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AN ALTERNATIVE MEASURE OF CORE INFLATION

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AN ALTERNATIVE MEASURE OF CORE INFLATION

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Resumen
Se combinan las ideas de media podada y del índice de Edgeworth para construir una medida alternativa de inflación subyacente. Este medida se llama "Poda de los componentes más volátiles" (Trim of Most Volatile Components – TMVC). En cualquier momento del tiempo, esta medida poda los componentes del índice de precios que eran más volátiles en un periodo anterior. TMVC sigue la tendencia de la inflación mejor que otras medidas de inflación subyacente en la zona del euro, pero en EEUU la evidencia es más débil.

Abstract
We combine the ideas of the trimmed mean and the Edgeworth index to construct an alternative measure of core inflation named "Trim of most volatile components (TMVC)". At each point of time this measure trims away the components of the price index, which have been most volatile in the past. TMVC tracks trend inflation better than other core inflation measures in the euro zone, but in the US the evidence is weaker.

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1 Introduction

This paper introduces a new measure of core inflation. It is named "Trim of Most Volatile Components (TMVC)" and it trims the headline inflation by removing the most volatile components representing temporary noise in consumer prices. TMVC combines the ideas of two existing measures of core inflation: Trimmed mean and the Edgeworth index.

Central banks monitor development in prices thoroughly, especially those who have an inflation target as the anchor of the monetary policy. For this reason they have a natural interest in different indicators for the underlying price development. The research on measures for core inflation has been growing for a number of years and especially within central banks the interest of finding good measures of the underlying inflation has been pronounced.

The literature on measures of core inflation includes several papers from central banks. Among these are Hogan et al. (1989) from Bank of Canada; Wynne (1999) from the European Central Bank; Clark (2001) from Federal Reserve Bank of Kansas City; Vega and Wynne (2003) from Federal Reserve Bank of Dallas; and recently Mankikar and Paisley (2004) from Bank of England. Especially three measures of core inflation have attracted attention. The first type is the "ex. food and energy"-type, which simply excludes prices of certain articles considered to be particularly volatile. The second type is a trimmed mean measure, which was proposed by Bryan and Cecchetti (1994). This measure trims away the components with the highest and lowest inflation rates. The third type, proposed by Diewert (1995) and Dow (1994), is a variance weighted index called the Edgeworth index. It is calculated by weighting the individual components by their volatility such that the most volatile components have the lowest weights. The trimmed mean and the Edgeworth index are described more detailed below and a review of some conceptual issues is provided by Wynne (1999). The main contribution of the present paper is the introduction of TMVC, which captures the essence of core inflation, namely cleaning the headline inflation rates from temporary noise. The approach most closely related to the one in this paper is that of Clark (2001), who systematically excludes the (same) eight most volatile components.

The rest of the paper is organized as follows: The next section provides a brief discussion of the concept of core inflation. Section 3 presents the data used in the analysis and describes how performance of core inflation measures will be evaluated. In section 4 we describe two existing measures of core inflation. The ideas behind these measure are combined to construct an alternative measure (TMVC), which is described in section 5. Section 6 concludes the analysis.

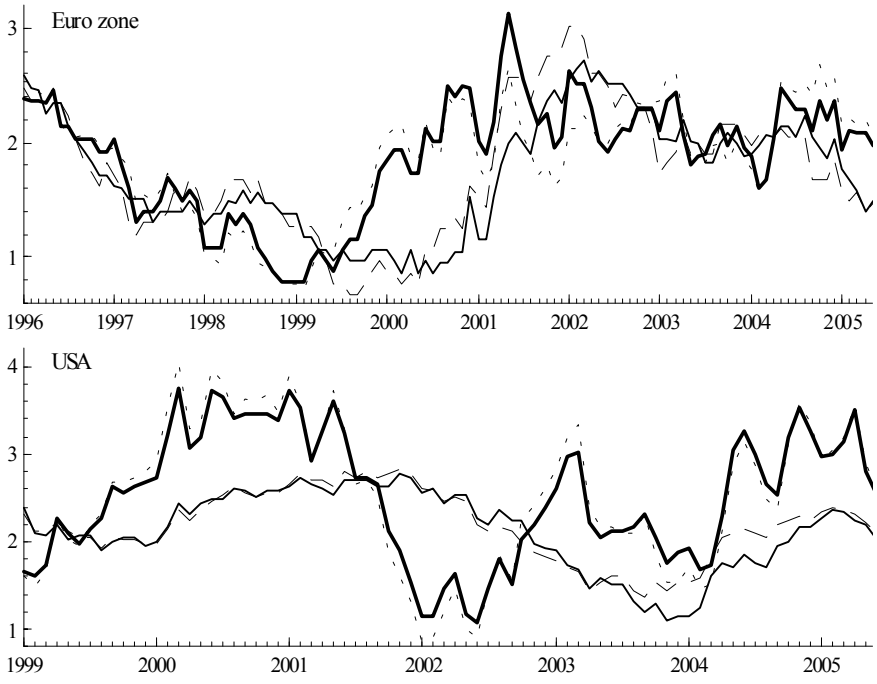
2 Core Inflation

There is not a unique definition of core inflation in the economic literature. Different suggestions have been made. These include the following three: (i) the measure with the highest correlation with the growth in money supply, Bryan & Cecchetti (1994); (ii) the measure which has the highest correlation with a smoothed trend inflation, Bryan et al. (1997); and (iii) the best forecaster of inflation, Smith (2004). The definition applied must depend on the purpose of the analysis. In the present analysis we focus on measures ability to describe underlying price movements and therefore apply a definition similar to the one of Bryan et al (1997), cf. section 3.3.

The concept of core inflation refers to the underlying or persistent part of the inflation. Hence, the temporary noise should be taken out of the price increases so that the underlying part is emphasized. The question is how to do this. In the US a typical measure of core inflation is calculated from the consumer prices (CPI) minus food and energy, while a typical measure in the euro zone excludes energy and unprocessed food. These components are considered to be influenced by temporary large movements, which disturb the picture of the underlying price development. Using these approaches we get the so-called "ex. food and energy" measures. The two typical measures of core inflation are plotted in Figure 1. Indeed, excluding the energy part of the prices does change the overall picture of the price development. Excluding the food components, however, does not seem to change much.

It is certainly relevant to discuss if it is the appropriate components, which are excluded in the "ex. food and energy" measures. Excluding the same components every time inflation rates are published has the advantage that it is easy to communicate to the public. But it might be more relevant at certain dates to exclude other components than food and energy, e.g. if indirect taxes on certain items such as tobacco change, to get a reliable picture of the underlying development in prices. This is the purpose of the trimmed mean introduced in section 4 and of TMVC in section 5.

Figure 1. Annual inflation rates



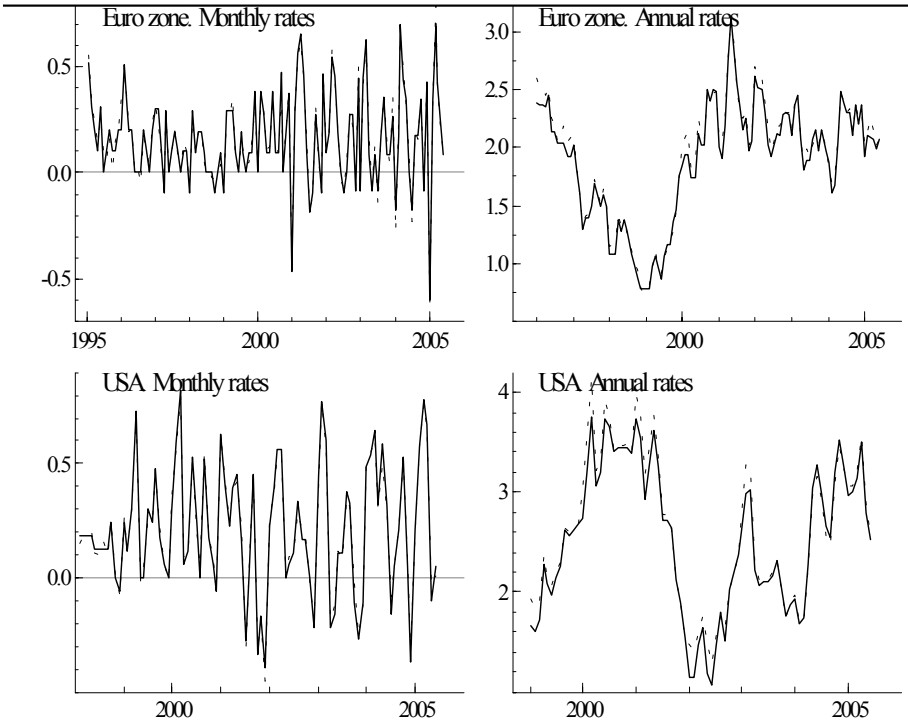
Note: Bold: Headline inflation; Thin: Ex. food and energy;
Dotted: Ex. food; Dashed: Ex. energy.

3 Data

To examine the properties of TMVC compared to other measures of core inflation, data from the euro zone and USA are considered. Euro zone data for HICP are from Eurostat (extracted from EcoWin), while the source of the US CPI data is Bureau of Labor Statistics (BLS). Data are not seasonally adjusted. This section describes the data used in the analysis.

When calculating the inflation rates based on the disaggregated data according to (2) below, small differences from the official published inflation rates arise. This is due to roundings of the weights and more importantly the fact, that the consumer prices indices are calculated as chained indices. The differences between the official published inflation rates and those calculated with formula (2) are minor, and the main developments in the inflation rates are intact, cf. Figure 2.

Figure 2. Official and calculated inflation rates



Note: Full line: Official rates; dotted line: calculated rates.

3.1 Euro zone data

Data for euro zone prices, which cover the period from January 1995 to June 2005, are disaggregated according to the following principle: If data or weights for one or more x-digit components are not available for the entire period, the x-1 digit components are is used The only exception is "Social protection", which has zero-weights up to December 1999 but nevertheless is included. This leaves us with 79 sub-indices. The component with highest weight is "Catering services" (7.761% in 2005) and the one with lowest weight is "Maintenance and repair of other major durables for recreation and culture" (0.001%) according to Table A1 in Appendix A.

Data are described in detail in Vega and Wynne (2003), who also present some descriptive statistics of the data covering the period from January 1996 to December 2000. The data used in the present analysis are more or less equivalent to those applied by Vega and Wynne. However, several series, which they eliminate in advance because of abnormal behavior, are kept and it is left to the trimming procedures to eliminate extreme observations.

3.2 US data

Data for the US cover the period from January 1998 to June 2005[1] and are disaggregated following the same principle as for the euro zone with two exceptions: (i) Missing data from January to April 2000 for the series "Indoor plants and flowers" have been calculated by linear interpolation. (ii) The series "Health insurance" was residually calculated from the known components of "Medical care services". In total the CPI is disaggregated into 137 sub-indices where "Owner's equivalent rent of primary residence" has the highest weight (23.158% in 2005) and "Delivery services" has the lowest weight (0.007%). Appendix B reports the disaggregation used in the analysis.

3.3 Tracking trend inflation

For monetary policy purposes a measure of core inflation should mirror the underlying trend inflation. To evaluate various measures of core inflation, we follow Vega and Wynne (2003), who evaluate the performance by the ability to track the underlying trend in the headline inflation defined using the Hodrick-Prescott filter with smoothing parameter $\lambda = 14,400$ as observations are monthly. The performance is measured by the root mean square error statistic

$$RMSE = \sqrt{\sum_{t=1}^{T}(\Pi_t^* - \overline{\Pi}_t)^2/T}, \tag{1}$$

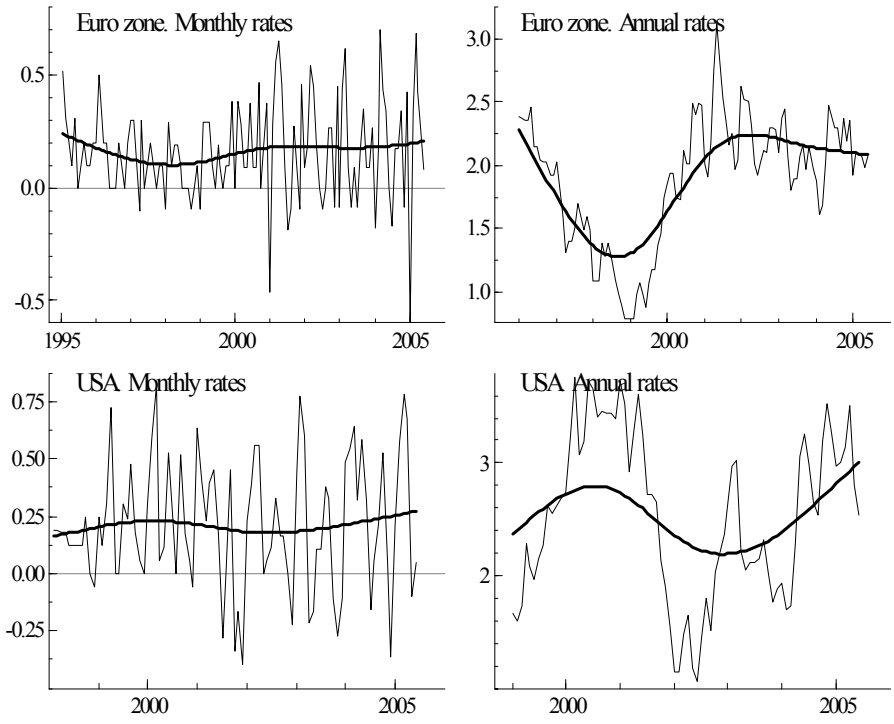
where Π_t^* is the core inflation candidate at date t, $\overline{\Pi}_t$ is the trend inflation, and T is the total number of observations.[2] Figure 3 shows the HP filters calculated for the euro zone and the US with monthly and annual inflation rates.[3]

[1] The relatively short period is due to the fact that BLS changed the method of compiling CPI in 1997.

[2] Cutler (2001) is interested in measuring how well a core inflation candidate forecasts the British RPIX inflation. She evaluates the performances of various measures by calculating the mean square error with a lead on the RPIX.

[3] Because of the well-known end-points problems of the HP filter, this is not in itself a good candidate for a core inflation measure in real time. See Vega and Wynne (2003) for more on this subject.

Figure 3. HP filters



As benchmarks for the following analysis, we calculate the RMSE using the headline inflation and the inflation rate excluding food and energy. Table 1 presents the results. In the euro zone HICP excluding unprocessed food and energy tracks trend inflation worse than headline inflation, while CPI excluding food and energy performs better than headline in the US.

Table 1. Root mean square error statistics

	Euro zone		**USA**	
	Headline	Ex. f&e	Headline	Ex. f&e
Monthly	0.208	0.212	0.276	0.200
Annual	0.275	0.390	0.581	0.574

Note: Ex. f&e is CPI excluded food and energy for the US and HICP minus unprocessed food and energy for the euro zone.

4 Two measures of core inflation

In this section we present two measures of core inflation, which have been applied extensively in the literature. These are used for comparisons with the new measure, which is introduced in section 5.

To introduce a little notation, let us consider a price index, P_t, which is separated into n components each with price index $p_{i,t}$, $i = 1, 2, ..., n$. The weight in the overall index for component i at time t is $\omega_{i,t}$ such that $\sum_{i=1}^{n} \omega_{i,t} = 1$ for all t. With the price increase in component i over k periods of time,

$$\pi_{i,t} = 100 * \frac{p_{i,t} - p_{i,t-k}}{p_{i,t-k}},$$

we can calculate the headline inflation as

$$\Pi_t = \sum_{i=1}^{n} \omega_i \pi_i, \tag{2}$$

where the time notation is omitted for simplicity. The measures below are calculated for annual inflation rates ($k = 12$) but also for monthly rates ($k = 1$) in order to examine the role of the time span as well as seasonality in the trimming procedures, since data are not adjusted for seasonality.

4.1 Trimmed mean

The idea of the (weighted) trimmed mean is to take out the most extreme price changes, i.e. the highest and lowest inflation rates. In general, the trim is symmetric such that $\alpha\%$ of the highest rates and $\alpha\%$ of the lowest rates are trimmed away.

Formally, to calculate the trimmed mean, we sort the inflation rates of the sub-indices for all t: $\pi_1^s, \pi_2^s, ..., \pi_n^s$ with corresponding weights $\omega_1^s, \omega_2^s, ..., \omega_n^s$ such that $\pi_j^s \leq \pi_{j+1}^s$ for all j. The $\alpha\%$ trimmed mean is then calculated as

$$\Pi_t^\alpha = \frac{1}{1-2\alpha} \sum_{\alpha \leq \sum \omega_i^s \leq 1-\alpha} \omega_i^s \pi_i^s.$$

The more detailed the index is split, the more accurate the trimming will be. To ensure that the sums of the weights are the same at every date, the components at the split points will only enter the summation with part of the weight in the headline index. Trimming taking this into account may at certain points be very relevant since some components have very high weight cf. the description of data above. Hence, a more accurate description of the $\alpha\%$ trimmed mean calculated in the present

analysis is

$$\begin{aligned}\Pi_t^{\alpha} = \tfrac{1}{1-2\alpha} \sum_{i=1}^{n} \mathbf{1}(\sum_{j=1}^{i} \omega_i^s \geq \alpha \wedge \sum_{j=1}^{i} \omega_i^s \leq 1-\alpha)\omega_i^s \pi_i^s \\ +\mathbf{1}\left(\sum_{j=1}^{i} \omega_j^s < \alpha \wedge \sum_{j=1}^{i} \omega_{j+1}^s > \alpha\right)(\sum_{j=1}^{i} \omega_{j+1}^s - \alpha)\pi_{i+1}^s \\ +\mathbf{1}\left(\sum_{j=1}^{i} \omega_j^s < 1-\alpha \wedge \sum_{j=1}^{i} \omega_{j+1}^s > 1-\alpha\right)(1-\alpha-\sum_{j=1}^{i} \omega_j^s)\pi_{i+1}^s,\end{aligned}$$

where $\mathbf{1}(a)$ is an indicator function with value 1 if a is true and 0 otherwise. For $\alpha = 0$ we get the weighted average, i.e. the headline inflation, and for $\alpha = 50$ we get the weighted sample median.[4] It is obvious from the construction that the components might not be the same at date t and $t+j$, $j \neq 0$. On the other hand, the weights of the components are the same as in the headline index based on actual consumption looking apart from the two components at the split points.

An attractive feature of the trimmed mean is that, in contrast to the "ex. food and energy" approach, it excludes components based on contemporaneous observations. Hence, it is not a priori decided which observations to exclude. Furthermore, it can be argued that the trimmed mean is a more efficient estimate of inflation since the standard average often is troubled by excess kurtosis (heavy tails). On the other hand, the trimmed mean excludes highest and lowest inflation rates, which may not necessarily be the most volatile components.

An important question is what the optimal trim is. The optimal trim is defined as the one which minimizes (1).[5] Figure 4 shows the RMSE as a function of α. For the euro zone RMSE for monthly price changes is quite stable for trims higher than 25% with the optimal trim at 38% cf. Table 2. With annual inflation rates the optimal trim is 2%. These results illustrate clearly the effect of applying non-seasonally adjusted data. With monthly price changes components influenced by seasonality have to be removed to obtain the best track of trend inflation, while a much smaller trim is needed with annual rates.

For the US monthly rates, RMSE is less than 0.07 for trims between 19% and 24% with the minimum at 21%. For 12 months inflation rates the RMSE is less than 0.4 for trims 3% and 24% with optimum at 18%. In all cases the optimal trimmed means track trend inflation better than the headline inflations and the "ex. food and energy" rates.

[4] Federal Reserve Bank of Cleveland publishes US median CPI every month.

[5] Using US CPI data from 1967 to 1996 and defining trend inflation as the 36 month centered moving average, Bryan et al. (1997) find that $\alpha = 9\%$ is the optimal trim.

Figure 4. RMSE(α) for trimmed means

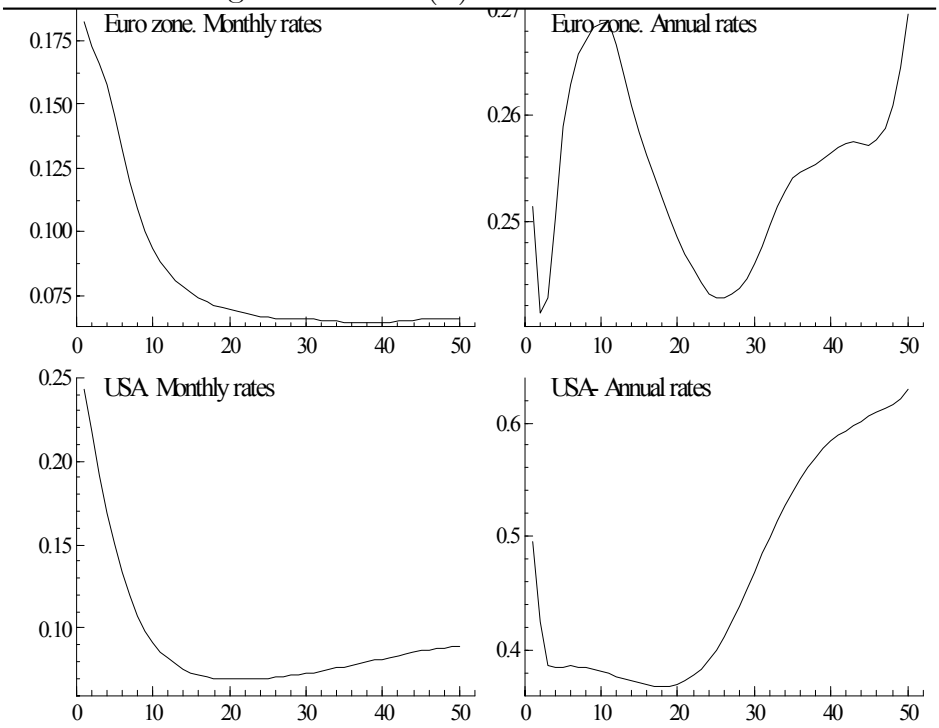


Table 2. Optimal trims

Euro zone				**USA**			
$k=1$		$k=12$		$k=1$		$k=12$	
α	RMSE	α	RMSE	α	RMSE	α	RMSE
38	0.065	2	0.241	21	0.069	18	0.368

Table 3 reports the components with most extreme inflation rates, i.e. the components which are most often trimmed away, even with relatively small trims. Not surprisingly the components trimmed away most often with monthly inflation rates are components affected by seasonality such as fruits and vegetables. But for the euro zone also travel related items and IT / electronic items experience extreme price changes. With annual inflation is mainly IT and energy related products, which are trimmed away, but also tobacco in the case of the euro zone.

Table 3. Components with most extreme inflation rates

Euro zone	
$k = 1$	E68, E24, E46, E7, E54, E61, E71, E47, E6
$k = 12$	E54, E52, E24, E53, E41, E26, E15
USA	
$k = 1$	U29, U31, U32, U28
$k = 12$	U132, U68, U99, U100, U69

Note: Components which have inflation rates among the five highest or five lowest at more than 50% of the dates.

4.2 Edgeworth Index

The idea behind the Edgeworth index is to give less weight to the more volatile components. Hence, on the contrary to the trimmed mean, the Edgeworth index includes all the original components, but the weights are different from those in the headline index. This is a main shortcoming of this measure since a component with very small weight in consumer price index may get a very high weight in the Edgeworth index if it's price has been stable.

Let σ_i^2 be the variance of the inflations rate of component i calculated over a given period of time, for example one year. Then the weight for component i in the Edgeworth index is calculated as

$$\omega_i^e = \frac{1/\sigma_i^2}{\sum_{i=1}^{n} 1/\sigma_i^2}.$$

With these weights the index is calculated as

$$\Pi_t^e = \sum_{i=1}^{n} \omega_i^e \pi_i.$$

We calculate the Edgeworth index with different periods to examine how important the choice of volatility-period is. The volatility-periods are fixed at 6, 12, 18 and 24 months. The results are reported in Table 4.[6] With annual inflation rates the volatility-period is more important than for monthly rates. For the US the Edgeworth index performs a bit

[6]The RMSEs in Table 4 are calculated for the same period for comparison. For the euro zone the period starts in January 1997 for $k = 1$ and in December 1997 for $k = 12$. For the US the starting dates are respectively January and December 2000. The RMSEs, however, do not change much when excluding some of the first observations.

better than the trimmed mean, while this is not the case for the euro zone.[7]

Table 4. RMSE for the Edgeworth index

	Euro zone		**USA**	
	$k = 1$	$k = 12$	$k = 1$	$k = 12$
6M	0.076	0.553	0.063	1.034
12M	0.077	0.413	0.062	0.476
18M	0.076	0.388	0.062	0.363
24M	0.079	0.376	0.060	0.327

Note: Calculations are made for the same periods.

The components with highest volatility, i.e. the components which have relatively low weights in the Edgeworth index, in the majority of the periods are listed in Table 5.

Table 5. Most volatile components

	Euro zone
$k = 1$	E7, E24, E46, E68, E71, E6, E47, E16, E61; E41
$k = 12$	E7, E24, E41, E23, E6, E26, E47, E68
	USA
$k = 1$	U28, U29, U31, U32, U90, U99, U21, U68
$k = 12$	U68, U99, U31, U100, U32, U69, U71, U29, U45, U21

Note: Based on a volatility period of 12 months.

Maybe as expected, there is a large overlap between most volatile components and components with extreme inflation rates. However, a couple of clothe items are also quite volatile as well as additional food and energy related components, which are not present in Table 3. On the other hand, IT and tobacco are not among the most volatile items. Because there are differences between the components with the highest / lowest price changes and the most volatile ones, there is a need for an additional measure for core inflation, which systematically trims away the prices which fluctuate the most. Such a measure is introduced in the next section.

[7] These results also hold when the calculation periods for the trimmed mean and the Edgeworth index are the same.

5 Trim of most volatile components (TMVC)

The measure presented in this section combines the ideas behind the trimmed mean and the Edgeworth index. Furthermore, it captures the basic idea of core inflation, namely that the most volatile components, i.e. components with extraordinary movements, systematically are excluded.

The trimmed mean removes the components with highest and lowest price changes as these are likely to be the most volatile ones. As demonstrated in the last section, however, this is not always the case. TMVC, on the other hand, directly removes the components with the highest variance, which intuitively seems more appealing. Note that in contrast to the trimmed mean, TMVC is not symmetric as only the sub-indices with highest variances are trimmed away.

An appealing feature of the Edgeworth index is that the most volatile items are given relatively small weights. This principle is maintained in the TMVC since the most volatile components are excluded. At the same time, a major disadvantage of the Edgeworth index, that items have different weights from those in the headline inflation, is not present in the TMVC.

Because of these features TMVC must be considered a serious alternative to the two other measures and intuitively more appealing. For this reason communication to public may also be easier with TMVC although "ex. food and energy" type measures still are preferred for communication purposes. The main use of TMVC is probably for investigators analyzing underlying price development, such as central bankers.

To construct TMVC, we sort the sub-indices by the variance for the h previous months, $\sigma_1^2, \sigma_2^2, ..., \sigma_n^2$, with corresponding weights, $\omega_1^\sigma, \omega_2^\sigma, ..., \omega_n^\sigma$, and inflation rates $\pi_1^\sigma, \pi_2^\sigma, ..., \pi_n^\sigma$, such that $\sigma_i^2 \leq \sigma_{i+1}^2$ for all $i = 1, 2, ..., n$. The β% TMVC is then calculated as

$$\Pi_t^\sigma = \frac{1}{1-\beta} \sum_{\sum \omega_i^s \leq 1-\beta} \omega_i^\sigma \pi_i^\sigma,$$

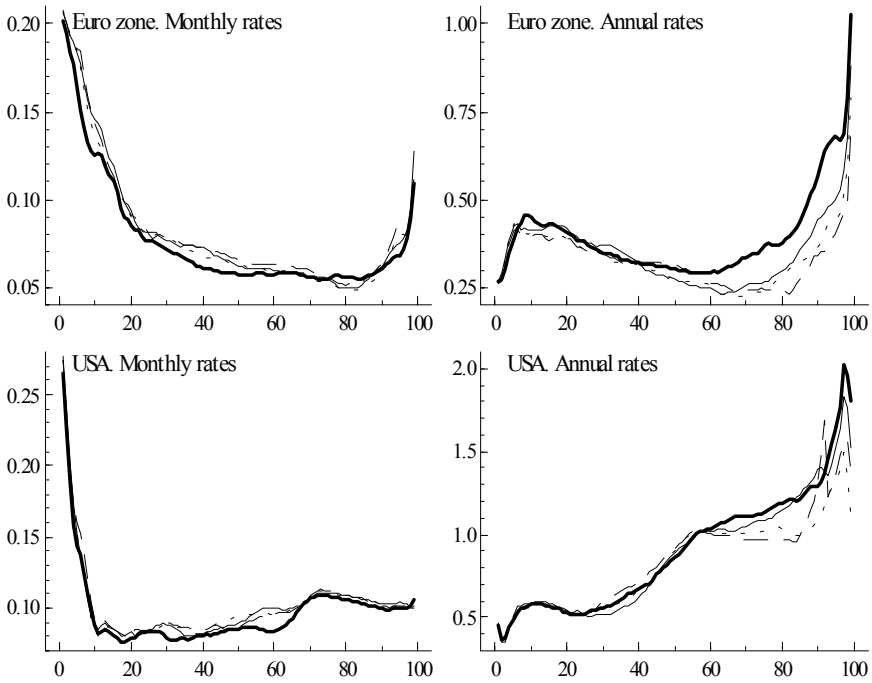
or formulated more precisely with indicator functions:

$$\begin{aligned}\Pi_t^\sigma = & \tfrac{1}{1-\beta} \sum_{i=1}^{n} \mathbf{1}\left(\sum_{j=1}^{i} \omega_i^\sigma \leq 1-\beta\right) \omega_i^\sigma \pi_i^\sigma \\ & + \mathbf{1}\left(\sum_{j=1}^{i} \omega_j^\sigma < 1-\beta \wedge \sum_{j=1}^{i} \omega_{j+1}^\sigma > 1-\beta\right)(1-\beta-\sum_{j=1}^{i} \omega_j^\sigma)\pi_{i+1}^\sigma.\end{aligned}$$

Figure 5 shows the RMSEs as a function of β for different volatility periods. As in the case of the Edgeworth index the choice of volatility period is more important when inflation rates are calculated for $k = 12$

than for $k = 1$. Table 6 reports RMSEs for TMVCs with the optimal β. For the euro zone the TMVC track trend inflation better than both the trimmed and the Edgeworth index. For the US both the trimmed mean and the Edgeworth index "beat" the TMVC on monthly inflation rates. With $k = 12$, however, TMVC track trend inflation better than the trimmed mean and with a much smaller trim. The Edgeworth index, on the other hand, does slightly better than TMVC when the volatility period is more than 18 months.

Figure 5. RMSE(β) for TMVC



Note: Volatility period: Bold: 6 month; Thin: 12 months; Dotted: 18 months; Dashed: 24 months.

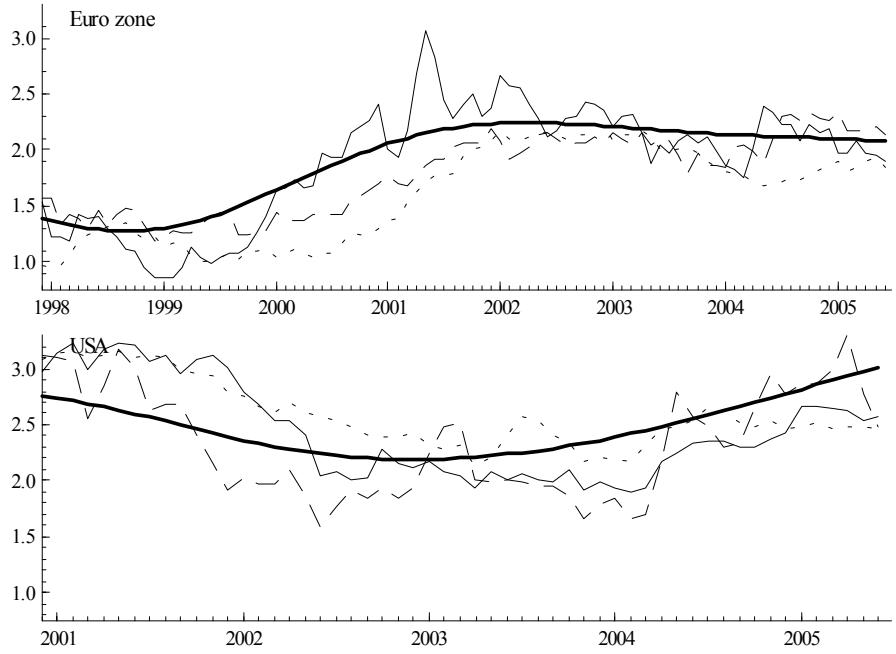
Table 6. RMSE for the TMVC with optimal trim

	Euro zone		**USA**	
	$k = 1$	$k = 12$	$k = 1$	$k = 12$
6M	0.054 (74)	0.268 (1)	0.076 (18)	0.361 (2)
12M	0.049 (80)	0.231 (63)	0.080 (21)	0.353 (2)
18M	0.048 (80)	0.220 (67)	0.079 (12)	0.367 (2)
24M	0.051 (80)	0.232 (82)	0.079 (18)	0.382 (2)

Note: Numbers in brackets are optimal trims.

All in all, TMVC is a good supplement to existing measures of core inflation, which supplies additional information when accessing underlying price development. To conclude the analysis, Figure 6 compares the three measures of core inflation with optimal trims and volatility periods. For the euro zone, the Edgeworth index is below the trend inflation for most of the period. Trimmed mean and TMVC fluctuate more around the trend, although TMVC is systematically lower in the middle of the period. In the US, TMVC fluctuates more around the trend than the two other measures, which are above trend inflation in the first part of the period. In the second part the trimmed mean is systematically below the trend.

Figure 6. Measures of core inflation



Note: Bold: HP filter; Thin: Trimmed mean; Dotted: Edgeworth index; Dashed: TMVC.

6 Conclusion

To judge the underlying development in prices, it is crucial to have reliable measures of core inflation. In this paper we combine the ideas behind two widely applied core inflation measures: The trimmed mean and the Edgeworth index. The outcome is named "Trim of most volatile components (TMVC)". At each point of time this measure evaluates the

importance of price changes on individual groups of article by their past volatility. Most volatile component are trimmed away to obtain the core inflation measure.

Performance of TMVC is compared to those of the trimmed mean and the Edgeworth index in terms of tracking trend inflation. In the euro zone the TMVC "beats" the two other measures, while the Edgeworth index performs slightly better in the US for annual inflation rates and much better with monthly rates.

References

[1] Bryan, M.F. & Cecchetti, S.G. (1994), 'Measuring core inflation', in Mankiw, N.G. (ed.), *Monetary Policy*, University of Chicago Press.

[2] Bryan, M.F., Cecchetti, S.G. & Wiggens II, R.L. (1997), 'Efficient inflation estimators', *NBER Working Paper* no. 6183.

[3] Clark, T.E. (2001), 'Comparing measures of core inflation', *Economic Review, 2nd Quarter*, Federal Reserve Bank of Kansas City.

[4] Cutler, J. (2001), 'Core inflation in the UK', *Discussion Paper No. 3*, External MPC Unit, Bank of England.

[5] Diewert, W.E. (1995), 'On the stochastic approach to index numbers', *Discussion Paper No. DP-95-31*, Department of Economics, University of British Columbia.

[6] Dow, J.P., Jr., 'Measuring inflation using multiple price indexes', *Unpublished Manuscript*, Department of Economics, University of California Riverside.

[7] Hogan, S., Johnson, M. & Lflèche, T. (1998), 'Core inflation', *Technical Report No. 89*, Bank of Canada.

[8] Mankikar, A. & Paisley, J. (2004), 'Core inflation: a critical guide', *Working Paper no. 242*, Bank of England.

[9] Smith, J.K. (2004), 'Weighted median inflation. Is this core inflation?', *Journal of Money, Credit and Banking* 36(2), 253-264.

[10] Vega, J.-L. & Wynne, M.A. (2003), 'A first assessment of some measures of core inflation for the euro area', *German Economic Review*, 4(3), 269-306.

[11] Wynne, M.A. (1999), 'Core inflation: A review of some conceptual issues', *Working Paper 9903*, Research Department, Federal Reserve Bank of Dallas.

7 Appendix A. Euro zone data

Table A1. Euro zone. Components of HICP

Food and non-alcoholic beverages (15.482)
- Food (14.241)
  - Bread and cereals[E1] (2.520)
  - Meat[E2] (3.762)
  - Fish and seafood[E3] (1.185)
  - Milk, cheese and eggs[E4] (2.189)
  - Oils and fats[E5] (0.514)
  - Fruit[E6] (1.169)
  - Vegetables[E7] (1.505)
  - Sugar, jam honey, chocolate and confectionery[E8] (0.993)
  - Food products n.e.c.[E9] (0.404)
- Non-alcoholic beverages (1.241)
  - Coffee, tea and cacao[E10] (0.367)
  - Mineral waters, soft drinks, fruit and vegetable juices[E11] (0.874)

Alcoholic beverages, tobacco and narcotics (4.154)
- Alcoholic beverages (1.529)
  - Spirits[E12] (0.300)
  - Wine[E13] (0.693)
  - Beer[E14] (0.536)
- Tobacco[E15] (2.625)

Clothing and footwear (7.440)
- Clothing[E16] (5.941)[1]
- Footwear including repair[E17] (1.499)

Housing, water, electricity, gas and other fuels (14.999)
- Actual rentals for housing[E18] (6.381)
- Maintenance and repair of the dwelling (1.540)
  - Materials for the maintenance and repair of the dwelling[E19] (0.605)
  - Services for the maintenance and repair of the dwelling[E20] (0.935)
- Water supply and miscellaneous services relating to the dwelling[E21] (2.448)[1]
- Electricity, gas and other fuels (4.629)
  - Electricity[E22] (1.953)
  - Gas[E23] (1.364)
  - Liquid fuels[E24] (0.792)
  - Solid fuels[E25] (0.073)

Heat energy[E26] (0.447)

Furnishings, household equipment and routine maintenance of the house (7.611)
Furniture and furnishings, carpets and other floor coverings (2.978)
Furniture and furnishings[E27] (2.605)
Carpets and other floor coverings[E28] (0.248)
Repair of furniture, furnishings and floor coverings[E29] (0.125)
Household textiles[E30] (0.553)
Households appliances (1.108)
Major household appliances whether electric or not and small electric household appliances[E31] (0.983)
Repair of household appliances[E32] (0.125)
Glassware, tableware and household utensils[E33] (0.639)
Tools and equipment for house and garden[E34] (0.459)
Goods and services for routine household maintenance (1.873)
Non-durable household goods[E35] (0.995)
Domestic services and household services[E36] (0.878)

Health[E37] **(4.136)**[1]

Transport (15.312)
Purchase of vehicles (4.724)
Motor cycles, bicycles and animal drawn vehicles[E38] (0.357)
Motor cars[E39] (4.368)
Operation of personal transport equipment (8.512)
Spares parts and accessories for personal transport equipment[E40] (1.044)
Fuels and lubricants for personal transport equipment[E41] (3.933)
Maintenance and repair of personal transport equipment[E42] (2.560)
Other services in respect of personal transport equipment[E43] (0.976)
Transport services (2.075)
Passenger transport by railway[E44] (0.406)
Passenger transport by road[E45] (0.474)
Passenger transport by air[E46] (0.518)
Passenger transport by sea and inland waterway[E47] (0.095)
Combined passenger transport[E48] (0.519)
Other purchased transport services[E49] (0.065)

Communications (2.823)
Postal services[E50] (0.225)

Telephone and telefax equipment and services[E51] (2.597)

Recreation and culture (9.461)
Audio-visual, photographic and information processing equipment (1.485)
Equipment for the reception, recording and reproduction of sound and picture[E52] (0.508)
Photographic and cinematographic equipment and optical instruments[E53] (0.141)
Information processing equipment[E54] (0.352)
Recording media[E55] (0.385)
Repair of audio-visual, photographic and information processing equipment[E56] (0.099)
Other major durables for recreation and culture (0.244)
Major durables for indoor and outdoor recreation including musical instruments[E57] (0.243)
Maintenance and repair of other major durables for recreation and culture[E58] (0.001)
Other recreational items and equipment, gardens and pets (1.795)
Games, toys and hobbies[E59] (0.417)
Equipment for sport, camping and open-air recreation[E60] (0.284)
Gardens, plants and flowers[E61] (0.616)
Pets and related products; veterinary and other services for pets[E62] (0.479)
Recreational and cultural services (2.404)
Recreational and sporting services[E63] (1.019)
Cultural services[E64] (1.385)
Newspapers, books and stationery (2.012)
Books[E65] (0.689)
Newspapers and periodicals[E66] (1.000)
Miscellaneous printed matter; stationery and drawing materials[E67] (0.323)
Package holidays[E68] (1.520)

Education[E69] **(0.964)**

Restaurants and hotels (9.459)
Catering services[E70] (7.761)[1]
Accommodation services[E71] (1.698)

Miscellaneous goods and services (8.159)
Personal care (2.627)
Hairdressing salons and personal grooming establish-

ments[E72] (1.120)
Electrical appliances for personal care; other appliances, articles and products for personal care[E73] (1.507)
Personal effects n.e.c. (1.116)
Jewelry, clocks and watches[E74] (0.535)
Other personal effects[E75] (0.582)
Social protection[E76] (0.967)
Insurance[E77] (1.867)[1]
Financial services n.e.c.[E78] (0.585)
Other services n.e.c.[E79] (0.998)

Note: Numbers in soft brackets are 2005-weights in percentage.
Hard brackets indicate that the components are used in the trimming procedures.
[1] This component is used in the calculations as one or more of components with higher digits only contain data from 1996 or later.

8 Appendix B. US data

Table B1. USA. Components of CPI

Food and beverages (15.291)
Food at home (8.183)
Cereals and bakery products (1.185)
Cereals and cereal products (0.400)
Flour and prepares flour mixes[U1] (0.050)
Breakfast cereal[U2] (0.221)
Rice, pasta, cornmeal[U3] (0.128)[1]
Bakery products (0.784)
Bread[U4] (0.225)[1]
Fresh biscuits, rolls, muffins[U5] (0.109)
Cakes, cupcakes, and cookies[U6] (0.220)[1]
Other bakery products[U7] (0.230)[1]
Meats, poultry, fish and eggs (2.272)
Meats, poultry, and fish (2.178)
Meats (1.456)
Beef and veal (0.725)
Uncooked ground beef[U8] (0.268)
Uncooked beef roasts[U9] (0.131)
Uncooked beef steaks[U10] (0.269)
Uncooked other beef and veal[U11] (0.057)
Pork (0.449)
Bacon, breakfast sausage and related products[U12] (0.147)[1]

- Ham[U13] (0.096)[1]
- Pork chops[U14] (0.103)
- Other pork including roasts and picnics[U15] (0.102)
- Other meats[U16] (0.282)[1]
- Poultry (0.413)
- Chicken[U17] (0.332)[1]
- Other poultry including turkey[U18] (0.081)
- Fish and seafood (0.309)
- Fresh fish and seafood[U19] (0.181)
- Processed fish and seafood[U20] (0.127)[1]
- Eggs[U21] (0.094)

Dairy and related products (0.849)
- Milk[U22] (0.324)[1]
- Cheese and related products[U23] (0.252)
- Ice cream and related products[U24] (0.147)
- Other dairy and related products[U25] (0.126)

Fruit and vegetables (1.276)
- Fresh fruits and vegetables (1.023)
- Fresh fruits (0.498)
- Apples[U26] (0.086)
- Bananas[U27] (0.075)
- Citrus fruits[U28] (0.094)[1]
- Other fresh fruits[U29] (0.243)
- Fresh vegetables (0.525)
- Potatoes[U30] (0.081)
- Lettuce[U31] (0.061)
- Tomatoes[U32] (0.138)
- Other fresh vegetables[U33] (0.244)
- Processed fruits and vegetables (0.253)
- Canned fruits and vegetables[U34] (0.133)[1]
- Frozen fruits and vegetables[U35] (0.076)[1]
- Other processed fruits and vegetables including dried[U36] (0.044)[1]

Nonalcoholic beverages and beverage materials (0.884)
- Juices and nonalcoholic drinks (0.610)
- Carbonated drinks[U37] (0.316)
- Frozen noncarbonated juices and drinks[U38] (0.025)
- Nonfrozen noncarbonated juices and drinks[U39] (0.275)
- Beverage materials including coffee and tea (0.275)
- Coffee[U40] (0.100)[1]
- Other beverage materials including tea[U41] (0.174)

Other food at home (1.716)

- Sugar and sweets (0.296)
  - Sugar and artificial sweeteners[U42] (0.051)
  - Candy and chewing gum[U43] (0.190)
  - Other sweets[U44] (0.055)
- Fats and oils (0.258)
  - Butter and margarine[U45] (0.083)[1]
  - Salad dressing[U46] (0.070)
  - Other fats and oils including peanut butter[U47] (0.104)[1]
- Other foods (1.163)
  - Soups[U48] (0.092)
  - Frozen and freeze dried prepared foods[U49] (0.241)
  - Snacks[U50] (0.249)
  - Spices, seasonings, condiments, sauces[U51] (0.208)[1]
  - Baby food[U52] (0.072)
  - Other miscellaneous foods[U53] (0.301)[1]

- Food away from home (6.113)
  - Full service meal and snacks[U54] (2.680)
  - Limited service meals and snacks[U55] (2.664)
  - Food at employee sites and schools[U56] (0.302)
  - Food from vending machines and mobile vendors[U57] (0.135)
  - Other food away from home[U58] (0.332)
- Alcoholic beverages (0.996)
  - Alcoholic beverages at home (0.635)
    - Beer, ale and other malt beverages at home[U59] (0.332)
    - Distilled spirits at home[U60] (0.108)[1]
    - Wine at home[U61] (0.195)
  - Alcoholic beverages away from home[U62] (0.361)

Housing (41.993)

- Shelter (32.686)
  - Rent of primary residence[U63] (6.133)
  - Lodging away from home (3.008)
    - Housing at school, excluding board[U64] (0.211)
    - Other lodging away from home including hotels and motels[U65] (2.798)
  - Owner's equivalent rent of primary residence[U66] (23.158)
  - Tenants' and household insurance[U67] (0.387)
- Fuels and utilities (4.951)
  - Fuels (4.021)
    - Fuel oil and other fuels (0.300)
      - Fuel oil[U68] (0.204)
      - Other household fuels[U69] (0.095)

- Gas (piped) and electricity (3.722)
  - Electricity[U70] (2.405)
  - Utility (piped) gas service[U71] (1.317)
- Water and sewer and trash collection service (0.930)
  - Water and sewerage maintenance[U72] (0.687)
  - Garbage and trash collection[U73] (0.242)

Household furnishing and operations (4.355)
- Window and floor coverings and other linens (0.301)
  - Floor coverings[U74] (0.037)
  - Windows coverings[U75] (0.075)
  - Other linens[U76] (0.189)
- Furniture and bedding[U77] (0.979)[1]
- Appliances[U78] (0.291)[1]
- Other household equipment and furnishings (0.648)
  - Clocks, lamps, and decorator items[U79] (0.355)
  - Indoor plants and flowers[U80] (0.135)[2]
  - Dishes and flatware[U81] (0.070)
  - Nonelectric cookware and tableware[U82] (0.088)
- Tools, hardware, outdoor equipment and supplies[U83] (0.325)[1]
- Housekeeping supplies (0.782)
  - Household cleaning products[U84] (0.340)
  - Household paper products[U85] (0.195)
  - Miscellaneous household products[U86] (0.246)
- Household operations[U87] (0.707)[1]

Apparel (3.841)
- Men's and boys' apparel (0.977)
  - Men's apparel[U88] (0.781)[1]
  - Boy's apparel[U89] (0.196)
- Women's and girl's apparel (1.638)
  - Women's apparel[U90] (1.364)[1]
  - Girls's apparel[U91] (0.274)
- Footwear (0.765)
  - Men's footwear[U92] (0.235)
  - Boy's and girls' footwear[U93] (0.168)
  - Women's footwear[U94] (0.362)
- Infants' and toddlers' apparel[U95] (0.188)
- Jewelry and watches (0.274)
  - Watches[U96] (0.037)
  - Jewelry[U97] (0.237)

Transportation (17.414)
- Private transportation (16.385)

New and used motor vehicles[U98] (4.692)[1]
Motor fuel (3.969)
Gasoline (all types)[U99] (3.934)[1]
Other motor fuels[U100] (0.035)
Motor vehicle parts and equipment (0.364)
Tires[U101] (0.212)
Vehicle accessories other than tires[U102] (0.153)[1]
Motor vehicle maintenance and repair[U103] (1.341)[1]
Motor vehicle insurance[U104] (2.470)
Motor vehicle fees[U105] (0.496)[1]
Public transportation[U106] (1.029)[1]

Medical care (6.132)
Medical care commodities (1.484)
Prescription drugs and medical supplies[U107] (1.092)[1]
Nonprescription drugs and medical supplies (0.392)
Internal and respiratory over-the-counter drugs[U108] (0.276)
Nonprescription medical equipment and supplies[U109] (0.115)
Medical care services (4.649)
Professional services (2.767)
Physicians' services[U110] (1.555)
Dental services[U111] (0.722)
Eyeglasses and eye care[U112] (0.236)
Services by other medical professionals[U113] (0.254)
Hospital and related services (1.516)
Hospital services[U114] (1.452)[1]
Nursing homes and adult day-care[U115] (0.063)
Health Insurance[U116] (0.366)[3]

Recreation (5.733)
Video and audio[U117] (1.691)[1]
Pets, pet products and services (0.600)
Pets and pet products[U118] (0.345)[1]
Pet services including veterinary[U119] (0.254)[1]
Sporting goods[U120] (0.616)[1]
Photography[U121] (0.212)[1]
Other recreational goods[U122] (0.425)[1]
Recreational services[U123] (1.819)[1]
Recreational reading materials[U124] (0.371)[1]

Education and communication (5.846)
Education (2.931)
Education books and supplies[U125] (0.220)[1]

Tuition, other school fees, and childcare[U126] (2.712)[1]
Communication (2.914)
Postage and delivery services (0.177)
Postage[U127] (0.170)
Delivery services[U128] (0.007)
Information and information processing (2.737)
Telephone services (2.187)
Telephone services, local charges[U129] (0.892)
Telephone services, long distance charges[U130] (0.679)[1]
Wireless telephone services[U131] (0.616)
Information technology, hardware and services[U132] (0.550)[1]

Other goods and services (3.750)
Tobacco and smoking products[U133] (0.804)[1]
Personal care (2.946)
Personal care products[U134] (0.658)[1]
Personal care services[U135] (0.652)[1]
Miscellaneous personal services[U136] (1.454)[1]
Miscellaneous personal goods[U137] (0.181)

Note: See Table A1.
[1] This component is used in the calculations as data or weights of one or more components with higher digits are not available.
[2] Missing data from January to April 2000 are calculated by linear interpolation.
[3] Residually calculated from available indices and weights.

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