impose certain limits to goods arbitrage. One may conclude that if it was possible to estimate them accurately we would obtain significant non-zero e and w coefficients for each strata. Considering, however, the inaccuracy of the data and the omitted-variable bias, the values for one or perhaps both parameters are expected to be non-significant. This may be especially true of goods with a fixed supply over the short term, the price fluctuations of which may appear to a large extent as fluctuations in the *mark-up*.

Let us assume the availability of estimates for the parameters e_i and w_i. After normalising them proportionately, the coefficients obtained from the equation

$$e_i^* := \frac{e_i}{e_i + w_i} \qquad w_i^* := \frac{w_i}{e_i + w_i}$$
$$\mathrm{E} := \sum_{i=1}^{K} w_i e_i^* \qquad \Omega := \sum_{i=1}^{K} w_i w_i^* \qquad (3)$$
$$e_i? := \frac{e_i^*}{\mathrm{E}} \qquad w_i? := \frac{w_i^*}{\Omega}$$

can be adopted. (If neither of the parameters is significant, normalising will not be possible and that particular item is to be *"dropped"*.) Then the base price index of the remaining goods can be written as

$$\Delta p_t = \sum_{i=1}^{K} w_i (e_i^* + w_i^*) \Delta p_{it} = \mathrm{E} \sum_{i=1}^{K} w_i e_i? \Delta p_{it} + \Omega \sum_{i=1}^{K} w_i w_i? \Delta p_{it} \qquad (4)$$

From the above formula, the following relative tradable / nontradable price index (real exchange rate index) can be constructed:

$$\Delta rer_t = \sum_{i=1}^{K} w_i e_i \Delta p_{it} - \sum_{i=1}^{K} w_i w_i \Delta p_{it} = \sum_{i=1}^{K} w_i (e'_i - w'_i) \Delta p_{it} \qquad (5)$$

Equation (2) was estimated by dynamic regression in the differences and levels (with a linear trend in this latter case) to determine the long-term parameters of the two independent variables. The parameter estimates for the first case will presumably have a downward bias. As it is not absolute values but only ratios that we are interested in, this is perhaps not a great problem. In the second case the quality of the estimates cannot be expected to be very good because of collinearity. We have made the estimations with both (monthly) seasonal *dummies* and without *dummies* in both cases, thus obtaining altogether four estimates for each parameter.

The following algorithm was used to determine the *tradability* index of each of the 160 CPI strata. First we checked whether the individual long-term parameter estimates were significant. If either parameter of an estimate proved to be significant and its pair insignificant, then the normalised parameters were taken to be 1 and 0, respectively. When both parameters appeared to be significant, they were normalised according to (3). When neither parameter was significant we omitted the estimate concerned. In this way we obtained 0-4 estimates for each item of CPI. Then we checked for the discrepancy between these estimates. In the absence of a meaningful (normalised) parameter estimate or when there were several estimates which diverged *"in an excessive degree"*, the item in question was deleted. Otherwise it was the (unweighted) average of the estimates that were regarded as the *bottom line* estimates obtained from the procedure.

The procedure outlined above was applied to a high number of selection parameter combinations. The effect of the chosen selection criteria are displayed in Charts 6.1 and 6.2. The individual selection parameters of the estimation are as follows:

t: denotes an acceptance level associated with a probability value (related to the t statistics). Should the computed test statistics result in a higher value for the parameter under review, this will render the tested (long-term) coefficient insignificant through accepting the null hypothesis, which assumes the tested parameter to be 0.

a: denotes the (lower) critical value for the denominator in the formula of the long-term parameters. Should the denominator be lower than *a* (that is: closer to zero), this will render the values of both long-term coefficients unreliable.

s: controls what level of deviation is tolerable between the estimates obtained from the four kinds of regressions. When it is 1, then the *"diametrically opposite"* estimates (one purely *tradable* and the other purely *nontradable*) for the reviewed item are also acceptable (the result then is ntr=0.5, tr=0.5). By contrast, when *s*=0, only the unanimous estimates or the single significant estimate can be kept.

n: is the number of the series (max 160) that *"produce"* suitable estimates with the selection criteria under consideration.

Charts 6.1 and 6.2 show the price level (INs) computed, using the original weights, from the data series that appeared to be suitable under the chosen selection parameters.

$$\Delta p_{tr} = \sum_{i=1}^{K} w_i e'_i \Delta p_{it} \; ; \quad \Delta p_{ntr} = \sum_{i=1}^{K} w_i w'_i \Delta p_{it} \; ; \quad \Delta p_{INs} = \sum_{i=1}^{K} w_i \Delta p_{it} \qquad (6)$$

To facilitate analysis, the CPI level has been subtracted from all three series, i.e. it is the deviation from the traditional measure that has been plotted.

It will be seen from what has gone before that, all other things being equal, the lower the value of *t*23, the higher that of *a*, and the lower that of *s* the more reliable the results are. Similarly, the higher the value of *n*, and the less the distortion caused by excluding any of the original 160 items – in other words, the nearer inflation calculated for the subclass using the original weights comes to the CPI 24 – the greater is the reliability.

Charts 6.1 and 6.2 show that the selection of the parameter *t* has a major influence over the results. If the t test criterion relating to the dynamic regression estimation is dropped (that is the critical probability of the t-statistic *t*=1), then the results will be qualitatively different from those that would be obtained using the standard significance levels (see Charts 6.1/c. d. g., and the two lower curves in Chart 6.2). A further shortfall of these results is their lack of robustness relating to the value *s* (Charts 6.1/ c. *versus* g.). Conversely, if one chooses a small critical probability (*t*), changing *s* will not lead to a qualitative modification in the results. In view of the above arguments it is the results displayed in Charts a. and b. that can be considered as relevant.

Chart 6.3 shows the correlation between *"dollar-wages"* and the real exchange rate indices that we have calculated under a variety of selection criteria. On the basis of the correlations, the real exchange rate calculated with the selection criterion p=0.05, i.e. the method treating *tradability* more like a binary category, seems to be a better indicator of competitiveness.

Finally, Chart 6.4 compares the *internal real exchange rate* we computed to the real exchange rates based on the CPI and the ULC, *"in circulation"* in the National Bank, as well as the (seasonally adjusted) wage level in basket currency terms. The Chart clearly shows that like the *"dollar wage"* and unlike the CPI-based real exchange rate, the internal real exchange rate is a good indicator of the real appreciation seen between 1992 and 1995, as well as of the correction in the wake of the 1995 stabilisation package. By contrast, under the regime following the 1995 adjustment, the internal real exchange rate no longer reflects the "appreciation" indicated by the wage data. This provides evidence for the view that the increase in wages expressed in foreign currency terms is covered by the increase in productivity, in other words,

23 At the same time, a very low *t* value will cause the insignificant parameter to be rounded downwards (to 0) and its potentially significant pair upwards (to 1). Therefore, choosing a very low *t* value will cause *tradable* and *non-tradable* prices to deviate from each other.

24 This is seen in the figure in that the INs curve does not (significantly) diverge from the horizontal axis.

there is no deterioration in the country's competitiveness. It is also noteworthy that the internal real exchange rate reflects the Russian crisis differently from the series of the other indices, which reflected short-term exchange rate volatility without delay.

This section has been the description of an experiment aimed to construct an internal real exchange rate index which is a good proxy for "genuine" real exchange rate indices. Although our approach was essentially heuristic we also tried to test for robustness in respect of arbitrary choices, with particular regard to estimating the *tradability* parameter and to choosing between parallel estimates.

7. Core inflation: expectations and coordination

Even the very term *core inflation* reflects the desire of many to capture an inherent and presumably essential feature of reported inflation indices. Valkovszky-Vincze (2000) analysed the concept of core inflation as presented in the literature. They found that by core inflation the different authors refer to things that have similar, but not identical, properties. Supporters of one view claim that core inflation is a price index over which monetary policy exerts (direct) influence. On another view it is something which contains small temporary "noise". In fact, the accurate definition of both criteria would require some kind of a "model" in order to reveal if they are identical or what differences they have. The cited paper concludes that, from a "functional" point of view, core inflation plays the role of a co-ordination instrument and it shapes expectations concerning the actions of the National Bank of Hungary. We are inclined to think that this is equally valid in respect of other central banks. What is meant more specifically by this role?

There are basically two approaches to the concept of expectations. According to one, represented by the classical fundamentalist theory in the literature, expectations stem from the state of the economy, and cannot be influenced by economic policy makers unless they change their rule of behaviour itself. On an alternative view, expectations are independent state variables which are not unequivocally determined by the state of the economy (including the rules of behaviour of economic policy makers and the information existing on them). Often there is no clear distinction between these two kinds of approach.

The National Bank's Quarterly Reports on Inflation place special emphasis on the fact that expectations form an essential part of the inflation process. At first sight this sounds very much like the second interpretation. On the other hand, the claim that the National Bank is seeking to influence expectations via its communication activity (see Valkovszky-Vincze [2000]) could be construed as an attempt to influence the beliefs about the Bank's adopted strategy in order to bring them closer to the truth. Under this interpretation the purpose of publishing the core inflation rate is to help ease the uncertainty about the Bank's prospective actions insofar as the selected core inflation measure is more closely linked to the Bank's decisions than the other price indices. This seems to be in contrast with the second interpretation, which holds that publishing core inflation has purely a coordinating function, aimed at singling out an inflation path out of the many possibilities via co-ordinating expectations. Here the core inflation index functions, as it were a "*sunspot*", i.e. an external random factor.

In the following we will not discuss the role of "*sunspots*" but attempt to give a clear-cut and precise definition of the requirements associated with the first – the fundamentalist – approach to core inflation.

We will not conceive of core inflation as a well-established concept, in other words, it will not be attributed an autonomous identity (within economic theory). Instead we will try to explore the notion that inflation indices convey useful information on monetary policy in order to foster the success of monetary policy. Valkovszky-Vincze (2000) compared core inflation "candidates" in the mirror of four criteria, namely the variance of the index, its cointegratedness with the CPI, its ability to closely follow trend inflation defined in a certain way and its "ability" to improve inflation forecasts. These are widely used criteria in the literature. Nevertheless, it seems worthwhile to consider what they mean when the focus of our investigation is the role of core inflation in influencing expectations. To this end, we wish to use a very simple model that may provide assistance in understanding the significance of the above criteria.

This model is a version of the classical monetary model. Take the logarithmic form of the quantity equation

$$p_t = m_t - y_t + v_t . \qquad (1)$$

Let us assume that the velocity of circulation of money depends on the nominal rate of interest, which, supposing a constant real interest rate normalised to 0, is identical to the rate of inflation expected by the private sector.

$$v_t = g\,(E_t\, p_{t+1} - p_t) \qquad (2)$$

The output is given as the sum of two independent supply shocks with zero expected value, one of which (ε_t) is a white noise and the other (q_t) has positive autocorrelation. Therefore,

$$y_t = q_t + e_t \qquad (3)$$

$$q_t = r q_{t-1} + h_t \qquad (4)$$

where $0<r<1$.

Let us assume that the instrument of monetary policy is m_t, which is set by the following rule

$$m_t = a q_{t-1}, \qquad (5)$$

where $a>0$.

This means that the central bank is capable of observing the smoother component of supply and will influence the quantity of money after a one-period lag as a function of this term. Due to positive autocorrelation the positive feedback ($a>0$) means the stabilisation of the price level. This is an *ad hoc* rule, but it reflects meaningful monetary policy objectives. This is how a monetary policy maker seeking price

stability should respond to real shocks. The assumption for the real variable reflects the existence of real shocks that are completely temporary and nothing much can be done about them. Yet there are also (relatively) permanent shocks which deserve a response even after a lag. It is assumed here that the central bank has the ability to accurately separate these shocks after a one-period lag.25 At the same time, it is also assumed that the central bank can only communicate this information with a certain amount of noise.26 Let us suppose that the central bank is communicating a variable uc_t which is observable to the private sector. In the equation

$$e_t = uc_t - u_t \tag{6}$$

u_t and uc_t are independent from each other, implying that both variables correlate with, but are less noisy than, ε_t. Let us define the core price index pc_t as:

$$pc_t = p_t + uc_t \tag{7}$$

(A "justification" for the definition is to be given later.)

The set of information on which the private sector relies when forming its expectations must also be defined. It comprises the price index, the core price index and total output (p_t, pc_t, y_t).27 This implies that the information available for the private sector is not as „good" as that for the central bank.28 Here follows a solution of the model by standard techniques.

Let us find the expectations of the private sector by the following formula:

$$E_t p_{t+1} = b_1 p_t + b_2 y_t + b_3 uc_t . \tag{8}$$

After the substitutions the following expression is given for the price index:

$$(1+g-gb_1)p_t = aq_{t-1} + (gb_2 - 1)y_t + gb_3 uc_t \tag{9}$$

As

$$q_t = y_t - uc_t + u_t$$

and

$$E_{t-1} y_t = r q_{t-1}$$

applying the expected value operator to equation (9) and solving it gives

25 Introducing the realistic assumption that this separation is not perfect would contribute nothing new to the point we wish to make in this paper.

26 That is, the quantity of money is not observable to the private sector, which might sound like an odd assumption. This could be resolved by increasing the number of the variables, but the benefit to be gained from generalization would not be worth the complication caused.

27 Naturally the observability of p_t and uc_t entails the observability of pc_t as well. As regards the information content pairs (p_t ,pc_t) and (p_t ,uc_t) are equivalent. This property is being utilised in formula (8).

28 Otherwise why should a core inflation index be published?

$$E_t p_{t+1} = \frac{1}{(1+g-gb_1)}(a + rgb_2 - r)(y_t - uc_t) \quad . \qquad (10)$$

Equations (8) and (10) lead to $\beta_1=0$, $\beta_2=-\beta_3=\beta$.

The solution can be summed up in the following two formulae:

$$E_t p_{t+1} = b(y_t - uc_t) \quad , \qquad (11)$$

where

$$b = (a - r)/(1+g-gr)$$

and

$$p_t = (1/1+g)((a - r + bgr)q_{t-1} + (bg - 1)h_t - e_t - bgu_t) \quad . \qquad (12)$$

The results we have found important can be summed up in the following propositions.

1. To be able to forecast it is sufficient for the private sector to know y_t-uc_t. That is, as uc_t is the log ratio of the total price index and the core price index, it is neither the current prices nor the core price index by itself, but their ratio that provides useful information for forecasting future prices. Clearly, this is a specific characteristic of the model, arising possibly from its excessive simplicity. But the varying significance of y_t-uc_t must also be true of more complicated models. This is because y_t-uc_t is equal to q_t-u_t, the best estimate of the private sector for the permanent supply term, i.e. the variable on the basis of which the central bank determines money supply.

2. How is our definition of the core price index justified? The following two formulae for the original and the core price index can be derived from the above model:

$$p_t = m_t + v_t - q_t - e_t$$
$$pc_t = m_t + v_t - q_t + u_t$$

Our assumption is that the variance of ų is smaller than that of ε_t, i.e. the core price index is indeed a less volatile price index than the original price index. Therefore, the core price index may be seen as a price index free from temporary supply shocks to the largest possible extent.

3. Parameter β in the price forecast of the private sector is positive (negative) if the intensity of the feedback (α) is bigger (smaller) than the output persistence parameter (ρ). If the two latter parameters are identical, the prices will behave as white noise. The intention to avoid this may explain why monetary policy makers

would not make (α) equal to (ρ) even if it was in their power to do so. Another possible explanation is that even if $\alpha=\rho$ would be optimal, monetary policy has no accurate knowledge of ρ.

4. The smaller is the variance of u_t, the smaller is that of the price index. In other words, the reduction in the error of the information relating to the relevant variable will reduce the variance in prices. This result is clearly what we have expected.

5. If the correlation of η_t and u_t is different from zero, this may reduce or, conversely, increase the variability of prices. This leads to the possible interpretation that the implication of non-zero correlation is that the error in the private sector's estimate of the permanent supply shock may be smaller or larger, depending on the parameters, than it would be if η_t and u_t did not correlate.

What bearing do the above statements have on the criteria set up to judge how "correct" core inflation is? It is clear that just as we intuitively thought the observation error variance will increase the variance in prices. Hence what makes an information variable better than another is the degree of accuracy with which it approximates the actual conditioning variable and thus the monetary policy decision. This does not necessarily imply that core inflation must have a smaller variance than inflation. This requirement is met, nevertheless, provided that the variance of the temporary supply shock is significantly bigger than that of the permanent component. On the other hand, the variance criterion is plausible when it is the various core inflation candidates that are to be compared.

The model highlights the fact that "good" core inflation provides information on the considerations governing central bankers' decision making, and hence, indirectly, on the decision itself. Consequently, if optimal core inflation is sought one cannot ignore the question of what kind of information one intends to impart. For example, if the primary influence on a central bank's decision making is real exchange rate expectations, then the relevant optimal core inflation is different from that when the bank is acting exclusively as guided by its inflation expectations. The criteria of co-integration and the ability to follow the inflation trend, investigated by Valkovszky-Vincze (2000), may be of relevance to different types of central banks. If the real exchange rate is an important information variable, then central bankers must be interested in the price level, too. This means that it is the co-integration criterion that is of importance for them. At the same time, for a central bank targeting inflation alone, i.e. uninterested in past inflationary surprises, it is more important that the core inflation index is a good approximation of the trend of inflation. The frequent requirement that core inflation indices should help predict the rate of inflation is a by-product of the model: it is derived from a property of the core inflation index, namely its ability to correctly foretell central bank decisions. As a statistical criterion this could be seen as a test of the validity of our ideas in the past on the informational function of core inflation.

Blinder (1997) gives a concise representation of the attitudes in connection with core inflation: "A university professor can easily answer the question of how much information is imparted by the monthly CPI. None. However, being a deputy

chairman of Fed I certainly could not have said the same to the journalists waiting for a reply." The monthly CPI is important because everybody thinks it is important. Central bankers are expected to respond to new information, therefore they cannot help but do so. Even if they think this is irrational it would be unrealistic to expect the "market" to patiently wait until monetary policy makers or researchers feel certain about something. One crucial function of core inflation indicators may be to help prevent "overreaction". But the hasty response they seek to avoid may vary according to the general situation and monetary policy objectives prevalent in each particular country. Thus the concept of core inflation cannot be seen as either a purely statistical phenomenon or a universal problem that is free of "national" characteristics. Let us look at a few practical examples.

Temporary changes in non-processed food prices. There is hardly any reason that would justify a monetary policy response to such changes even if such a response would be feasible. Therefore, the right core inflation index seems to be such that excludes these effects. At the same time, the operation of food markets may vary from country to country. While in some countries such "supply" shocks occur frequently and tend to cause significant changes in the CPI, in other countries they are supposed to be of no consequence. If the latter is the case there is no reason to "meddle with" the price index on their account.

Changes in taxation. The issue to resolve here is how persistent the effects on inflation of a specific tax change will be given the reaction of markets. Also, whether the real distortion caused by the tax change is of a type that will prompt monetary policy makers to take corrective action on the basis of their preferences and views on the operation of the economy. For example, an increase in labour costs is likely to speed up inflation, and not only in the very short run. An inflation-wary monetary policy maker will conclude from this that "tightening" may be in order. However, tightening may further aggravate the probably ensuing direct drop in profitability and take the economy towards recession. This is no trivial problem for a monetary policy maker seeking to achieve real economy objectives as well. Easing is another alternative, but, like Buridan's donkey, the monetary strategist may also decide not to make moves in either direction. If the latter is the case the effect of the tax change may be excluded from the core inflation index.

Fuel price changes. Experience has shown that changes in oil prices tend to be persistent, lacking, however, a permanent positive or negative trend. Central bankers may be faced with the genuine dilemma whether to treat oil price changes the same way as changes in non-processed food prices or to take them seriously instead. The outcome of their pondering obviously depends on the exposure to fuel prices of a country's price level. Another criterion of decision making may be whether monetary policy makers wish to correct the changes in the terms of trade and in the real exchange rate that follow or not.

We would like to conclude by adding two further practical comments. 1. In view of the fact that monetary policy objectives and the structure of the economy may change over time, a correct core inflation index, as well as the weights given to the individual components, may also undergo a simultaneous change. 2. The relevance or irrelevance of a particular price shock to core inflation does not depend on whether the shock is temporary or not. The appropriate propagating mechanisms might make the most ephemeral shock persistent and even relevant.

8. Summary and economic policy conclusions

Consumer price indices have come to fulfil numerous practical functions and are often incorporated into regulations and treaties. Such an "application" for Hungary is the Treaty of Maastricht. Satisfying the Maastricht criteria will soon become a relevant issue to Hungarian economic policy. As things are, compliance will become vital when the country's accession to the European Monetary Union will be up for decision. At the same time, the country's "progress" towards satisfying these criteria also seems to have some relevance to the more general and imminent issue of EU membership. As the CPI measures inflation convergence, which is one of the Maastricht criteria, this is one more reason why the issue of CPI measurement should not be neglected.

Let us start with the assumption that Hungary intends to satisfy these criteria in order to be admitted to the union (monetary union). Should the prevailing trends continue the simultaneous achievement of exchange rate stability and inflation convergence will not be feasible (given the trend of CPI-based real exchange rate appreciation). This means that if the exchange rate remained stable, the Hungarian CPI would exceed euro-area inflation by a larger-than-allowed margin. This would basically leave Hungary two choices: 1. Revaluation of the forint (making it appreciate). 2. "Price fixing", i.e. freezing certain prices falling under government control. Although nominal appreciation would not imply a breach of these criteria, many fear the large costs likely to be incurred in the process. Also, the effectiveness of this solution seems dubious in the short run as the relationship between the exchange rate and inflation is not as simple to calculate as would make for an easy choice of an inflation path that is appropriate for a given rate of appreciation. In view of its short-term effectiveness, the second course of action seems to be more feasible, but it is not cost-free either. Freezing prices usually entails the postponement of necessary adjustments, posing a subsequent threat of protracted conflicts and inefficient allocation of resources.

Is there a solution and is it worthwhile to look for one? The answer largely depends on our view of whether non-satisfaction of the criteria poses a substantive problem from the point of view of either Hungarian or union stability. To the extent that the extra inflation - i.e. the portion of inflation in excess of the change in the rate of exchange - is the result of the Balassa-Samuelson effect and/or the under- or overestimation of the price level, non-compliance cannot be regarded as a serious problem.[29]
Indeed, there is overwhelming evidence for the influence of both effects. We argued in Section 3 that, for a long time to come, the virtual price increase due to new products, improvement in the quality of services and the transformation of financial links between the public and the private sector would continue to play a more significant role in Hungary than, say, in the USA. The Boskin report found a roughly 1% upward bias in the USA along with a 2-3% rate of inflation (see Section 3). Therefore the idea of constructing a "correct" cost-of-living index from the current CPI promises to partly solve or resolve the problem. A positive result would imply a several percentage point "gain" in the rate of inflation in Hungary. This would

29 Kovács-Simon (1998) and Jakab-Kovács (1999) tested the operation of the Balassa-Samuelson effect in Hungary, using different methods.

eliminate the danger of an unnecessary delay in the country's admission to the monetary union or the need for adopting another (costly) strategy in order to win admission.

However, we have also found that the definition of the Hungarian CPI as a "pure" cost-of-living index is not acceptable for several reasons and that changing it into such an index would be no easy task. Even though the Hungarian CPI cannot be directly regarded as a "monetary" price index either, it would be possible to change it into one by means of introducing minor changes in its sample and using appropriate weights. The majority of our proposals would require only minute or one-off changes in the current system of consumer price statistics. Last but not least, as noted earlier, redefining the Hungarian CPI, which is published on a regular basis, as a monetary expenditure price index would also be consistent with the concept of the HICP, the official price index of the European Union. In this sense the existence of such a price index would take the system of Hungarian institutions a step closer towards meeting the harmonisation obligations. However, the question is whether Hungary should take great pains with the quality and new goods bias from the point of view of the HICP. The answer is that it does not have to, but is allowed to. The HICP itself can be regarded as a mixed construction, which, besides its declared purpose of being a suitable measure of the costs of inflation, also embraces other cost-of-living type considerations. Therefore it would not run contrary to the HICP concept if the Hungarian CPI (Hungarian HICP) were transformed into an index that would be a better gauge of changes in the cost of living. The pertaining Eurostat directives contain no strict methodological constraints, and naturally, the EU recognises the discretion of national statistical agencies as to the (specific) modes of taking account of the effects of quality change, etc.[30, 31]

On the other hand, we have found the current CPI to be unsuitable as a cost-of-living index. Consequently, there is need for a separate cost-of-living index, which could be published on a less frequent basis. Different from the current CPI in several aspects, it could be published by the Central Statistical Office on a quarterly or annual basis. We believe that this price index would be more suitable for the indexation of welfare expenditures and the purposes of wage negotiations than the annual price index derived from the monthly CPIs. The existence of two consumer price indices could admittedly lead to some confusion. We can trust nevertheless that the economic agents would find a way to pick out and combine the bits of information most relevant to their different purposes. The National Bank of Hungary is one of the institutions that would find the existence of two consumer price indices quite a challenge in the formulation of monetary policy objectives and the selection of instruments.

30 Certain simple manipulations are explicitly forbidden. For example, in the matter of quality change, if a good is stripped out of the price index to be replaced with a newer version of the good, it is forbidden to automatically assume the same price level for the new good as that of the old good. The stress is on the word "automatic" as the procedure is allowed if there is a good reason for it. There is no clear definition for the term "good reason" though.

31 We would like to emphasise the importance we attribute, even apart from the Maastricht criteria, to the correct accounting in the price index of quality change taken in a broad sense. Our proposals should not be regarded as a "call for manipulation" grounded in some kind of "Machiavellian" ideas. Far from it. A well-grounded development of price index calculation may yield reverse results, proving the change in the cost of living to be understated rather than overstated.

Our other proposals are not for regularly published consumer price indices, but for indicators derived from disaggregated consumer prices in order to be used as *analytical devices*. The available information can be used to serve a number of different ends. One is the calculation of real exchange rates with the help of a specially weighted price index we have constructed. We have also found that demand for durable goods requires special considerations. We have calculated a "data-dependent" internal real exchange rate index based on consumer prices. It needs further research to assess whether this index can explain the errors in other (traditional) real exchange rate indicators and whether it is capable of predicting any foreign currency market pressure. We have also described what considerations are to be made when selecting a core inflation index. In our view, in terms of its true function, a core inflation index provides information on monetary policy and this is the basic concept which should guide its makers.[32] The points made in the above passage and in the one relating to the cost-of-living indices demonstrate that, contrary to current practice, greater importance should be attributed to price indices computed at lower than monthly frequency: this also holds good for consumer price statistics.

32 Being not raw statistics, core inflation indices may be computed and published by any institution (whether private or public).

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Appendix

Table 4.1

Descriptive statistics of price indices with different weighting and of the official CPI*

	Official price indices		Unweighted (Jevons)	Inverse variance-based weighting			
				Exogenous		Iterative	
	CPI	NBH core		m-o-m	12-month	m-o-m	12-month
Average	20.0	19.7	19.2	16.6	19.0	17.4	17.1
Stand. error	5.90	5.60	5.90	5.50	4.70	5.60	4.40
Range	22.3	20.3	21.1	19.7	19.7	21.0	17.8
Min.	8.90	8.70	7.70	6.70	9.30	7.00	7.90
Max.	31.2	29.0	28.8	26.4	29.0	28.0	25.7

- Based always on 12-month rates of inflation given in percentage points. Sample period was 1992-99 in all cases.

Table 4.2

Groups with the 10 largest and smallest weights generated by the different weighting methods

		Expenditure-based weights (CSO official)*		Variance-based weighting based on **			
				month-on-month indices		12-month indices	
		Item and weight (%)		Item and weight (%)		Item and weight (%)	
top 10	1.	OHO	5.9	Domestic holiday-making (without vouchers)	5.9	Furnishings, fittings & fixtures	3.9
	2.	Fuel	4.9	Espresso coffee	3.5	Bicycles	2.7
	3.	Electricity	3.0	Men's suits	2.5	Videos, headphones	2.7
	4.	Telephone	3.0	Confectionery products	2.1	VCRs, tape recorders, record players	2.6
	5.	Beer	2.8	Men's trousers, jackets	1.8	Toilet articles	2.6
	6.	Tobacco	2.6	Bicycles	1.8	Heating and cooking appliances	2.6
	7.	Spirits	2.5	Cleaning, laundry	1.6	Cameras, watches, etc.	2.5
	8.	Pipeline gas	2.1	Sports, museum admission	1.6	Refrigerators, freezers	2.4
	9.	Bread	1.8	Women's skirts, etc.	1.6	Home improvements and maintenance	2.1
	10.	Pharmaceuticals	1.8	Clothes making and mending	1.6	Detergents	2.1
last 10	1.	Tinned fish	0.1	Rice, etc.	0.1	Gambling	0.0
	2.	Cleaning, laundry	0.1	Pharmaceuticals	0.1	Travel to work and school	0.0
	3.	Mutton, rabbit and other meats	0.0	Bacon	0.1	Pharmaceuticals	0.0
	4.	Dried pulses	0.0	Eggs	0.0	Pork and poultry fat	0.0
	5.	Men' socks	0.0	Fish	0.0	Local public transport	0.0
	6.	Motorcycles	0.0	Pork	0.0	Cut flowers and houseplants	0.0
	7.	Children's underwear	0.0	Fresh vegetables	0.0	Eggs	0.0
	8.	Radio sets	0.0	Flour, hulled grains	0.0	Fresh fruit	0.0
	9.	Other fabrics	0.0	Pork and poultry fat	0.0	Fresh vegetables	0.0
	10.	Children's socks	0.0	Potatoes	0.0	Potatoes	0.0

*CSO official: the table shows the arithmetic means of weights used in 1998-99.

**Variance-based weights were always derived from the period 1996-99. Other periods have also been checked leading to no significant change in the results.

Table 5.1
CPI-160 of Section 5

CSO code + Name of item

Administered prices:

531	PHARMACEUTICALS
552	SCHOOL BOOKS
615	REFUSE COLLECTION, ETC.
616	WATER CHARGES
617	SEWERAGE
643	LOCAL PUBLIC TRANSPORT EXCLUDING TAXI
645	TRAVEL TO WORK AND SCHOOL
646	FREIGHT TRANSPORT
650	TELEPHONE
651	POSTAL SERVICES

Consumer durable goods:

400	LIVING AND DINING ROOM FURNITURE
401	KITCHEN AND OTHER FURNITURE
402	REFRIGERATORS, FREEZERS
403	WASHING MACHINES, DISHWASHERS
404	HEATING AND COOKING APPLICANCES
405	VACUUM CLEANERS, SEWING MACHINES
410	CARS, NEW
411	CARS, SECOND-HAND
412	MOTORCYCLES
413	BYCICLES
420	RÁDIÓS
421	TELEVÍSION SETS
422	VCRs, TAPE RECORDERS, RECORD PLAYERS
424	CAMERAS, WATCHES, MUSICAL INSTRUMENTS
431	JEWELLERY
522	COOKING UTENSILS, CROCKERY, CUTLERY
523	FURNISHINGS, FITTINGS & FIXTURES
540	TYRES, VEHICLE ACCESSORIES, COMPONENT PARTS

Energy

500	COAL
501	BRIQUETTES, COKE
502	FIREWOOD
503	FUEL OIL
504	PURCHASED HEAT
505	ELECTRICITY
506	NATURAL AND MANUFACTURED GAS
507	BUTANE AND PROPANE GAS (IN BOTTLES)

Food:

100	PORK
101	BEEF AND VEAL
102	OTHER MEATS
103	OFFAL

104	POULTRY
105	SALAMI, SAUSAGES, HAM
106	SUNDRY MEAT PRODUCTS
107	TINNED MEATS
108	FISH
109	TINNED FISH
110	EGGS
111	MILK
112	CHEESE
113	DAIRY PRODUCTS (excl.cheese)
120	BUTTER
121	LARD
122	BACON
123	COOKING OIL
124	MARGARINE
130	FLOUR, HULLED GRAINS
131	RICE, OTHER CEREALS
132	BREAD
133	ROLLS
134	PASTA
135	SUGAR
136	CHOCOLATE, COCOA
137	CONFECTIONERY AND ICECREAM
138	OTHER CONFECTIONERY
139	CANDIES, HONEY
140	POTATOES
141	FRESH VEGATABLES
142	FRESH DOMESTIC AND TROPICAL FRUIT
143	FRUIT AND VEGATABLE JUICES
144	PRESERVED AND FROZEN VEGETABLES
145	PRESERVED AND FROZEN FRUIT
146	DRIED PULSES
147	NUTS, POPPY-SEEDS
150	PRESERVED MEAT PRODUCTS
151	READY-MADE MEAT-FREE MEALS
152	SPICES
160	DINING OUT
161	DINING (COMPANY CANTEEN AND MEAL TICKETS/LUNCHEON
162	MEALS AT SCHOOL
163	MEALS AT KINDERGARTENS, CRECHES
164	BUFFET PRODUCTS
172	TEA
173	NON-ALCOHOLIC BEVERAGES

Services:

171	ESPRESSO COFFEE
601	CLOTHES MENDING, MAKING, ETC
613	HOME IMPROVEMENTS & MAINTENANCE
620	REPAIRS OF HOUSEHOLD APPLIANCES
621	CLEANING, LAUNDRY
630	PERSONAL CARE
631	HEALTH SERVICES
640	VEHICLE REPAIR AND MAINTENANCE
642	CAR AND GARAGE RENTAL
644	TAXI

647	HAULAGE
660	RECREATIONAL GOODS MAINTENANCE
661	EDUCATIONAL SERVICES
662	THEATRE, CONCERTS
663	CINEMA
665	OTHER PUBLIC ENTERTAINMENT
680	DOMESTIC HOLIDAYS WITH HOLIDAY VOUCHERS
681	DOMESTIC HOLIDAYS WITHOUT HOLIDAY VOUCHERS
682	RECREATION ABROAD
690	PHOTOGRPAPHIC SERVICES
691	SERVICES N. E. C.

Excisables:

170	PRE-PACKED COFFEE
180	WINE
181	BEER
182	SPIRITS
190	TOBACCO
541	MOTOR FUELS AND OILS

Other goods:

300	COTTON AND COTTON-RICH FABRICS
301	WOOLLEN AND WOOL-BLEND FABRICS
302	OTHER FABRICS
310	MEN'S COATS
312	MEN'S SUITS
313	MEN'S TROUSERS AND JACKETS
314	MEN'S PULLOVERS, CARDIGANS
315	MEN'S FOOTWEAR
316	MEN'S UNDERWEAR, SHIRTS
317	MEN'S SOCKS
320	WOMEN'S COATS
322	WOMEN'S SUITS AND DRESSES
323	WOMEN'S SKIRTS AND TROUSERS
324	WOMEN'S PULLOVERS, CARDIGANS
325	WOMEN'S FOOTWEAR
326	WOMEN'S UNDERWEAR
327	WOMEN'S STOCKINGS, SOCKS
330	CHILDREN'S COATS
332	CHILREN'S OVERWEAR
334	CHILDREN'S PULLOVERS AND CARDIGANS
335	CHILDREN'S FOOTWEAR
336	CHILDREN'S UNDERWEAR
337	CHILDREN'S SOCKS
338	INFANTS' CLOTHING
340	CLOTHING ACCESSORIES
341	HABERDASHERY
342	SUITCASES, LEATHER GOODS
510	HOME IMPROVEMENTS & MAINTENANCE
520	UPHOLSTERY, CARPETS, CURTAINS
521	BED AND TABLE LINEN
524	DIY SUPPLIES
525	HOUSEHOLD PAPER AND OTHER PRODUCTS
526	DETERGENTS
530	TOILET ARTICLES

550	NEWSPAPERS AND PERIODICALS
551	BOOKS
553	SCHOOL AND STATIONERY SUPPLIES
554	SPORTS EQUIPMENT & LEISURE ACTIVITIES, TOYS
555	RECORDS, VIDEO-CASETTES
556	PHOTOGRAPHIC SUPPLIES
557	VIDEO-CASETTES, HEADPHONES
560	CUT FLOWERS AND HOUSE PLANTS
561	PETS
562	JEWELLERY AND GIFTWARE
612	APARTMENT BLOCK SERVICE CHARGE

Excluded series:

610	RENT
611	OWNER OCCUPIED HOUSING
664	TELEVISION SUBSCRIPTION
671	GAMBLING
672	MEMBERSHIP DUES, DONATIONS

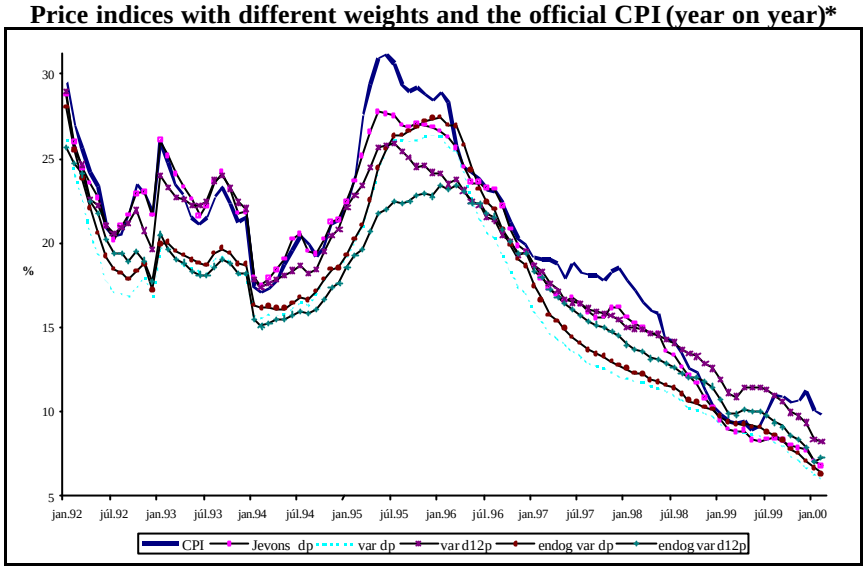
Table 5.2
Weights given to the individual clusters by the Central Statistical Office

Weights given to the individual clusters comprising the CPI, derived from their weight in consumption two years before:

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Administered prices	3.7	5.245	5.838	6.93	7.266	8.356	9.03	9.6	10.047
Consumer durables	12.1	10.207	9.621	9.672	8.962	7.622	7.346	6.856	8.635
Food	26.9	25.814	25.699	26.367	27.097	27.131	26.1	25.76	23.535
Excisables	18.2	17.096	16.579	15.582	15.585	15.275	15.132	15.132	15.35
Other goods	17.9	18.209	18.022	18.222	17.989	16.499	16.414	16.274	15.953
Energy	4.8	6.598	7.706	6.956	6.488	8.038	8.5	8.89	8.632
Services	9.7	9.663	9.665	8.713	8.596	8.736	9.225	9.225	10.515
Excluded series	6.7	7.168	6.87	7.558	8.017	8.343	8.253	8.263	7.333

Chart 4.1

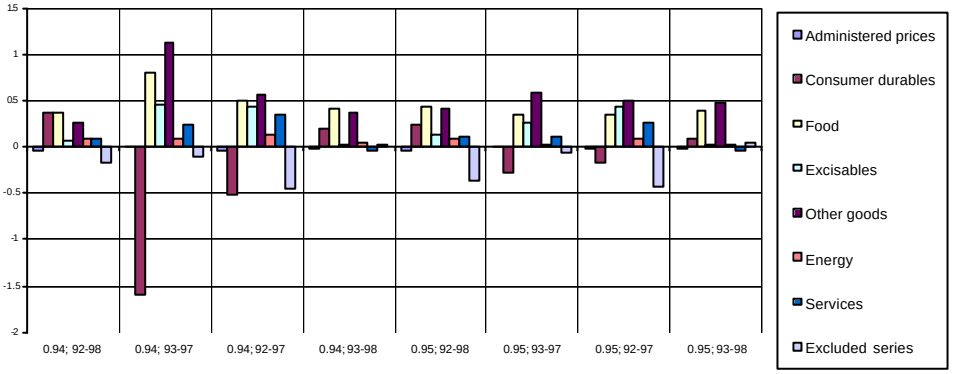
Price indices with different weights and the official CPI (year on year)*



* Explanation *CPI*: official CPI, *Jevons dp*: unweighted Jevonsian index, *var dp:* exogenous variance-based weights using month-on-month indices, *var d12p*: same using 12-month indices, *endog var dp* and. *endog var d12p*, respectively, same using an iterative (endogenous) solution.

Chart 5.1

Weights derived from the elasticity of substitution for different beta parameters and time periods (first approximation)



The horizontal axis shows the parameter b and the time periods on which the calculations are based.

Chart 5.2

Weights derived from the period 1992-98
(Excluding consumer durables and goods with administered prices)

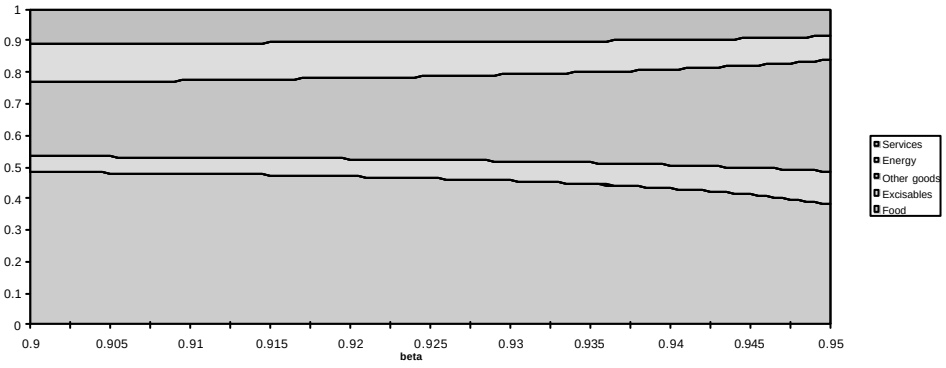


Chart 5.3
Deviation of the computed real interest rate relevant price index from the CPI
(logarithm of the level)

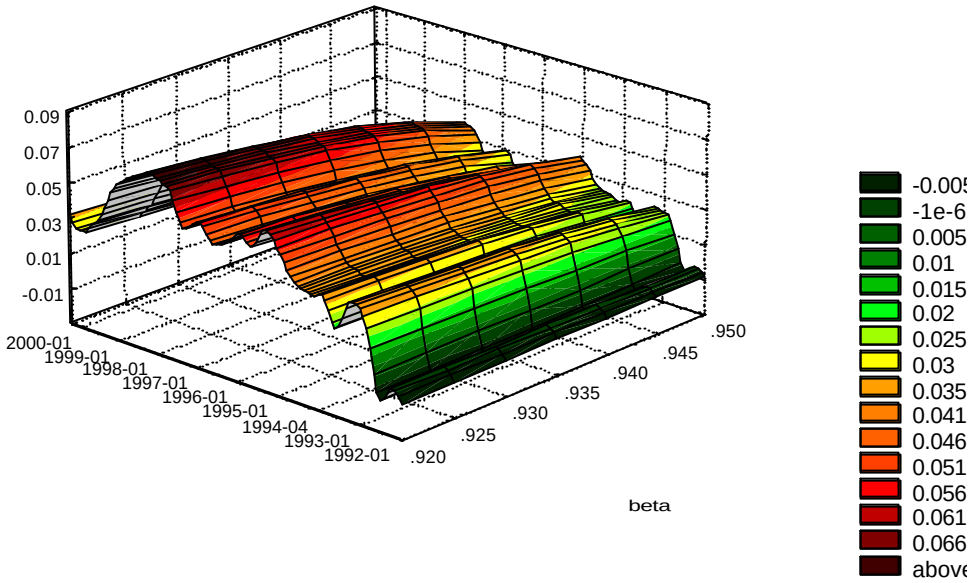


Chart 5.4
Real interest rate relevant price indices
Deviation of price indices based on various time periods from the CPI
(logarithmic level)

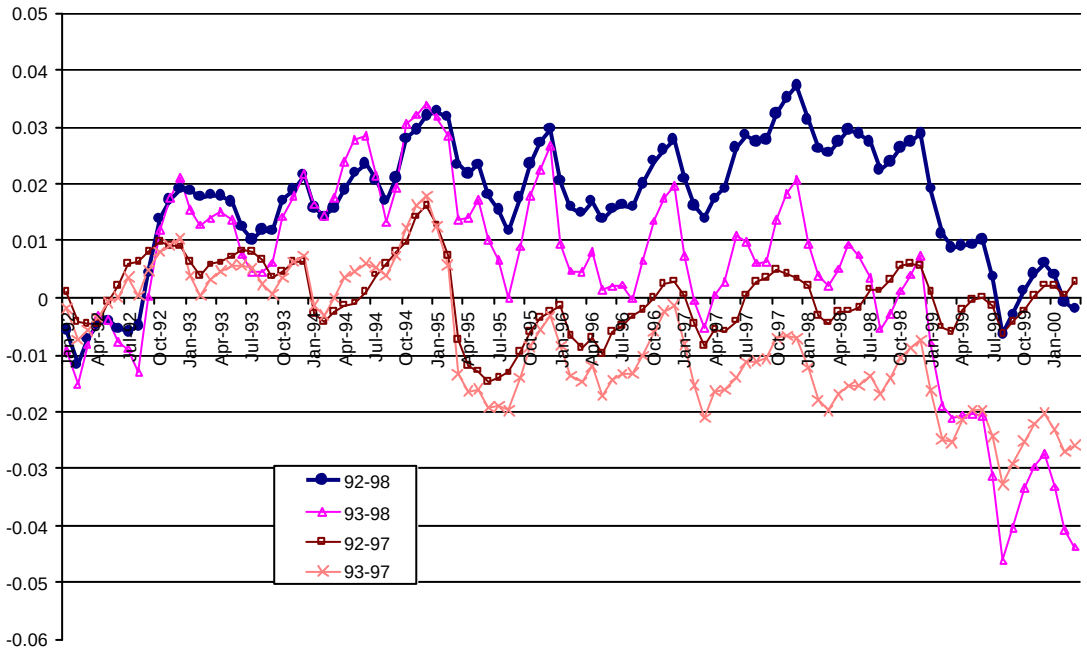


Chart 5.5
Real interest rates (ex ante), computed using the seasonally adjusted CPI and the modified CPI

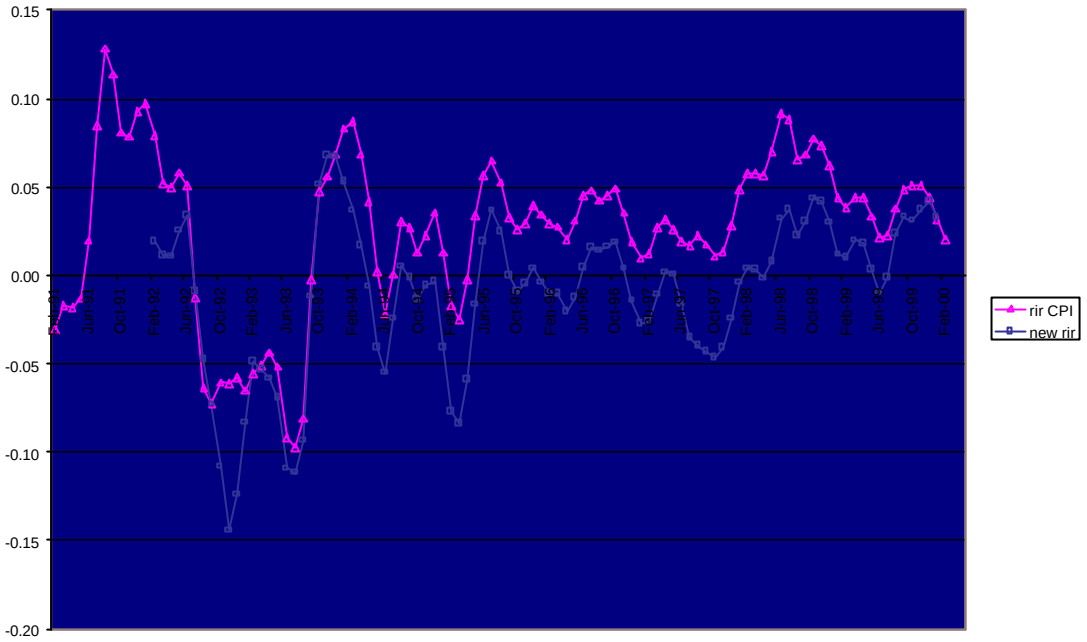


Chart 5.6
Relative price trends of the clusters, as deviation from the full CPI (logarithmic level)

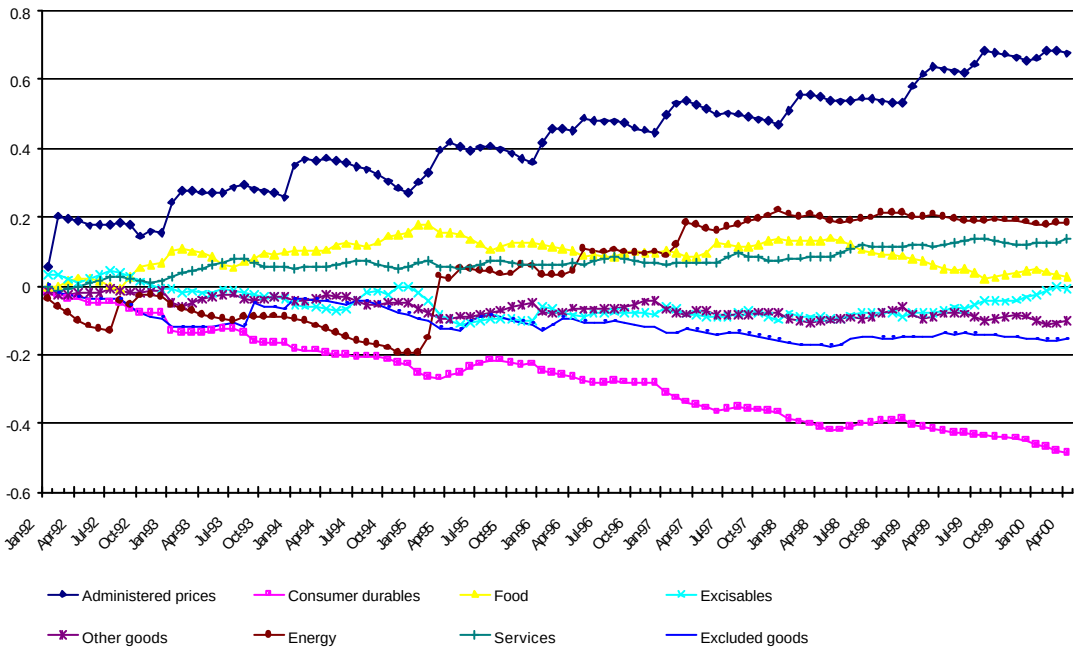
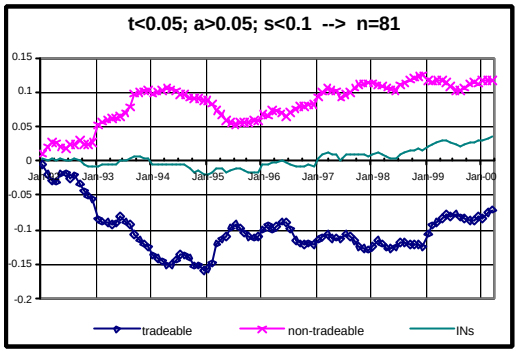
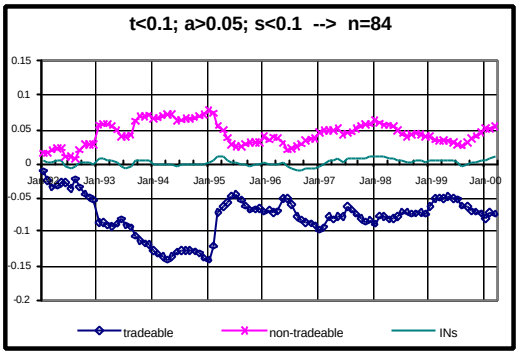


Chart 6.1

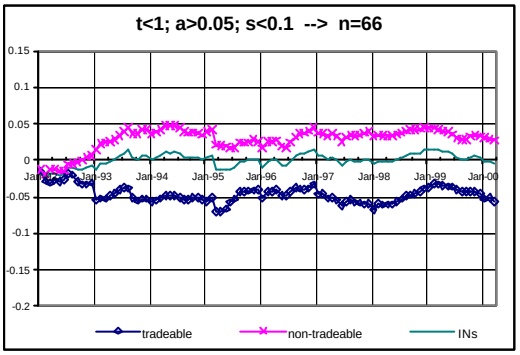
Tradable and non-tradable price indices as determined by various selection criteria of parameter estimation



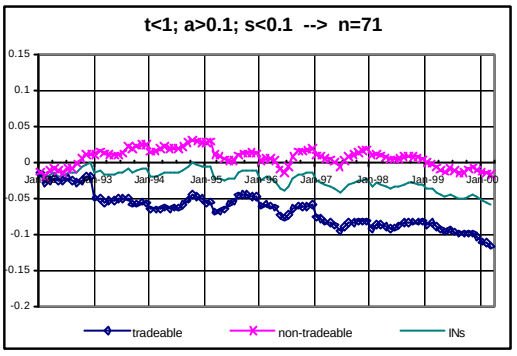
a.



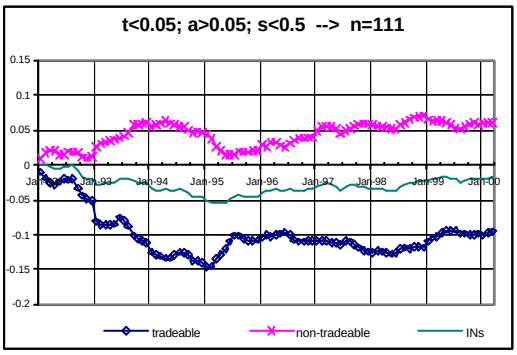
b.



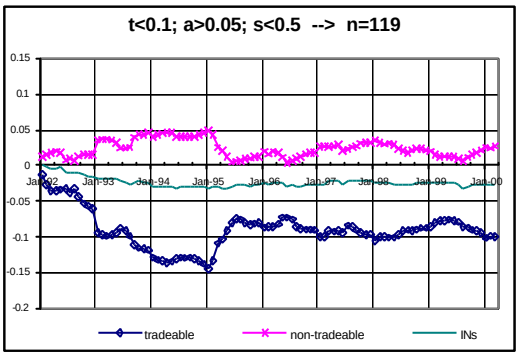
c.



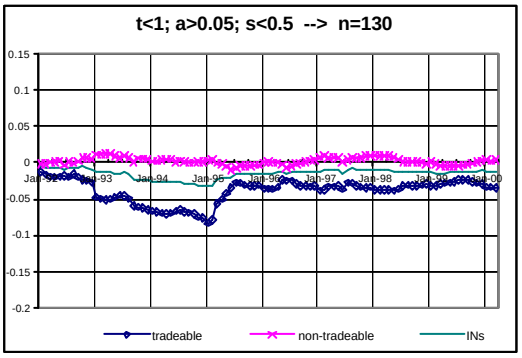
d.



e.



f.



g.

Chart 6.2
Internal real exchange rate or the difference between non-tradable and tradable price indices, using different selection parameters
(logarithmic levels)

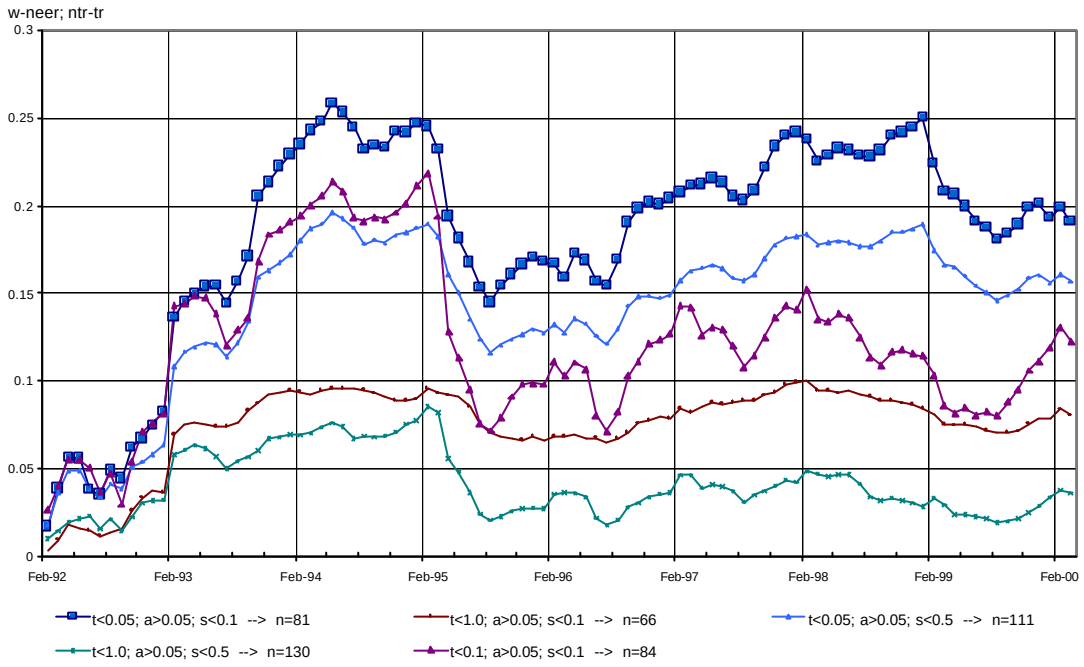


Chart 6.3
Time series correlations

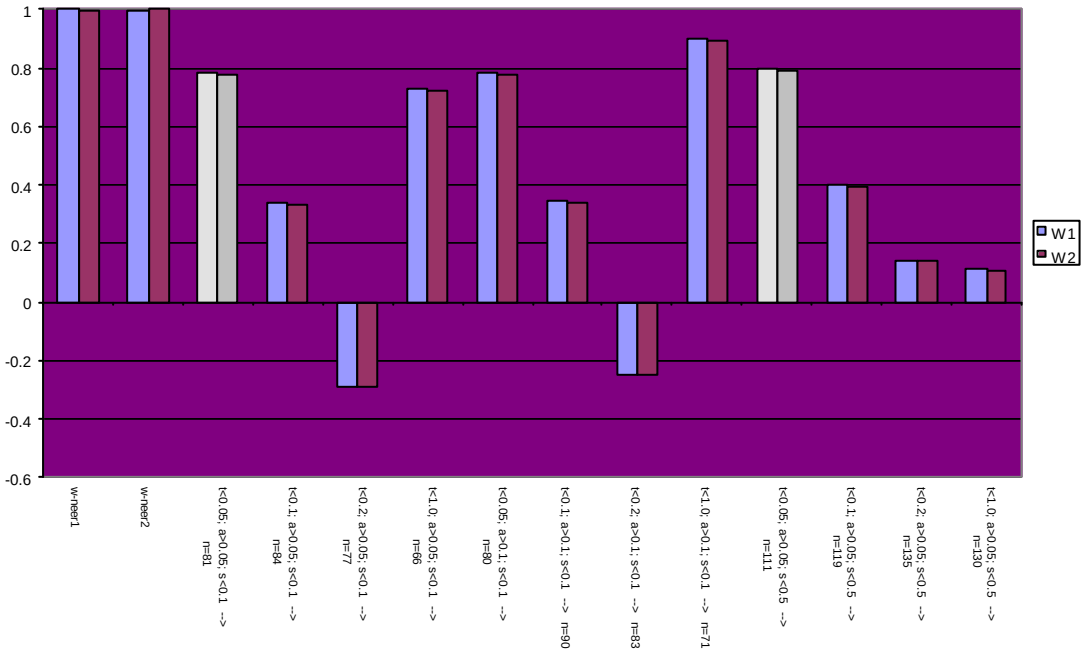
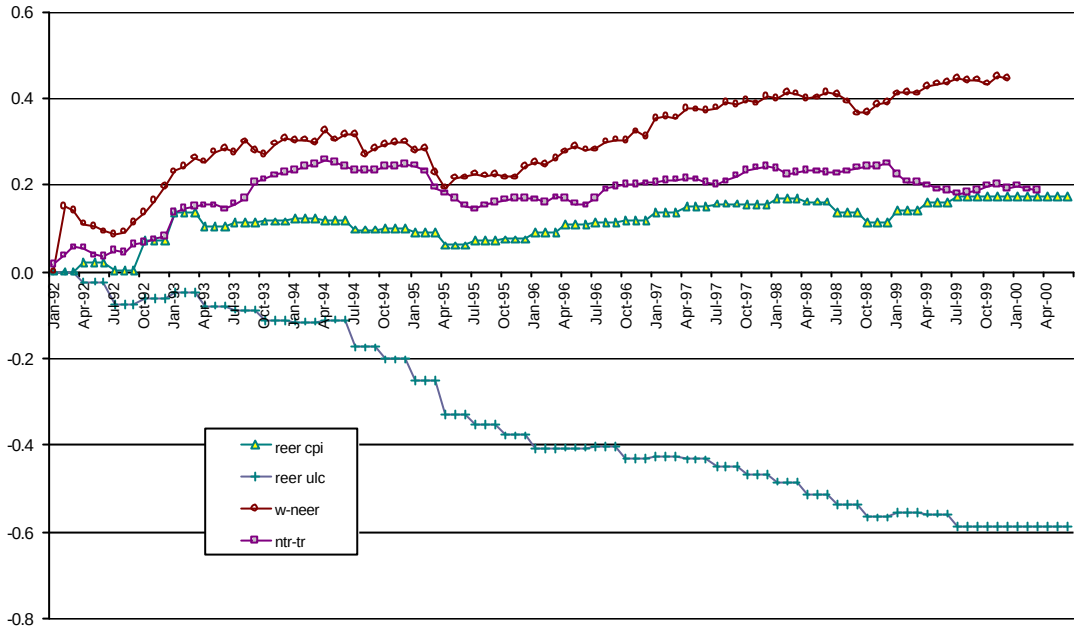


Chart 6.4
Various real-effective exchange rate indices



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