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ESTIMATES OF AND PROBLEMS WITH CORE INFLATION IN HUNGARY♣

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Abstract

The traditional CPI measure has many drawbacks, when used for very different purposes, and it is not at all surprising that a great deal of work has been devoted to its improvement. Besides seasonal adjustment, various other techniques have been developed to find the *"core"* inflation index. Although a generally accepted definition of core inflation does not exist, the literature converges towards identifying certain desirable properties that a *"good"* core index must possess.
After reviewing the literature we describe how the publication of a core index fits into the monetary policy strategy of the National Bank of Hungary. Monetary policy both in the form of setting the instruments and by communicating to the public is geared to arrive at a mutual understanding with the markets. By publishing a core inflation index, the NBH aims at providing the public with a price measure that can function as a co-ordination device between policy makers and market participants. As the *"index number"* problem is clearly connected with relative price changes, we analyze in some depth this issue, too. We argue that there have been clearly visible tendencies in relative price developments that jeopardize some of the traditional uses of inflation measures. Our results suggest that a substantial amount of noise and apparent seasonality have come about as a result of government decisions. Finally we muster some possible procedures to define core indices in Hungary, by comparing their smoothness and forecasting ability from several points of view. Our conclusion is that there is no overwhelming reason to abandon the current *"exclusion"* approach toward the core.

1 Introduction

This paper gives a short summary of the Hungarian macroeconomy and monetary policy in Section 2. Then in Section 3 the Hungarian application of the core inflation concept is described, and compared to other implementations. Section 4 provides an analysis of the relative price problems in Hungary, whereas Section 5 offers our latest results on potential core inflation measures. Section 6 concludes and an Appendix proposes a new aggregate inflation concept, possibly useful for monetary policy makers.

2 Economic and monetary policy background in Hungary

2.1 A short history

Hungary is a transition economy with special features. The following is a brief overview of some of its characteristics that bear relevance on the understanding of its monetary policy and the inflationary process. For a more detailed analysis of the period before 1998, Surányi-Vincze [1998] can be consulted, whereas the most recent developments are covered in the various issues of the Quarterly Review on Inflation, published by the National Bank of Hungary. For a comparative analysis see Wyplosz [1999] and the studies in Cottarelli-Szapáry [1998], in particular Begg [1998].

At the beginning of the 1990s, Hungary, like other formerly socialist economies, had to undergo significant structural changes, and a large scale reorientation of trade. As a result output declined and unemployment rose in the early '90s, while there were sharp increases in the price level. As the country inherited a distorted relative price structure, inflation was accompanied by huge relative price changes. Hungary was specific in that it had accumulated a rather substantial foreign debt in the socialist era, and did not get any debt relief afterwards.

Fiscal expansion and domestic demand led to recovery before 1995, which resulted in increasing indebtedness, and in high real wages. Monetary policy's "balancing" via devaluations and higher interest rates was unsuccessful. Returning to a sustainable fiscal path required genuine fiscal adjustment, which took place in 1995, and was supplemented by a step devaluation. Restoring solvency was accompanied by an adjustment of real wages, and this, together with accelerated privatization in a stable macroeconomic environment, led eventually not just to recovery, but to rather high growth, too. Monetary policy was supporting fiscal policy by providing nominal predictability in terms of inflation and exchange rate changes.

The history of inflation in the 1990's can be divided into three periods. In the first period, until September 1991, the rate of increase in consumer prices

accelerated, reaching its peak in the middle of 1991. In the second period, until 1995, first a rapid disinflation occurred, then the rate of inflation stabilized. The third period, starting in early 1995, saw first a short episode of acceleration of inflation to levels comparable to those in 1991, followed by an almost continuous disinflation.

Table 1 Hungary: Some macroeconomic data

	1995	1996	1997	1998	1999
GDP annual growth rate (%)	1.5	1.0	4.4	5.1	4.3
Total public sector debt (% of GDP)	87	72.6	63.7	61.2	60-62
Current account balance (% of GDP)	-5.7	-3.9	-2.3	-4.8	-4.1
Average dollar wage per month (in 1998)			309		
CPI (end of year % change year on year)	28.3	19.8	18.4	10.3	10.6

(Preliminary data for 1999.)

2.2 The policy of the National Bank of Hungary

The 1998 Annual Report of the NBH states: "*The National Bank of Hungary considers the sustainable reduction of inflation and - in the long run - achieving price stability as its most important tasks.*" In order to understand what these terms mean it is best to quote at length from the first Quarterly Report on Inflation, which summarizes the Bank's official stance on the nature of the inflationary process and its tasks therewith.

"*The National Bank of Hungary (NBH) sees three factors which are predominantly important in determining inflation. The development of aggregate demand and supply is the most important factor for sustainable disinflation. The second factor is inflationary expectations, which play a significant role both in producers' pricing behavior and in nominal wage negotiations. The third component is imported inflation, which is the sum of foreign inflation and the nominal depreciation of the Forint. These three components determine the trend of inflation. The inflation rate can, of course, be influenced by ad hoc factors as well, such as tax changes or supply shocks causing one-off shifts in the price level. The National Bank of Hungary believes that the significance of rapid relative price changes and structural adjustments - which were major determinants of the inflation process earlier - decreased as the transition to a market economy ended.*

Sustainable disinflation is possible only through the cooperation of fiscal and monetary policies. The maintenance of the preannounced crawling peg exchange rate regime influences the pricing behavior and inflationary expectations of market participants, and the gradual reduction in the monthly devaluation rate confirms the credibility of the monetary authorities' inflation forecast. The central bank has an effect on aggregate demand as well, by changing monetary conditions the NBH aims to prevent a discrepancy between the growth of aggregate

demand and supply. Although given the current advanced level of capital account liberalization, the central bank's interest rate and exchange rate decisions cannot be independent from each other. By determining the domestic interest rate and the nominal exchange rate the NBH strives to develop and maintain monetary conditions that do not jeopardize the external balance, either from the side of competitiveness or of the savings-investment balance. Central bank decisions affect aggregate demand only indirectly and with a lag, and in the current exchange rate regime international capital market developments also limit the NBH's ability to influence domestic interest rates. Therefore, the efficient control of aggregate demand can be achieved only through the cooperation of fiscal and monetary policies.

In order to maintain external balance and to control inflationary pressures due to a dynamically growing domestic demand, the central bank's interest rate policy aims at stimulating domestic savings. International capital market volatility led to a significant increase in the interest rate premium on Forint-denominated investments, therefore the maintenance of the preannounced exchange rate path requires higher real interest rates. As in the past period since the introduction of the crawling peg regime in 1995, the NBH does not assign an aggressive disinflationary role to the exchange rate per se in the future. The exchange rate path is determined evaluating the differences in domestic and foreign inflation and the expected difference in the growth rate of productivity. The significance of the exchange rate path lies in its credibility and sustainability, thus the expected depreciation is built-in within pricing behavior, reducing the inertia of inflationary expectations and enabling monetary authorities to set a lower goal for inflation."

To summarize: for the NBH price stability is a long-term goal, which is only achievable by a process of sustainable disinflation. Sustainability is derived from the idea that too fast and not coordinated attempts to disinflate have frequently resulted in currency or capital market crises in developing countries where government and foreign debt were not negligible factors.

The short-term framework of policy contains a crawling band for the nominal exchange rate, for which repeated announcements are made jointly by the government and the NBH. Within this framework the NBH's main short-term target is to keep the nominal exchange rate within the announced bands, if necessary by exchange market intervention, but also by setting appropriate short-term interest rates. Nominal interest rates are set with a view to the following issues. Firstly the interest rate must be high enough to avoid the depreciation of the forint to the weak edge of the band, resulting in reserve losses. Secondly the interest rate cannot be so high as to imply too large a premium on forint assets leading to hot money inflow. Thirdly the interest rate must be high enough to support disinflation by checking the expansion of domestic demand.

The longer-term exchange rate strategy must be understood from the concept of sustainability. The NBH (together with the government) would not normally increase the rate of devaluation, though there exists no explicit promise to that effect, but the size of cuts in that rate is influenced by macroeconomic developments between two announcements. In particular unfavorable inflation-

ary developments (resulting in real appreciation), or the deterioration in the foreign debt level, or an acceleration of government indebtedness are taken as indicators of a more delicate macroeconomic balance, and would militate against further cuts in the announced depreciation. Policy puts an emphasis on shaping expectations without "surprising" the public. The goal is to achieve a mutual understanding with the market. Policy both in the form of setting instruments (exchange rate bands and interest rates) and by communicating to the public is geared to arrive at this mutual understanding. The publication of the Quarterly Report is to be seen in this perspective. In the words of the first issue: "The objective of the Quarterly is to regularly provide the public with a view on the current and expected path of inflation and also about how the central bank evaluates the macroeconomic environment which determines inflation. By doing so, it is hoped that a much wider public than before will be familiar with the objectives of monetary policy and the central bank's measures will be easier to follow and to understand."

The core inflation index, published by the NBH, has its main role in the communication strategy of the NBH. The Bank's internal analysis of inflation is quite detailed, and the inflation reports exhibit much more about inflation than just the CPI and the core, where the latter is called explicitly as the trend in inflation. By publishing a core inflation index the NBH aims at providing the public with a price index which can function as a coordination device, and can play a useful role in the improvement of mutual understanding between monetary policy and market participants. The next section shows how the core inflation concept of the NBH fits into international practice and literature, and what its actual implementation has meant.

3 The place of the Hungarian core inflation measure

This section uses extensively the relevant discussions from the excellent survey on core inflation in Wynne [1999]. Some of the most important propositions are summarized first, then we ask how the Hungarian practice relates to that framework.

3.1 What is the core of inflation?

The answer of the literature is not clear. It appears to be different from measuring the cost of living, or even the cost of inflation via holding money balances. Most core definitions implicitly entail at least one of the following two requirements: the core must measure what part of inflation is attributable to monetary policy, and also it must have little noise in a statistical sense. Most current core definitions intend to achieve both of these goals. The two requirements can be unified if one believes that monetary policy is less hectic than the real economy. Though this assumption does not appear to have any empirical foundation, we may say that it is implicitly contained in most core inflation definitions.

However, as Wynne [1999] points out, monetary inflation, that is inflation

attributable to monetary policy, is not a well-defined concept. Even if we had the simple theory entailed by the quantity equation *cum* an exogenous supply of money we should notice that prices are determined jointly by the money supply, the output and the velocity processes. Providing the money supply is independent of the other two processes, the impact of monetary policy can be perfectly measured by money growth, and though it would have a positive correlation with the price index, it would not solely determine it. With an endogenous policy rule the problem is more difficult, as the underlying processes are not orthogonal. It is not by chance that today researchers studying the effects of money look for monetary innovations, i.e. shocks to monetary policy that are independent of the state of the economy. Inflation, however, cannot be attributed only to monetary surprises. For instance, a totally deterministic rule to increase the money supply by 20 per cent per year would certainly lead to a positive rate of inflation, but it would not necessarily involve any statistical innovation. Indeed this is probably the most serious criticism against the semi-structural approaches initiated by Quah-Vahey [1995], apart from other problems noted by Wynne [1999].

The core is frequently identified with the central tendency in price movements, a so-called common component in individual price changes. At first sight the common component and limited influence estimators (Dynamic Factor Index, median, trimmed means), proposed by Bryan-Cecchetti [1994] and Bryan-Cecchetti-Wiggins II [1997], pick on the smoothness or trend approach rather than wish to measure the effects of monetary policy. They assess which limited influence estimator is best capable of tracing trends, defined as a long moving average. This smoothness approach can be related to Blinder's proposal (Blinder [1997]) to define a core via its ability to predict future inflation. Obviously the identification of a trend with the ability to forecast depends critically on other assumptions whose validity may be doubted.

Probably the most conservative approach is the "ex food and energy" approach. The underlying idea is that we can somehow divine that certain events cause temporary price level changes. These events are frequently identified with temporary supply shocks, though nothing excludes the possibility that we would like to clean our inflation measure from temporary demand changes as well. It is widely believed that prices belonging to certain groups, like energy and foodstuffs, are dominated by such temporary factors, justifying their exclusion from the overall price index. This approach is simple, and has a lot of intuitive appeal that makes it acceptable not only to central banks but financial market participants as well. Though in no case does a clear theoretical foundation exist for the actual implementation, the individual instances that call for exclusion seem to be understandable.

A related issue is deducting the effects of indirect tax changes. The serious problem we encounter here is whether an indirect tax change is a temporary shift in the price level or in inflation? As Wynne [1999] points out there is no *a priori* reason to believe that inflation remains unaffected by an indirect tax change, at least for some time, and the empirical identification of the size of an indirect tax change is anything but easy.

It must be noticed that limited influence estimators can also result in filtering out temporary shocks. The difference between the exclusion methods and limited influence estimators lies in the nature of how zero weights are applied to certain prices. In terms of the limited influence estimators, zero weights are changing over time and are procedurally defined, whereas in the case of the (pure) exclusion methods exclusion is made once and for all, and is based on extraneous information.

3.2 Implementation of the core inflation concept in Hungary

It can be argued that excluding known temporary shocks is reasonable provided we want to obtain a smooth inflation index that is a good predictor of future inflation and is, at the same time, close to the (*ex post* defined) trend. The Hungarian approach is indeed an exclusion approach. Since July 1998 the NBH has regularly published a core inflation index which excludes from the consumer price index the effects of price changes in seasonal foodstuffs (eggs, potatoes, vegetables, fruit), solid and liquid fuel (coal, briquette, coking coal, firewood, heating fuel) and gasoline. The core inflation index calculated in this way covers 91% of the original consumer price index. The prices excluded are rather variable and the resulting core index is less variable than the total CPI. On the other hand, the respective relative prices do not have clear trends, thus, in the long term, the average core is close to the average CPI. (See Section 5 below.) With regard to good communicability these features are very important. At first the variability of the index may lead to confusion and the possibility of diverging expectations, which would result in difficulties with coordination. On the other hand, the NBH's rule of not cutting the rate of devaluation if there is a tendency towards "excessive" real exchange rate appreciation calls for an index which closely follows the level of the CPI, which is a sort of cost of living index. (Cost of living considerations are crucial for setting wages, while nominal wages too high relative to the exchange rate can deteriorate the exporting sectors' profitability.) It can be seen from Table 2 in Wynne [1999] that this approach satisfies some important criteria, like being computable in real time, understandability, and not changing frequently. It is perhaps curious that recently the Hungarian Central Statistical Office (CSO) started to publish its core inflation index based on similar principles, but excluding some 20 per cent of the CPI. This may not follow the precept of being close to the CPI, which can be explained by the fact that the CSO does not possess policy motives. See, however, our results in Section 5.

3.2.1 A case study: drug prices

The NBH deviated from the calculation of the core inflation after about one year. The break with the implicit rules was prompted by a specific event, but the case is interesting and we can learn some lessons from it. It was a governmental decision to cut subsidies for a number of patented drugs in the summer of 1999. It was also well known that cheap generic substitutes existed for each

of these medicaments, thus economic rationality predicted that the resulting price increase would call for a very sharp substitution effect, and the drugs with higher consumer prices would lose market share significantly. The CSO as an agency whose operations are directed by formal rules refused to accept this logic and, having no factual grounds for changing the weights attached to these drugs, used its old procedure to calculate its price index. This resulted in a substantial increase in the rate of inflation. On the other hand the NBH changed its practice and redefined the core index, by excluding now drugs as well, but without making a full backward adjustment[1]. As a result the difference between the monthly CPI and the NBH core was about one per cent on a monthly basis.

The NBH's solution does not appeal to our esthetic sense. On the other hand, the drug price increase did not just qualify to being a temporary shock to the price level. In terms of the above economic reasoning, what happened in fact was a very gross case of erroneous measurement, which is a general property of the Laspeyres index. Was the NBH wrong to make the *ad hoc* adjustment? We think transparency did not suffer since the procedure was open and clearly explained and probably well understood. One may object that footnotes might also have done the trick. However, it is known that readers frequently fail to notice footnotes.

It could be argued that had the NBH introduced a limited influence estimator the problem would not have emerged at all. As similar cases can very well appear in the future, the introduction of a well-chosen limited influence estimator may be advisable. One traditional objection against this is the supposed difficulty with its understandability by the public (see Wynne [1999] Table II). However, it is doubtful whether the general public would care too much, whereas professional analysts must be intelligent and educated enough to absorb such a novelty. (See our related results reported in Section 5.)

4 Relative price issues[2]

Defining a core inflation concept seems to be related to relative price changes. What are the sources of the most important relative price changes that may bear relevance on the core inflation problem?

1. Seasonality.
2. Other cyclical behavior at lower frequencies.
3. Indirect tax changes.
4. Government policies with respect to regulated prices.
5. Certain prices changing less frequently than others.
6. Supply shocks.
7. Relative demand shocks.

[1] Conversely, as we were not bound by previous publications, we made the full backward adjustment in our calculations. Thus, before mid-99 our data slightly deviate from the core time series published by the NBH.

[2] This section heavily draws on Vincze [1999].

8. Trends in relative prices due, for instance, to productivity growth differentials.

In the following we will present a decomposition of the Hungarian CPI. We will not discuss each of the above problems, but many of these will recur during the investigation in different guises.

4.1 The role of nominal exchange rates

On Chart 1 the percentage change in the nominal effective exchange rate of the Forint is compared with CPI inflation. This figure shows apparently little coherence before 1995, and an increased coherence after 1995. Still the similarity after 1995 seems to be rather qualitative. The only year when the rate of change in the exchange rate and in consumer prices paralleled each other rather closely was 1995. Since 1996 both indices have declined, but the drop in the rate of depreciation was generally several percentage points higher than that in inflation.

4.1.1 The case for tradables: the exchange rate as an anchor

Are we able to identify "tradable" prices? Obviously if two goods have identical physical attributes, but are consumed at different locations, their prices might not be necessarily the same. So for purists the concept of tradables is a chimera. One can be more pragmatic, however, and can ask whether the main implication of tradability (the Law of One Price) is a satisfactory approximation. Usually we must avail ourselves with something even more modest, and we have to look for the fulfillment of the "Law of One Price Change", i.e. approximately identical rate of change, expressed, of course, in the same currency. We would have our best chance of finding tradable prices that satisfy this definition if we were looking for intermediate goods. Goods and services whose prices make up the CPI usually have some non-tradable content (local services etc.), thus are not perfect candidates. Unfortunately, data problems cause us to confine our attention to the CPI basket, where we may ask whether it is possible to find some part of it that can, for practical purposes, be identified with a tradable price index.

Our approach of identification was the following. From standard microeconomics we can suppose that the marginal cost of products and services is some function of input prices as well as of the amount supplied. If markups are stationary then an approximately tradable good can be defined as one whose price depends only on foreign inflation and on the nominal exchange rate in the long run. Neither domestic demand in a small economy, nor other costs, like nominal wages, should have an impact on an ideal tradable price asymptotically. This reasoning suggested the specification of autoregressive distributed lag models for each price index that make up the Hungarian CPI, where regressors included the nominal exchange rate, nominal wages and seasonal dummies. The estimates of long run parameters are consistent in a wide range of circumstances (see Pesaran-Sin-Smith [1997]). If we disregard foreign inflation, which can be

taken as approximately zero in view of the very low inflation in the EU, an (informal) pre-test of tradability is as follows: a good is hypothetically tradable if the nominal exchange rate alone is significant in its equation, and the long-run parameter of the exchange rate is not far from 1. (Because of the noisiness of individual series we could not really strive to have a more formal test.)

Based on this probe less than half the prices pass the hurdle. A very important observation is that all the goods classified as durable belong to this category! Taking their aggregate index as the subject of the test one gets the same result with a long-run coefficient of 1.02. Next, one can test whether this aggregate is cointegrated with nominal exchange rates at different sample periods. Provided the answer is positive this subcomponent of the CPI can be regarded as a good approximation of a tradable price index.

Augmented Dickey-Fuller and Phillips-Perron tests were carried out for the difference of the log tradable price index and the log nominal exchange rate for three subperiods. It turned out that the period between the March stabilization in 1995 and the Russian crisis in 1998 is where the null of no cointegration can be rejected most confidently. Including the Russian crisis would lead to a weaker result, and for the whole period no cointegration cannot be rejected at traditional significance levels.

Thus we adopted the durable subcomponent of the CPI, representing about 10-15 % of the total, as a proxy for the price index of tradables. One can see from Chart 2 that the relative prices of durables have followed a clear negative trend, and from Chart 3-7 that individual prices within this class have had the same property, making this subgroup exhibit a very high degree of internal similarity.

4.2 Relative consumer prices

At the beginning of transition there was a widespread feeling that transition would require very large changes in relative prices. The reason for this was obvious. Under the socialist regime the price system had not accomplished its function of equilibrating supply and demand, as social or other considerations militated for keeping certain prices low and others unreasonably high. (The latter was largely helped by the existence of trade barriers.) Needless to say, price distortions might exist in any economy, not only in centrally planned ones. However, the common perception was that here the problem had been more marked, and the warranted changes larger. Certainly some of the required relative price adjustment occurred rather early in transition, usually following immediately upon price and trade liberalization. However, it has been observed that relative price adjustment has proved to be a rather prolonged process that has not come to an end in most countries. (See Koen-De Masi [1997].)

Having identified a price subaggregate that can be reasonably well explained by exchange rate movements we proceeded to investigate relative price changes. It appeared that further disaggregation was necessary. Both on *a priori* and statistical grounds one can distinguish between seven other subaggregates.

1. Non-energy administered (regulated) prices, characterized by infrequent

changes. Chart 2 shows that relative administered prices have exhibited a positive trend, and have grown substantially. They show a zigzag picture, undergoing short periods of large hikes, and more protracted periods of almost no change. This is true for most individual prices, though some of the individual relative prices have remained virtually unchanged on average (Chart 3-1).

2. Energy prices. Energy prices have partly been regulated, and also exposed to world price developments, i.e. supply shocks from our point of view. The relative energy price was declining at a mild pace until 1995, when it rose steeply, followed by the continuation of an upward trend (Chart 2). This shape was due to deliberate policies, which had checked energy price increases before 1995 for social reasons, but the correction of the relative energy price was part of the fiscal adjustment package. From Chart 3-2 one can observe that individual prices within this subgroup show high variation.

Several utility and basic commodity prices are still regulated to some extent. In some periods governments were suspected of using price regulation to fight inflationary pressures by freezing certain prices belonging to their dominion. Indeed, this behavior was not unique to transition countries; many other developing countries saw something similar during stabilization attempts. These price freezes are usually discredited as myopic in the sense that they postpone rather than resolve the inflation problem. Again this claim must have a lot of relevance for particular cases. However, it would be a mistake to regard it as universal truth and deplore every government intervention in monopolistic price setting as unwise and short-termist. It is obvious that if price regulation is binding, monopolists could increase profits by setting their relative prices higher. Thus there is an inherent tendency, especially for private regulated monopolies, but also for state monopolies, provided that managers have preferences for higher profits, to elbow for price increases. Whether current relative prices are below or above competitive (marginal cost) prices must be largely private information, thus lobbying for higher prices is not inconceivable. By the same token, in an inflationary environment, where nominal prices should be changed from time to time and this repricing should be based on expectations on price formation elsewhere in the economy, regulated monopolists are prone to prefer mistakes on the upper side, that is, achieving higher ex post relative prices than expected. This is in sharp contrast with rational behavior in industries where competitive pressure is higher, since in those industries overpricing is as harmful as underpricing. The conclusion from the above reasoning is that regulated monopolists tend to constantly push towards relative price increases, but whether this is justified on efficiency grounds cannot be decided *a priori*, and the outcome may also depend on the extent of regulatory capture. The fundamental point here is that under imperfect competition *cum* regulation there is a range of indeterminacy for relative prices. This is why questions like the one raised by Blanchard [1998] seem not to be easy to tackle. Blanchard asks whether governments must decide to bring relative administered prices to their correct level before or after disinflation. This, however, might only be possible to decide if we accept that a unique correct level exists. This also means that governments cannot have a hands-off stance on this issue, and should take responsibility for

price setting in this area. This should involve a clearly defined strategy, rather than some quantitative assessment of what the correct prices should be.

3. Excisable goods. Excisable good relative prices do not show a zigzag pattern, but certain big changes have occurred in them. On the whole they exhibited a slightly negative relative price trend, which was notably reversed for some time in 1995. (Chart 3-6.)

4. Processed food prices. These have been pretty stable in relative terms (Chart 2), and they constitute an internally coherent subgroup (Chart 3-4).

5. Non-processed food prices. These seem to be relatively stable in the long term, but have had cycles, exhibiting not just very large short-term fluctuations, but fluctuations that have apparently been persistent (Chart 2). The subgroup is not at all homogenous (Chart 3-5), showing that here local market effects clearly dominate.

Non-processed food prices provide an additional input to uncertainty in inflation. Besides the natural reasons for the existence of potentially large supply shocks, changing and unpredictable agricultural policies have played an important role. Initial relative price distortions existed but since agricultural price structures in western countries are also distorted it is difficult to see what the long-term behavior will be. This uncertainty is especially important for transition countries since CPI baskets sometimes contain as large a share of food prices as 40 %; thus large fluctuations in food prices may be uninformative about underlying trends.

Foodstuffs are certainly tradable and traded, despite significant barriers. Still trade barriers have caused substantial differences between the level of food prices in Hungary, and, say, those in Western Europe. EU accession can accelerate the disappearance of the gap, and even its expectation can have an effect on price making in the interim period. Recent research has shown that the level of agricultural protection in transition countries varies (Banse [1999]), Hungary's being much lower than that of Poland or Slovenia, and even lower than that of the Czech Republic, which also has a lower level of protectionism than the EU average. It is not just current regulation but also the expectations of EU and accession country policies towards agriculture that shape agricultural decisions and, in consequence, prices. It would be difficult to argue that food prices in the world are set by unfettered markets, therefore one cannot even assume that relative price structures today prevailing in the EU will be what transition country relative prices will converge towards. The uncertainty regarding the future is clearly very high.

Thus, here again, we meet prices that are probably increasing in the medium term, but their path is heavily influenced not just by the weather, the *par excellence* uncertainty factor in agriculture, but also by government policies. With obvious modifications the previous conclusion applies here as well: under the present circumstances the construction of a government strategy towards agricultural prices is a must, if the reduction in uncertainty of future (general) price developments is desirable.

6. Services. These are almost the mirror image of durables, exhibiting a slight, but consistently positive, upward trend (Chart 3) and strong internal

similarity (Chart 3-3).

It is remarkable that these prices seem to have a rather smooth upward relative trend. This phenomenon is not really particular to transition economies, it can be observed in several industrial countries, or probably everywhere. The most popular explanation (the Balassa-Samuelson hypothesis) relies on differential technological growth and wage equalization. (See Kovács-Simon [1998] for some support for differential productivity growth in Hungary.) Changes in relative demand might also play a role. We must notice also that the smooth upward trend is definitely less steep than that of administered prices, and is much less noisy than that of either administered or food prices. Though the evolution of relative non-tradable prices is rather smooth and steady, in no way can we infer that present trends would continue *ad infinitum*. Nevertheless, we can expect only gradual changes in them.

7. Other tradables. This is in essence a "rest of prices" category. Their average relative price has had a slight negative trend (Chart 2), with the individual relative prices possessing smooth trends, both negative and positive (chart 3-8).

4.3 The cross-sectional variability of prices

Traditionally economists considered the variability of prices as one of the main costs of inflation. (See Driffill-Mizon-Ulph [1990]). The concept of variability can be understood either as the conditional variance of aggregate inflation, or as the (cross-sectional) variability of relative prices. There is a general expectation among economists to find positive correlation between relative price variability and the level of aggregate inflation, and there exists important literature (see, for instance, Cukierman [1982]) that formulated hypotheses with respect to the positive correlation between relative price variability and the variance of aggregate inflation.

Relative price change distributions are usually found to be non-normal, and this was true for our sample, too. Recently the models in Ball-Mankiw ([1994], [1995]) drew substantial attention among those who examined this problem in the context of transition economies. Assuming downward rigidity in prices, relative price changes must necessarily mean a rise in the average price level. From a theoretical point of view, it is doubtful whether specifically downward rigidity in prices exists. Why price reductions may not be very frequent phenomena can be explained provided that trend inflation is significantly positive, and changing prices is costly. In that case, keeping prices constant is equivalent to decreasing relative prices without incurring the costs of price changes. Thus, positive (large) inflation induces observed downward rigidity, which might not be present if price stability (zero inflation) would be the rule.

The same model can be used for arguing that higher relative variability of prices might give incentives to price makers, in circumstances of costly price changes, to price comparatively high, in effect to temporarily increase inflation when relative price uncertainty is high. This idea has found its way into empirical research on transition inflation, with Coorey-Mecagni-Offerdal [1998], Pujol-Griffiths [1998], Wozniak [1998] reporting evidence in support of this hy-

pothesis on different samples. One shortcoming of this literature seems to be its failure to draw a clear distinction between relative price variability implied by higher relative price uncertainty and that implied by permanent changes in relative prices. The latter obviously imparts some variability to cross-sectional relative inflation rates, even if that variation is perfectly foreseen.

Though separating uncertainty and predictability is not easy, some considerations may suggest that in transition countries in general, and in Hungary in particular, a large portion of relative inflation variability has been due to permanent relative price changes, thus it should not be identified with relative price uncertainty. In a similar vein high positive skewness of cross-sectional inflation rates, which has been found to positively correlate with inflation in the short term, may not be attributable to the positive skewness of underlying relative price shocks, as demanded by the Ball-Mankiw model, but can be completely foreseen. For instance, if it is well known in advance that some government influenced prices will be changed at some prespecified date, then cross sectional skewness may be highly positive, but this has nothing to do with the skewness of unexpected relative price shocks.

Chart 4 shows the monthly pattern of basic statistics for the cross-sectional distribution of individual price changes. There is large variation, significant non-normality and little pattern. However, by applying a symmetric 5 % trim one could get a clear pattern (see Chart 5). (See the precise definition of trimming in the following section.) There does not seem to exist any great difference among months with respect to skewness and kurtosis, whereas there is a well visible positive correlation between the mean and variance. It seems that most of the non-normality can be got rid of by trimming 10 %, whereas the close association between the mean and variance suggests a non-linear stochastic seasonal pattern in price making.

5 Computing and comparing core inflation indices

In this section we examine some proposed core inflation indices. These include the NBH's official core index, the CSO's core index, a narrow core that is obtained by excluding all "volatile" subgroups resulting in about 50 % exclusion, an optimal 18 % symmetric trimmed mean (see below), a 5 % symmetric trimmed mean, and a 5 %-15 % asymmetric trimmed mean (see the definition below).

The NBH and CSO core inflation indices were given naturally. Our narrow core was obtained by keeping the tradable, services, processed food and other non-durable subcategories. To arrive at the optimal trimmed mean estimator we defined the long-run trend in consumer prices by taking a 24-month moving average. (We did not want to choose a 36-month average and losing too many data points thereby.) The trend so defined proved to be free of seasonality, but had two large outliers in 1994:1 and 1994:3, as the two-year window was unable to smooth out the large price hikes in 1995:1 and 1995:3. Some basic statistics for the trend and the original CPI appear in Table 2. See also Chart 6.

Table 2 Basic statistics

	mean	median	standard deviation	skewness	kurtosis
CPI	1.47	1.4	0.66	1.58	8.04
Trend CPI	1.52	1.58	0.33	-0.46	2.21
NBH core	1.43	1.4	0.62	1.48	8.36
CSO core	1.45	1.4	0.55	1.61	9.1
Narrow core	1.36	1.3	0.57	1.64	9.92
Optimal trim	1.09	1.	0.47	2.08	12.91
5 % trim	1.27	1.2	0.53	1.68	10.24
Asymmetric trim	1.45	1.4	0.57	1.65	10.31

(The underlying data are monthly, seasonally adjusted (except for the trend), and given in percentage points.)

Trimmed means are calculated in the following way.

$$\Pi_{l,u}^t = \frac{\sum\limits_{i \in \tau_t} \pi_i^t w_i^t}{\sum\limits_{i \in \tau_t} w_i^t}$$

where $\Pi_{l,u}^t$ is the $l\%-u\%$ (asymmetric) trimmed mean of individual inflation rates. Here $\tau_t, \tau_t^u, \tau_t^l$ is a partition of the 160 base series' parameters such that

$$\forall \;\; i \in \tau_t^l, \quad j \in \tau_t, \quad k \in \tau_t^u : \quad \pi_i^t < \pi_j^t < \pi_k^t$$

$$\left| l - \sum_{i \in \tau_t^l} w_i^t \right| = \min_{\tau_t^l}$$

$$\left| u - \sum_{i \in \tau_t^u} w_i^t \right| = \min_{\tau_t^u}$$

and l and u are the trimming bands' width, π_i^t is the i-th CPI-representative's monthly price change, w_i^t is the corresponding weight in the CPI , τ_t^u and τ_t^l corresponds to the series dropped out by the trimming process and τ_t consists of the (indices of the) series left in.

In order to find an optimal trim, we calculated root mean squared error statistics for the deviation between the trend and a number of trimmed means. We included also asymmetric trims, with bandwidths between 0 and 20 %.

$$RMSE = \sqrt{\sum_t (\Pi_{l,u}^t - \overline{\Pi_t})^2}$$

where $\Pi^t_{l,u}$ is a trimmed mean with parameters l and u, and $\overline{\Pi_t}$ is the trend.

We selected as the "best" mean squared error estimate the $18\% - 18\%$ symmetric trim, though the $18\% - 17\%$ asymmetric trim gave a somewhat better result. We added to the list the 5% symmetric trim that proved to have a "smoothing" effect on the cross-sectional distribution (see above), and had approximately the same exclusion level as the NBH core. The $15\% - 5\%$ trim was included on an ad hoc basis, in order to have a trimmed mean that deviates less than the others from the actual CPI on average. Chart 5 shows the different core measures relative to the CPI.

All of the proposed core measures proved to be seasonal, and even after seasonal adjustment (with the X11 method) had a large outlier at 1993:1. To assess their quality we carried out three exercises: 1.Testing for cointegration with an Augmented Dickey-Fuller (ADF) test, between the seasonally adjusted core measure and seasonally adjusted CPI. 2. Computing RMSE with respect to the trend as defined above. 3. Running a dynamic regression with the contemporary value and four lags of the monthly core index as regressors, and future 1-year CPI inflation as regressand.

With exercise 1 we intend to capture whether the core has a tendency to be aligned with the CPI, i.e. with the cost of living index, exercise 2 enables us to compare the ability of core measures to track the trend in inflation, whereas exercise 3 helps us see whether the core indices are able to provide information on future inflation at the 1-year horizon.

Table 3 contains the results of exercises 1 through 3.

Table 3 Performance of core measures

	ADF statistics	RMSE	R^2 in the respective regression
NBH core	0.13	0.87	0.18
CSO core	-1.33	0.88	0.21
Narrow core	0.41	0.7	0.24
Optimal trim	-1.86	0.76	0.13
5 % trim	-1.49	0.83	0.16
Asymmetric trim	-1.7	0.88	0.17

The following conclusions can be derived from Tables 2 and 3. The NBH core and the CSO core are very similar by the statistics, indeed the CSO core fares a little bit better. However, as the drug price example demonstrates, the use of interim extraneous (qualitative) information, such as the "manual" adjustment applied to the NBH core, is a more reasonable procedure than sticking to a predetermined rule at every cost. The narrow core measure does a better job than the others at forecasting inflation, but none of the core measures seem to be very good at it. Also the narrow core produces a measure closest to the trend inflation in the RMSE sense. Though the optimal trim is good at tracking trend inflation (almost by definition) it performs rather poorly in most other respects, with the exception of having a low variance. The asymmetric trim gets the average core inflation closer to the average CPI inflation, but is almost indistinguishable in its other features from the exclusion-type core

indices. It is very likely that the NBH and CSO cores are not far from this sort of asymmetric trimmed mean. More exclusion tends to underestimate the average inflation with respect to actual, suggesting that many temporary hikes in individual inflation rates are permanent price level increases. If we insist on having a core measure that cannot deviate too much from the cost of living index in the long run, then the selected core index must take into account this requirement. The ADF tests suggest that the ratios of core measures to the CPI do not seem to be stationary, a result that might be driven by small sample bias in some cases (NBH core, CSO core, asymmetric trim), but not for the rest (see Chart 5.)

6 An evaluation

It seems prudent for the NBH to report and analyze several price indices, especially if noise and long-run relative price trends remain present in the data. There is no overwhelming reason to give up the "ex food and energy" approach even if we know that it is almost necessary that further definition changes will happen. However, experimenting with trimmed means must continue, though presently it does not seem to be the case that a trimmed mean measure can substitute for the official core index. Still, as an alternative, a well-chosen trim can be published, if the choice can be clearly explained. Nevertheless, a purely statistical approach, based on an unchangeable algorithm, does not seem to be feasible for the time being.

A substantial amount of noise and apparent seasonality have come about because of government decisions. Governments must be aware of their responsibility for price setting, whenever it exists, indeed in our case, an orderly devolution of this responsibility would be preferable to sweeping the problem under the carpet.

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8 Appendix

8.1 A proposal for defining an inflation measure relevant to central bankers

Core-like indices are formed because they can express in a concise way some feature of price developments that is important for the central bank. Now if importance is defined somehow, weights attached to individual prices must be assigned according to their relative importance. Many central banks believe that real interest rates have an important effect on inflation via their impact on

the output gap. Is it necessarily true that expenditure share weights correctly express the relative importance of any consumption good from this perspective?

One can ask the following pair of questions: If it is known for sure that the price of water will increase from January 1, will anyone consider substituting intertemporally today's bathing for tomorrow's, by increasing the water consumption during the month of December? On the other hand, would the known fact of a January 1 increase in the tax on tobacco not call for many to accumulate cigarette reserves in December? As these simple examples make it clear, the degree of intertemporal substitutability must be wildly varying within the CPI. Therefore the intertemporal substitution effects of interest rates must be variable across goods also. This problem may not be relevant for many cases, it is however very relevant for a country like Hungary, where there have existed pronounced relative price trends, and these trends characterize certain goods or services whose intertemporal substitutability must be obviously special. Of course we talk of public services, like water supply whose prices, as was shown, increased at a particularly high rate. The question is: can we define a price index that applies weights according to the ease of intertemporal substitution?

Macromodels usually work with a single good, and if more than one are considered, they are normally assumed to be combined by a homothetic utility function, which entails an exact dual price aggregate index. Such an approach cannot distinguish between different degrees of intertemporal substitutability. A simple deviation from the traditional models can be provided if we assume that the per-period utility function is the addilog function introduced by Houthakker.

$$U(c) = \sum_i \frac{c_i^{1-\sigma i}}{1-\sigma_i} \tag{1}$$

where c is an N-vector, with generic element c_i. Assuming the usual additive utility functional for measuring infinite utility streams with a time preference parameter β, the linearized Euler equation (neglecting second order stochastic terms) can be written as follows.

$$E_t(c_{i,t+1}) - c_{i,t} = \frac{1}{\sigma_i}(i_t + \log(\beta) - (E_t(p_{i,t+1}) - p_{i,t}) \tag{2}$$

Lower case letters denote logarithms for consumption and price of the ith good (c_i, p_i), and i_t is the log of the gross interest factor. Here σ_i is the good specific utility function parameter. Now suppose that for each good there exists a constant relative weight that captures its effect on the output gap (say via some labor requirement), and the aggregate effect can be written as

$$\sum g_i(E_t(c_{i,t+1}) - c_{i,t}) = \sum_i \frac{g_i}{\sigma_i}(i_t + \log(\beta)) - \sum_i \frac{g_i}{\sigma_i}(E_t(p_{i,t+1}) - p_{i,t}) \tag{3}$$

Then the second term on the right-hand side is an inflation index which measures the effect of expected inflation on the output gap, with the true weights

$\frac{g_i}{\sigma_i}$. We need the additional assumption that in the very short term (from one month to the next) expected inflation does not differ substantially from realized inflation. Also we can assume that there exist a large number of goods, and the weights g_i and σ_i are drawn from independent distributions. Then using $\frac{1}{\sigma_i}$ would be a reasonable weighting scheme for an inflation index that would try to capture inflation relevant for the output gap, from a consumption point of view.[3]

Of course it is still open how to measure the $\frac{1}{\sigma_i}$ weights. A calculation can be based on two - possibly far away - years' data in the following manner.

Let us set base year individual prices and total expenditure to unity. Then base year weights (w_{0i}) give the base year consumption of each good. The other year's consumption must satisfy:

$$C_{1i} = \frac{w_{1i}E}{P_{1i}} \tag{4}$$

where E is total expenditure, and upper case letters denote levels. From (2) we get a solution after neglecting expectations and dropping the $i_t + \log(\beta)$ term.

$$\frac{1}{\sigma_i} = \frac{\log w_{1i} - \log w_{0i} - p_{1i} + g}{-p_{1i}} \tag{5}$$

The true g would give the parameters, but we are interested in relative weights, thus we can calculate a pseudo-g from the requirement that $\sum_i \frac{1}{\sigma_i} = 1$. We get for g the following formula.

$$g = \frac{N - 1 - \sum_i \frac{\log w_{1i} - \log w_{0i}}{p_{1i}}}{\sum_i \frac{1}{p_{1i}}}$$

[3] It can be proved that $\frac{\sigma_i}{\sigma_j} = \frac{\epsilon_I(c_j)}{\epsilon_I(c_i)}$, where $\epsilon_I(c_i)$ is the income elasticity of the Marshallian demand function for good i.

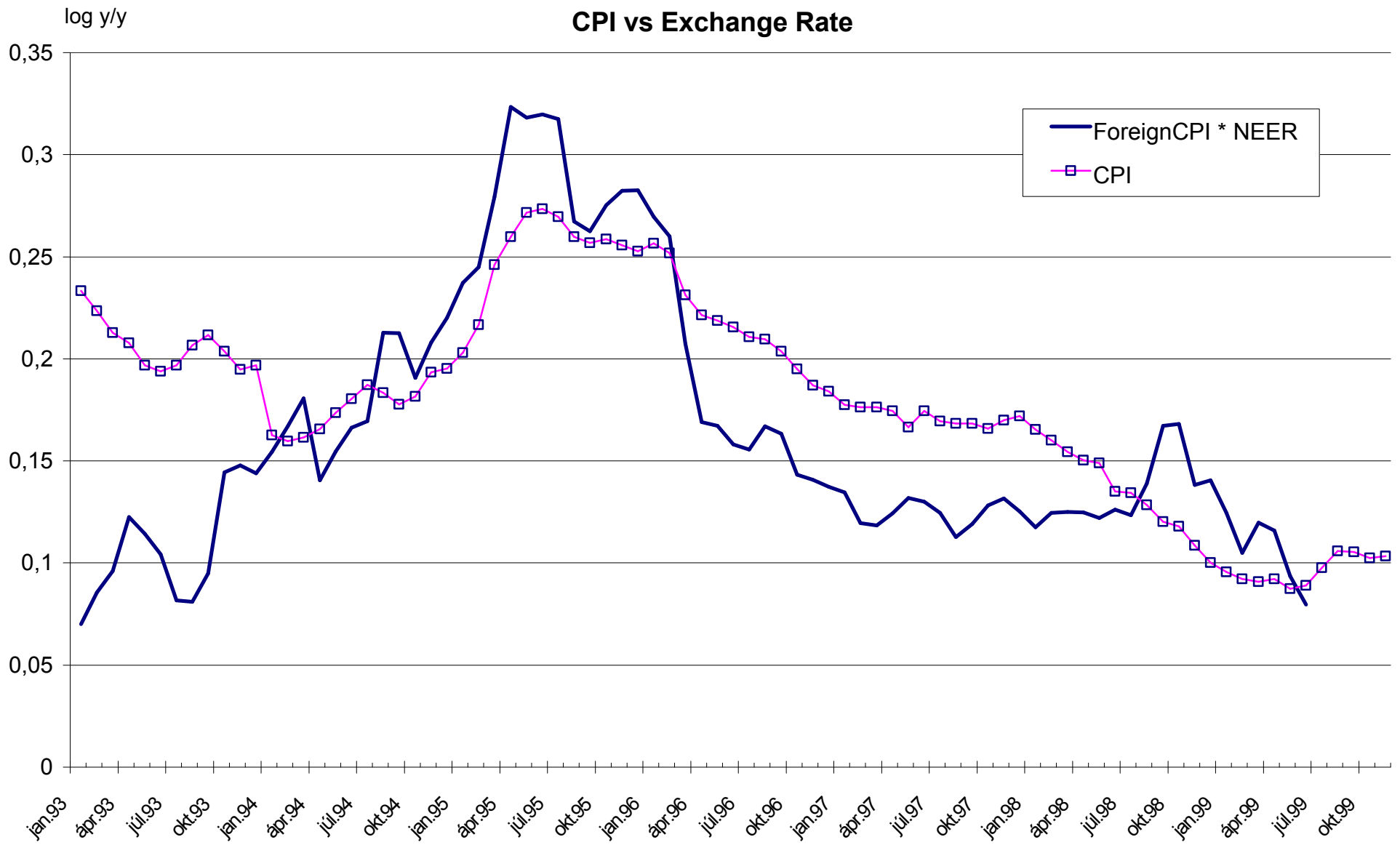

log y/y
CPI vs Exchange Rate
0,35
0,3
0,25
0,2
0,15
0,1
0,05
0
ForeignCPI * NEER
CPI
jan.93
ápr.93
júl.93
okt.93
jan.94
ápr.94
júl.94
okt.94
jan.95
ápr.95
júl.95
okt.95
jan.96
ápr.96
júl.96
okt.96
jan.97
ápr.97
júl.97
okt.97
jan.98
ápr.98
júl.98
okt.98
jan.99
ápr.99
júl.99
okt.99

Chart 1

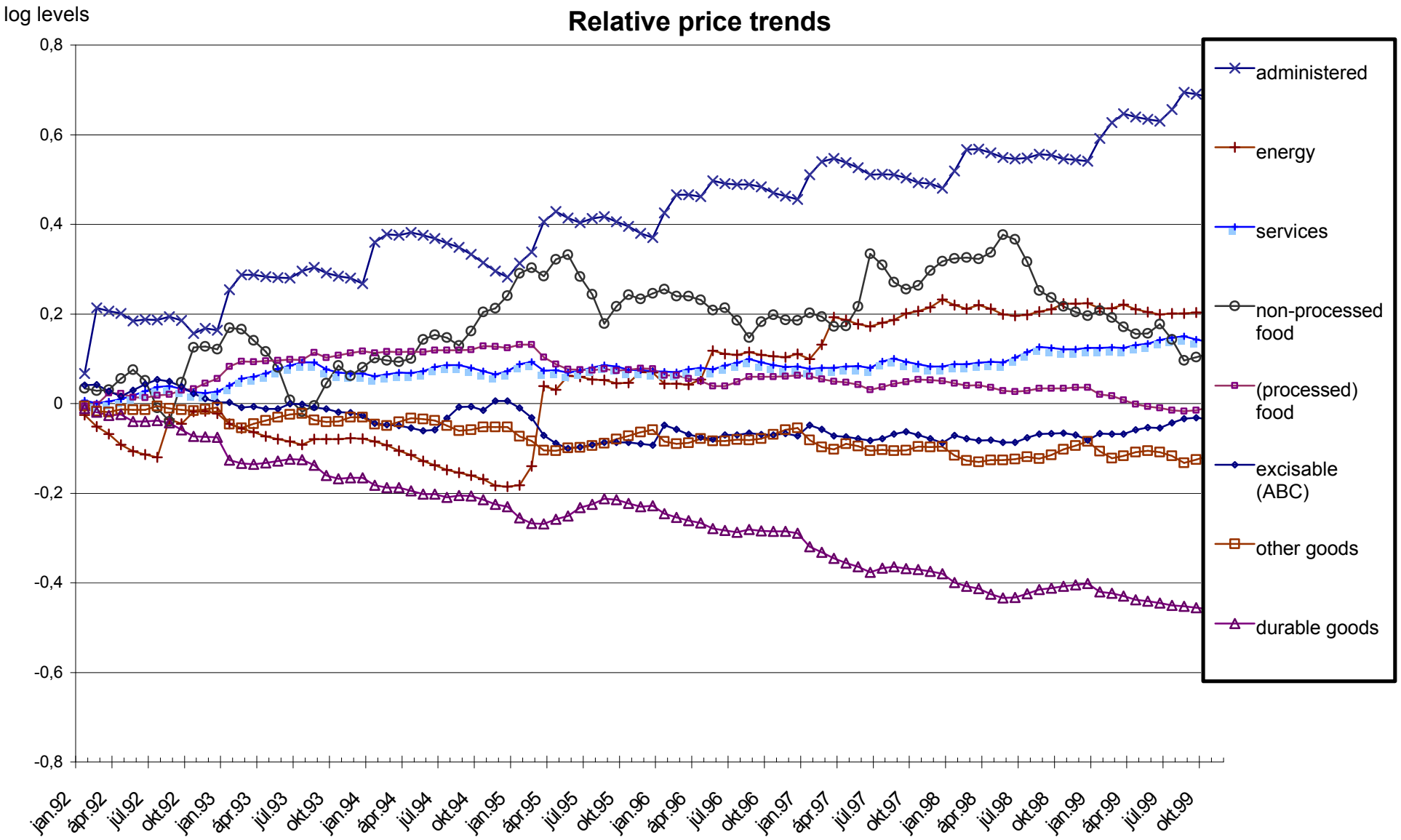

log levels
Relative price trends
0,8
0,6
0,4
0,2
0
-0,2
-0,4
-0,6
-0,8
jan.92
ápr.92
júl.92
okt.92
jan.93
ápr.93
júl.93
okt.93
jan.94
ápr.94
júl.94
okt.94
jan.95
ápr.95
júl.95
okt.95
jan.96
ápr.96
júl.96
okt.96
jan.97
ápr.97
júl.97
okt.97
jan.98
ápr.98
júl.98
okt.98
jan.99
ápr.99
júl.99
okt.99
administered
energy
services
non-processed food
(processed) food
excisable (ABC)
other goods
durable goods

Chart 2

CPI subindices relative to the CPI

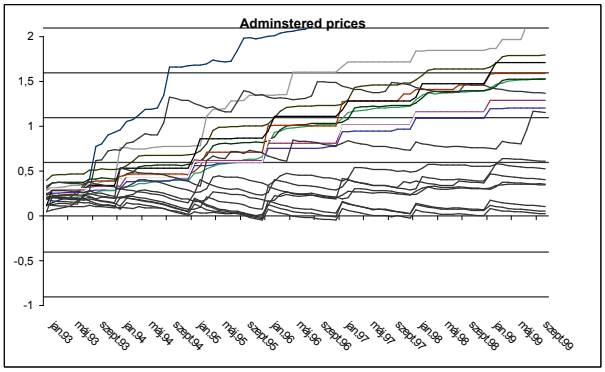


Chart 3-1

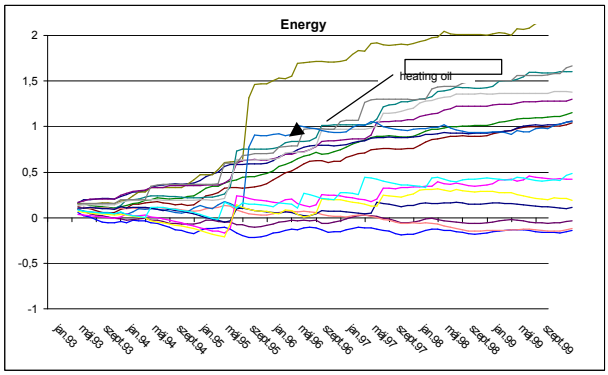


Chart 3-2

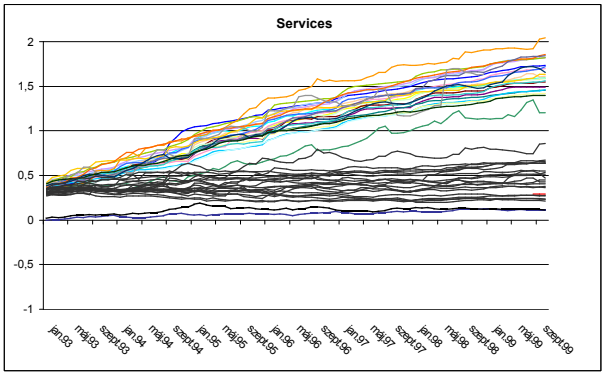


Chart 3-3

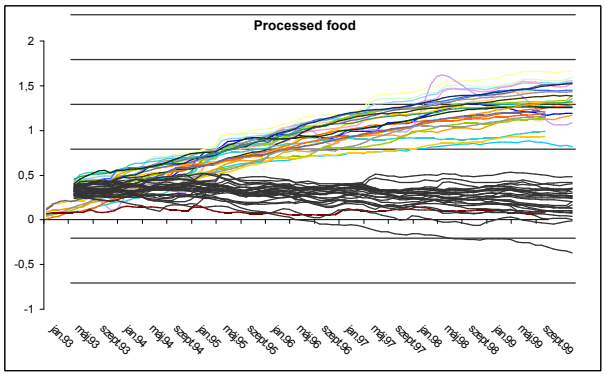


Chart 3-4

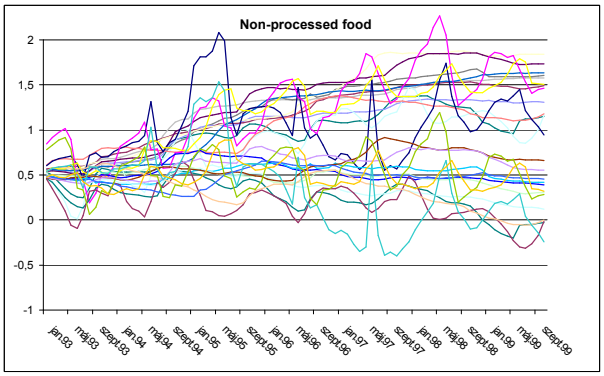
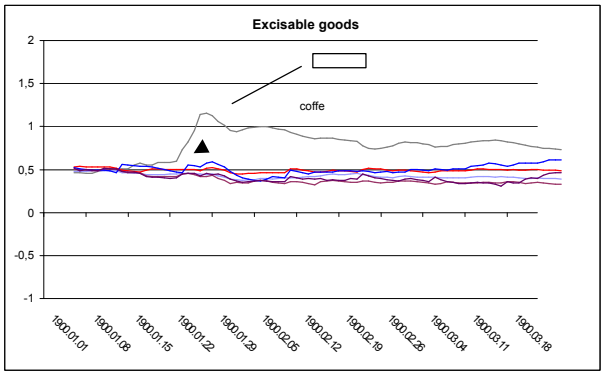
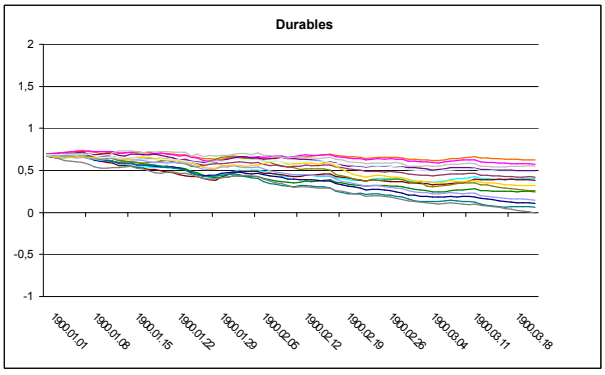


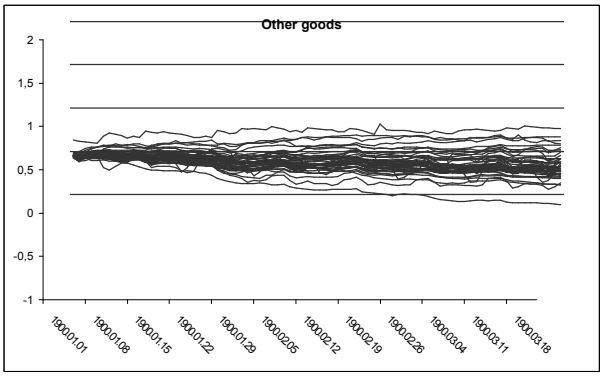
Chart 3-5



Cahrt 3-6



Cahrt 3-7



Cahrt 3-8

Chart 3

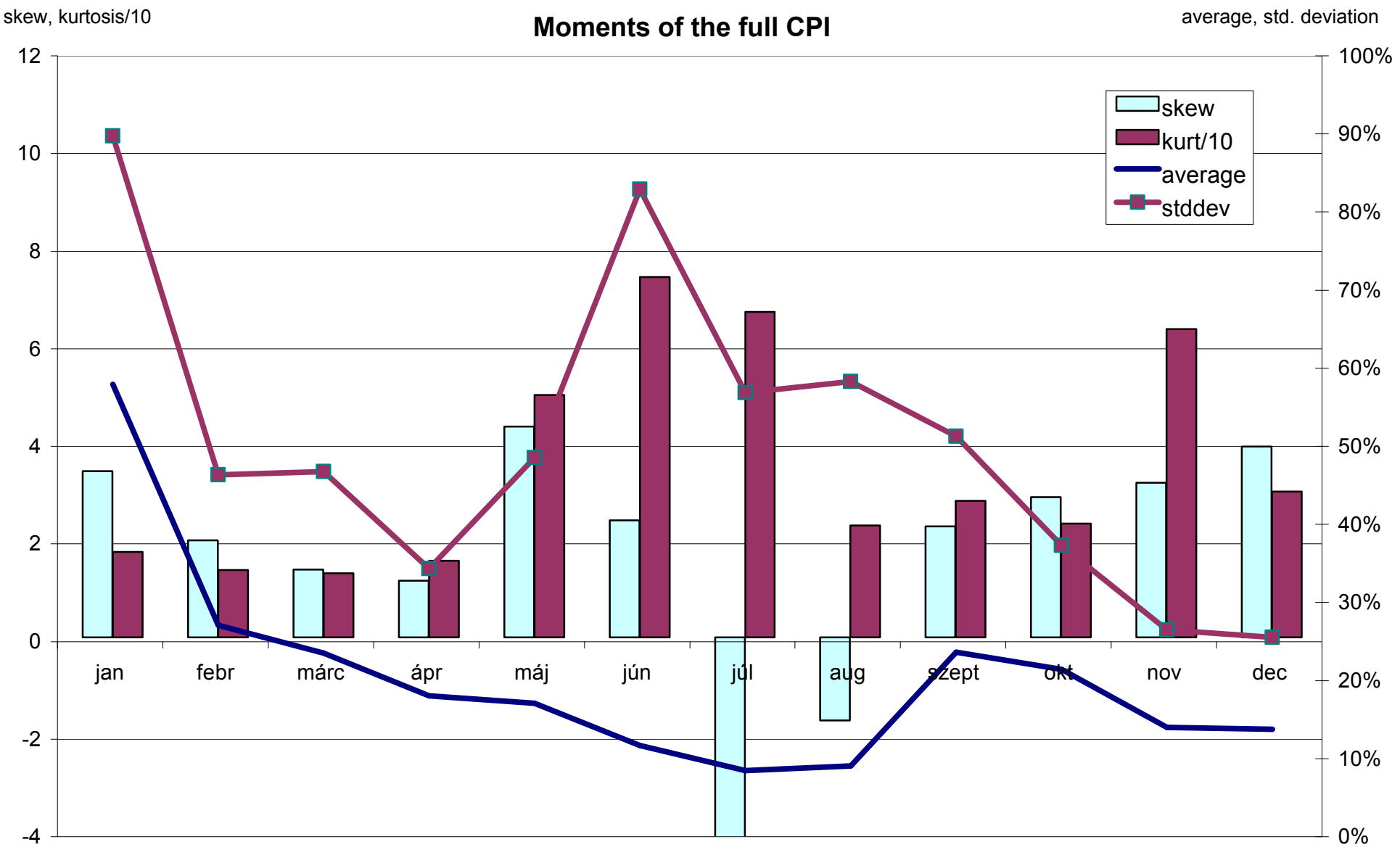

skew, kurtosis/10
Moments of the full CPI
average, std. deviation
12
10
8
6
4
2
0
-2
-4
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
skew
kurt/10
average
stddev
jan
febr
márc
ápr
máj
jún
júl
aug
szept
okt
nov
dec

Chart 4

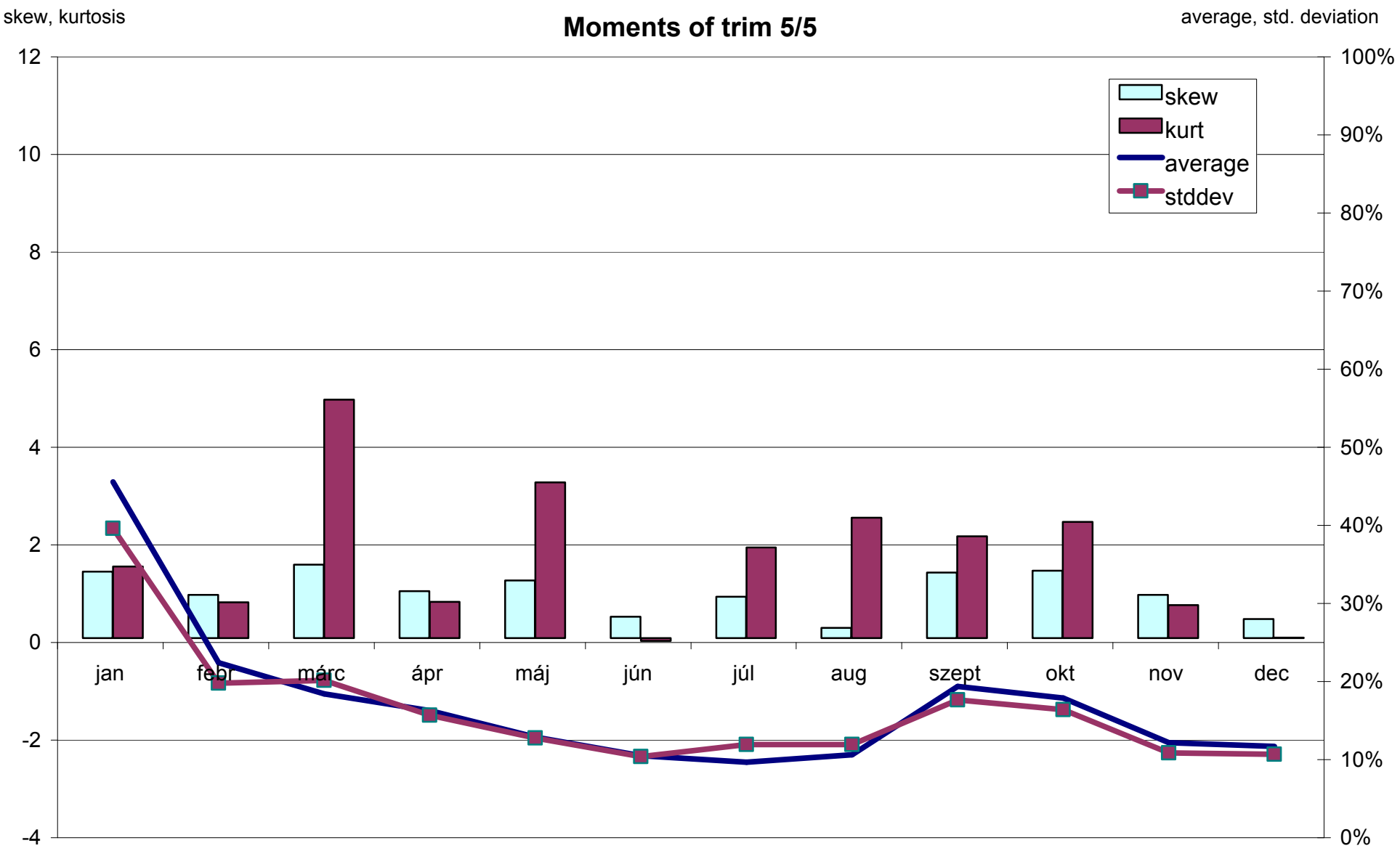

skew, kurtosis
Moments of trim 5/5
average, std. deviation
12
10
8
6
4
2
0
-2
-4
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
skew
kurt
average
stddev
jan
febr
márc
ápr
máj
jún
júl
aug
szept
okt
nov
dec

Chart 5

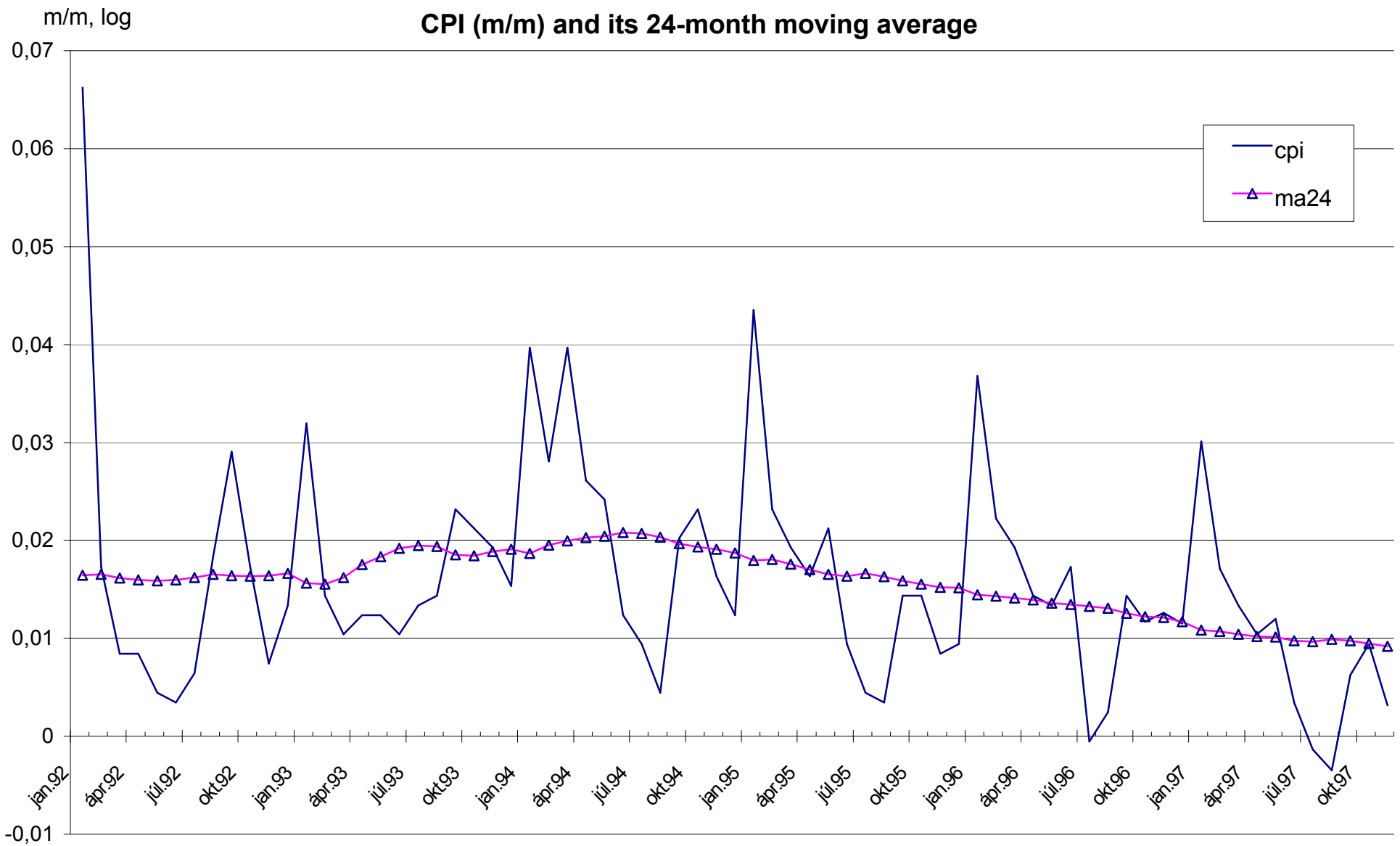

m/m, log
CPI (m/m) and its 24-month moving average
0,07
0,06
0,05
0,04
0,03
0,02
0,01
0
-0,01
cpi
ma24
jan.92
ápr.92
júl.92
okt.92
jan.93
ápr.93
júl.93
okt.93
jan.94
ápr.94
júl.94
okt.94
jan.95
ápr.95
júl.95
okt.95
jan.96
ápr.96
júl.96
okt.96
jan.97
ápr.97
júl.97
okt.97

Chart 6

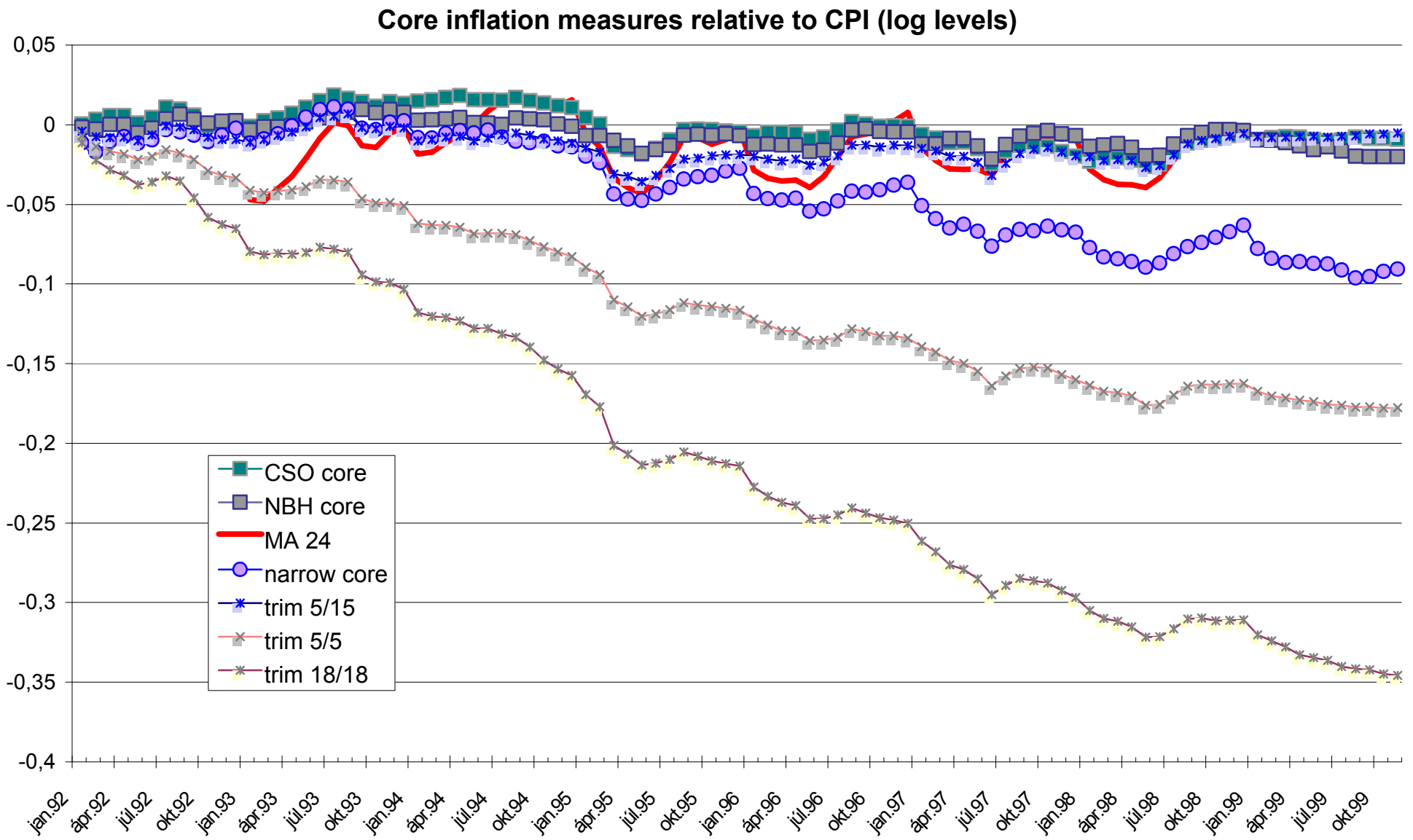

Core inflation measures relative to CPI (log levels)
0,05
0
-0,05
-0,1
-0,15
-0,2
-0,25
-0,3
-0,35
-0,4
CSO core
NBH core
MA 24
narrow core
trim 5/15
trim 5/5
trim 18/18
jan.92
ápr.92
júl.92
okt.92
jan.93
ápr.93
júl.93
okt.93
jan.94
ápr.94
júl.94
okt.94
jan.95
ápr.95
júl.95
okt.95
jan.96
ápr.96
júl.96
okt.96
jan.97
ápr.97
júl.97
okt.97
jan.98
ápr.98
júl.98
okt.98
jan.99
ápr.99
júl.99
okt.99

Chart 7

MNB Füzetek / NBH Working Papers:

1995/1 (november)
Simon András: Aggregált kereslet és kínálat, termelés és külkereskedelem a magyar gazdaságban 1990-1994

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1995/3 (február)
Dr. Kun János: Seignorage és az államadósság terhei

1996/1 (március)
Simon András: Az infláció tényezõi 1990-1995-ben

1996/2 (június)
Neményi Judit: A tõkebeáramlás, a makrogazdasági egyensúly és az eladósodási folyamat összefüggései a Magyar Nemzeti Bank eredményének alakulásával.

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