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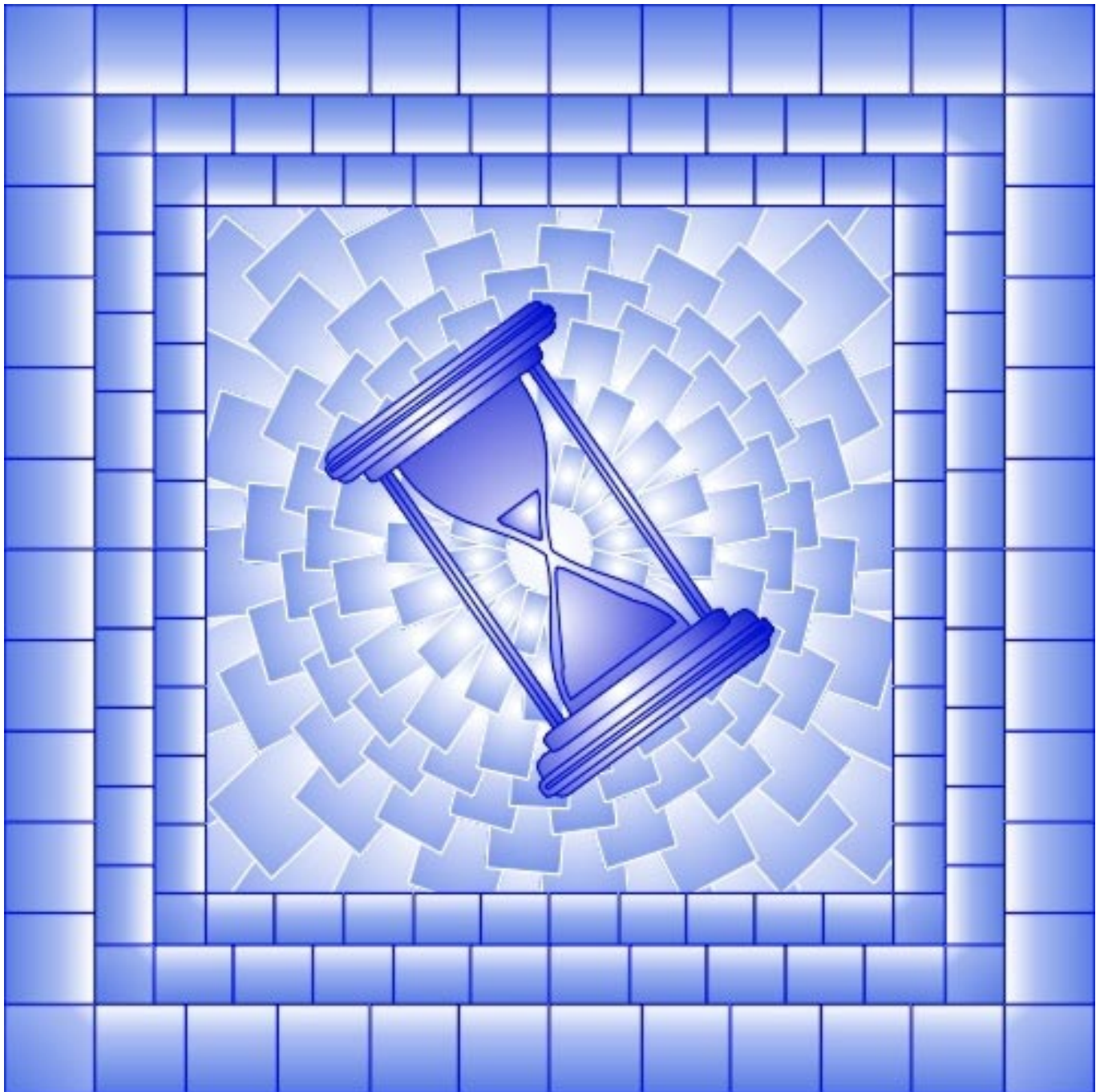
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Core Inflation A Weighted Median Index

By Jacques Taillon

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Core Inflation – A Weighted Median Index

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Preface

Prices Division first started publishing the Analytical Series in December 1996 as a means to convey conceptual and applied research undertaken by its staff, and at times, by other persons from within or outside Statistics Canada on the subject of price indexes.

All papers are reviewed by a panel of experts from within Statistics Canada or outside the agency. Views expressed in the papers are those of the authors and do not necessarily reflect those of Prices Division or Statistics Canada.

The purpose of the series is to disseminate knowledge and stimulate discussion. Questions and comments on any aspect of the papers are welcome and can be forwarded to Louis Marc Ducharme, Director (Internet email: ducharl@statcan.ca; Telephone: 613-951-0688) or to Robin Lowe, Chief, Quality Assurance (Internet email: lowerob@statcan.ca; Telephone: 613-951-9495), Prices Division, Statistics Canada, Ottawa, Ontario, K1A 0T6.

Abstract

Over the years, the concept of core inflation has become of crucial importance for the central banks of various countries. Indeed, many of them have at some point given themselves the mandate to reduce inflation and achieve price stability. The Bank of Canada undertook this mandate in February 1991.

Core inflation should reflect what is basic in price movements and ignore temporary fluctuations that have no long-term impact on prices. The phenomenon of core inflation must be of a lasting nature.

The targets were initially set on the basis of the overall consumer price index (CPI). However, the Bank of Canada has stated that for practical reasons, it will focus on the consumer price index excluding the volatile food and energy components.

The question that many are asking is the following: is a measure such as the CPI excluding food and energy a good indicator of core inflation? At the meeting of the 1996 Price Measurement Advisory Committee, a review of the literature on core inflation was presented. The Committee recommended taking a closer look at a weighted median index as a means of estimating core inflation. This article deals with the question of a weighted median index.

This study covers the period January 1985 to January 1997. The rates of change in the weighted median index calculated from monthly movements are quite often lower than the rates of change in the official index. This behaviour reflects the usual distribution of monthly price movements for the CPI, meaning a large proportion of the monthly movements are close to zero, and the remaining price movements are, in majority, positive.

Because of this behaviour of monthly movements, the weighted median index advances much more slowly than the official index. This behaviour is just as evident when inflation advances at annual rates of 4% to 5% as when it ranges around 2%.

An index based on the weighted median of monthly movements in the CPI yields somewhat disconcerting results. Even though some think that the official CPI does not clearly reflect the concept of core inflation, one does not necessarily expect to see such a large gap develop over time.

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1.0 Core inflation¹

1.1 Origin of the concept of core inflation

Over the years, the concept of core inflation has become of crucial importance for the central banks of various countries. Indeed, many of them have at some point given themselves the mandate to reduce inflation and achieve price stability. The Bank of Canada undertook this mandate in February 1991.²

The Bank of Canada recognises that a certain number of public policies besides monetary policy may play an important role in this mandate. But it sees its role as central when it adds that... since inflation cannot persist over an extended period without monetary accommodation, for price stability to be reached, it is essential for monetary policy to work firmly and consistently to that end.³

However, monetary policy influences inflation indirectly via its effects, transmitted through interest rates and the exchange rate, on total dollar spending and hence on the pressure of demand relative to the economy's capacity to produce goods and services. Because this process takes time, monetary policy cannot realistically offset the effects of unexpected price changes in the short run.⁴

The targets were initially set on the basis of the overall consumer price index (CPI). However, the Bank of Canada has stated that... for practical reasons, it will focus on the consumer price index excluding the volatile food and energy components...⁵ The Bank of Canada believes that it would be inappropriate for [its] monetary policy to try to offset short-run movements in the CPI caused by these fluctuations in the prices of food and energy.⁶ Indeed, when these two components are excluded, the volatility of the consumer price index is reduced. Thus, when bad weather conditions cause a major reduction in the supply of fruits and vegetables, prices tend to move sharply upward. This phenomenon is usually temporary, and prices soon return to approximately their former level. This, then, is not a long-term inflationary phenomenon, but rather a temporary and transitory one. A body responsible for monetary policy, such as the Bank of Canada, therefore avoids basing its decisions on this type of phenomenon.⁷

¹ *The author wishes to thank Michel Piché and Micki Kaminska for their work on the data and their diligence and kindness, Joanne Moreau and Charles Bérubé for their helpful comments, as well as Gail Logan and Nathalie Charron for the proofreading and text processing. The research for this study was completed in April 1997.*

² *Bank of Canada Review*, March 1991, "Press Release: Targets for Reducing Inflation", p. 5.

³ *Idem*, p. 5.

⁴ *Bank of Canada Review*, September 1991, "Targets for Reducing Inflation: Further Operational and Measurement Considerations", p. 4.

⁵ *Bank of Canada Review*, *Op. cit.*, March 1991, p. 6.

⁶ *Bank of Canada Review*, March 1991, "Background Note on the Targets", p. 12.

⁷ *Bryan, Michael F. and Stephen G. Cecchetti (1993) "Measuring Core Inflation", National Bureau of Economic Research Working Paper Series, No. 4303, p. 1.*

Thus it becomes easier to read movements in the consumer price index when certain more volatile components are excluded. On the other hand, it should be emphasised that the outright elimination of food and energy from the calculation of inflation means that the long-term contribution of these two components also disappears. The Bank of Canada will also exclude indirect taxes when they cause sudden fluctuations in inflation.⁸

The question that many are asking is the following: is a measure such as the CPI excluding food and energy a good indicator of core inflation? At the meeting of the 1996 Price Measurement Advisory Committee, a review of the literature on core inflation was presented.⁹ The Committee recommended taking a closer look at a weighted median index as a means of estimating core inflation. This article deals with the question of a weighted median index. The author acknowledges the significant contribution made by Scott Roger of the Reserve Bank of New Zealand on the subject of core inflation.

1.2 Definition of core inflation

Core inflation should reflect what is basic in price movements and ignore temporary fluctuations that have no long-term impact on prices. The phenomenon of core inflation must be of a lasting nature; otherwise analysing inflation would ultimately not make much sense.

Long-term price movements are influenced by aggregate demand, input costs and the expectations of consumers and firms. These factors should explain the behaviour of long-term inflation. Roger explains the concept of core inflation by using the economic theory of firms.¹⁰ As he points out, the latter cannot necessarily be transposed to movements of consumer prices. However, it sheds light on the understanding of the phenomenon.

In an economic climate where there are no disturbances affecting relative prices due to supply or consumer preferences, most firms will increase their prices in line with their estimation of the general rate of inflation or with the general rate of increase in their production costs. By aggregating all these estimates, we obtain what could be called core inflation.

Evidently, firms make errors when estimating price movements, and some dispersion of the different inflation expectations is to be anticipated. However, the estimation should be unbiased, and there is no obvious reason why these errors should be distributed asymmetrically.

⁸ *Bank of Canada Review*, *Op. cit.*, September 1991, p. 3.

⁹ Taillon, Jacques (1997) "Review of the Literature on Core Inflation", *Analytical Series*, No. 4, Catalogue No. 62F0014MPB, Prices Division, Statistics Canada.

¹⁰ Roger, Scott (1995) "Measures of Underlying Inflation in New Zealand, 1981-95", *Discussion Paper Series*, Reserve Bank of New Zealand, p. 26-27.

Furthermore, if a disturbance affects relative prices – that is, if a good or service becomes either more or less expensive in relation to other goods or services – a firm will have to choose between raising its prices immediately in the case of an increase or waiting until such time as it had planned to do so. If there are costs associated with an immediate price increase, the firm will raise its prices only if the disturbance is sufficiently great. Roger therefore thinks that most firms will increase their prices on the basis of the general inflation rate. Only firms having to deal with major disturbances will tend to increase their prices beyond their expectation of the general inflation rate.

1.3 Desired characteristics

Core inflation is a work tool for central banks. The desired characteristics of such a measure must satisfy a number of practical criteria. All these criteria have only one ultimate goal, namely the credibility of the measure on which to base the central bank's monetary policies.¹¹ The measure used for core inflation must:

- adequately represent the concept of price stability sought by central banks,
- be available soon after the reference period,
- be easy to understand,
- be easily reproduced by an external source,
- be non-revisable, and
- be accepted by the different economic players.

1.4 Different methods

In recent years, a number of methods for estimating core inflation have been proposed. These methods are described in a review of the literature on core inflation (Taillon, 1997), and they are presented in Appendix 2 with their respective advantages and disadvantages. These methods are specific adjustment, exclusion, econometric models, smoothing, the trimmed mean and the weighted median.

1.5 Choice of the consumer price index as initial measure

All measures advocated for estimating core inflation take the consumer price index as their starting point. In fact, the CPI is considered the best available measure of inflation by all who are interested in core inflation. However, some observers believe that the CPI is overly vulnerable to influences that mask the real trend of inflation. For this reason, there are various methods of modifying the CPI to extract what is basic from it.

¹¹ *Idem*, p. 15-19.

2.0 Weighted median method

The weighted median method takes the median price movement of the subcomponents of the official measure (the CPI) for a given month. Each movement is weighted according to its importance within the basket for the month in question.

Bryan and Pyke¹² proposed this method in 1991. The idea is not a new one; back in 1922, Fisher proposed that an index be calculated using weighted medians.¹³

2.1 Motivation

As Roger explained,¹⁴ the method of a weighted median index comes from the hypothesis that extreme movements of prices in the components of the CPI actually reflect temporary supply disturbances (such as a major decrease in the supply of oranges after a poor harvest) and not core inflation. By contrast, price movements closer to the centre of the distribution are said to reflect demand pressures as well as expectations.

However, the method using weighted medians will yield results different from the official inflation measure only if the distribution of the price movements of the subcomponents is skewed.

Use of the weighted median method is therefore motivated by the observation that the price movement of the different components of the CPI is often skewed.¹⁵ As an example, charts 1, 2 and 3 show the distribution of the monthly movements of the 182 basic classes for the months of January 1985, July 1985 and January 1997 respectively. (All charts in this article are found in Appendix 4.)

2.2 Example of calculation

Consider the monthly movement of the All-items CPI for January 1990 compared to December 1989. To illustrate our point, we will choose the level of the eight major components.

¹² Bryan and Cecchetti (1993), *Op. cit.*, p. 1.

¹³ Fisher, Irving (1927) “*The Making of Index Numbers – A Study of Their Varieties, Tests, and Reliability*”, *The Riverside Press Cambridge, Boston*, p. 377-378.

¹⁴ Roger (1995), *Op. cit.*, p. 26-27.

¹⁵ Bryan and Cecchetti (1993), *Op. cit.*, p. 1.

Table 1: Calculation of the monthly movement of the All-items CPI (January 1990 compared to December 1989) using the weighted median method

Major component	Monthly movement (%)	Implicit weight (%)	Cumulative weight (%)	Weighted median	Weighted mean (CPI)
Recreation, education and reading	-0.8052	9.73	9.73		
Health and personal care	0.1086	4.17	13.90		
Household operations and furnishings	0.2345	10.05	23.95		
Alcohol and tobacco	0.3510	6.23	30.18		
Clothing and footwear	0.5877	8.54	38.72	0.6741	0.9
Transportation	0.7260	18.06	56.78		
Shelter	0.9150	25.60	82.38		
Food	2.5162	17.62	100.00		

After the monthly movements of the CPI major components have been sorted in ascending order, the weighted median represents the monthly movement corresponding to a cumulative weight of 50%. The weighted median is then calculated as follows:

$$\frac{[(50\% - 38.72\%)*(0.7260) + (56.78\% - 50%)*(0.5877)]}{(56.78\% - 38.72\%)} = 0.6741 = 0.7 \text{ (once rounded)}$$

In the case of a distribution skewed to the right, the weighted median method will show a smaller movement than the weighted mean.

2.3 Different parameters influencing the calculation

2.3.1 Monthly movements from January 1985 to January 1997

The 182 basic classes from the 1992 basket were reconstructed for the 1982 and 1986 baskets in order to obtain continuous series of monthly movements of the CPI from January 1985 to January 1997.

In this article, the CPI has not been purged of the effect of various indirect taxes such as the federal goods and services tax (GST). Even though the Bank of Canada offers some justification for eliminating the short-term effects of indirect taxes, this decision seems to have an arbitrary element to it. The Bank of Canada believes that the decision to adjust inflation-reduction targets for changes in indirect taxes is based on the fact that changes in indirect taxes are largely unpredictable or, as with the introduction of the GST, are a major one-time event.¹⁶

2.3.2 Different measures based on a weighted median index

The calculation of a weighted median index depends on a number of factors. We will examine the influence of three of these factors: the level of aggregation, the type of temporal movement, and the presence or absence of seasonality.

i) Levels of aggregation

We will look at weighted median indexes on the basis of different levels of aggregation:

- the 182 basic classes according to the classification of goods and services in the 1992 basket, such as fresh or frozen beef, rent, mortgage interest cost, telephone services, tuition fees and liquor purchased from stores (for a more complete list, see Appendix 3);
- 44 intermediate aggregates such as meat, rental accommodation, mortgage interest cost, communications, education and reading, and alcoholic beverages (for a more complete list, see Appendix 3); and
- the 8 major components of the CPI, namely food, shelter, household operations and furnishings, clothing and footwear, transportation, health and personal care, recreation, education and reading, and alcoholic beverages and tobacco products.

The 182 basic classes are formed from a direct aggregation of prices. Any higher level, such as the 44 intermediate aggregates or the 8 major components, was obtained by calculating weighted means using the weights of the 1982, 1986 and 1992 baskets. The results will therefore be hybrid, since a weighted median calculation will have been superimposed on a weighted mean calculation.

¹⁶ *Bank of Canada Review, Op. cit., September 1991, p. 6.*

ii) Monthly movement vs. movement over twelve months

Two types of movements are examined:

- the current month compared to the preceding month (monthly movement), and
- the current month compared to the same month of the preceding year (movement over twelve months).

A weighted median index on a base of December 1984=100 will then be reconstructed using monthly movements.

Percentage changes of the CPI, rather than CPI indexes, are used to calculate a weighted median index. Indeed, the level of the CPI index has a considerable effect. For example, for an index at 137.1 in January 1997 on a base of 1986=100, much of the movement of 37.1% since 1986 could have occurred some years ago. Hence, considerable timeliness would be lost in a weighted median index calculated with indexes rather than movements. Furthermore, once a good has increased in price much more quickly or much more slowly than the others, it will always be very far from the median. Such a weighted median index would no longer be very meaningful.

The same reasoning also applies, to a lesser extent, to the movement for the current month over the same month in the preceding year. In this case, the bulk of the movement could have occurred at the beginning of the one-year period. The movement of this good over twelve months might be continually much greater than the others, even if in the meantime, no monthly movement occurs.

iii) Seasonally adjusted series

Only the eight major components of the CPI are officially available in seasonally adjusted form. A more elaborate study could extend seasonal adjustment further, say, to the 44 aggregates referred to in this paper.

3.0 Analysis of results

3.1 Distribution of the consumer price index

To explain the use of a weighted median index, Roger examines the distribution of movements in the CPI. A weighted mean is the most effective estimator for estimating the central value of a normal distribution. However, the less normal the distribution, the less effective the mean becomes.

The weighted mean is much more influenced by outliers than is the weighted median. However, if the distribution is symmetrical, the influence of outliers will neutralise themselves when a weighted mean is calculated. In the case of a symmetrical distribution, the weighted mean and the weighted median will yield similar results. Using a weighted median index offers advantages only if the distribution is skewed.

3.1.1 Monthly movement

Roger has shown that quarterly price movements in New Zealand do not follow a normal distribution.¹⁷ Their distribution is sufficiently skewed that using a weighted median is a better choice for estimating the central value of the distribution of price movements.

With the monthly price movements from the Canadian consumer price index, the results obtained are similar. For an illustration of this point, consider charts 1, 2 and 3 showing the distribution of unweighted monthly price movements for January 1985, July 1985 and January 1997 for the 182 basic classes. In these three cases, the distribution of price movements does not resemble a normal distribution. The movements are highly concentrated at the centre of the distribution. In addition, a greater number of movements are on the right side of the distribution.

Table 2 gives an insight into the distribution of the unweighted monthly movements in the consumer price index from January 1985 to January 1997. For each month and each level of aggregation, the mean, standard deviation, skewness coefficient and kurtosis coefficient have been calculated. Table 2 also shows the mean of each of these measures for the period January 1985 to January 1997. The kurtosis coefficient is a measure that indicates whether an abnormally high (in the sense of a normal distribution) proportion of movements are in the middle of the distribution (or on the contrary if the distribution is especially flat). Outliers, associated with skewness, will have a major effect on the mean.

¹⁷ Roger, Scott (1997) "A Robust Measure of Core Inflation in New Zealand, 1949-96", presented at the 3rd meeting of the International Working Group on Price Indices (Ottawa Group), April 16-18, 1997, Voorburg, Netherlands, p. 21.

Table 2: Characteristics of the distribution of unweighted monthly movements of the CPI from January 1985 to January 1997 for three levels of aggregation

Level of aggregation	Mean	Standard deviation	Skewness	Kurtosis
182 basic classes	0.18	2.38	1.68	66.30
44 aggregates	0.28	1.43	0.22	15.57
8 major components	0.26	0.57	0.30	0.31

A normal distribution will have a skewness coefficient equal to 0, whereas the kurtosis coefficient will have a value of 3. A skewness coefficient greater than 0 indicates skewness to the right, whereas a value less than 0 indicates skewness to the left. For a kurtosis coefficient, a value greater than 3 indicates that the distribution is mostly concentrated around the middle, whereas a value less than 3 indicates a fairly flat distribution. Roger reports that a Monte Carlo simulation showed that if the kurtosis coefficient is greater than 5.5, it is preferable to use the sample median rather than the sample mean to estimate the population mean.¹⁸

When we observe the lowest level of aggregation, it becomes clear that the distribution of the monthly price movements of the 182 basic classes in the CPI does not follow a normal distribution.

3.1.2 Movement over twelve months

Similarly, Table 3 gives an insight into the distribution of movements over twelve months in the consumer price index from January 1986 to January 1997. For each month and each level of aggregation, the mean, standard deviation, skewness coefficient and kurtosis coefficient have been calculated. Table 3 also shows the mean of each of these measures for the period January 1986 to January 1997.

Table 3: Characteristics of the distribution of unweighted movements over 12 months in the CPI from January 1986 to January 1997 for three levels of aggregation

Level of aggregation	Mean	Standard deviation	Skewness	Kurtosis
182 basic classes	3.54	5.49	1.05	24.97
44 aggregates	3.44	4.31	-0.12	6.07
8 major components	3.27	2.13	0.36	1.34

¹⁸ *Idem*, p. 13.

In this case, the distribution of movements over twelve months is somewhat closer to a normal distribution than the distribution of monthly movements, but is nevertheless still fairly far from it.

We can therefore expect that a weighted median index for movements over twelve months will yield results closer to those of a weighted mean index than in the case of monthly movements. This is illustrated in charts 4, 5 and 6.

3.2 Weighted median index

3.2.1 Monthly movement

The rates of change in the weighted median index calculated from monthly movements are quite often lower than the rates of change in the official index. This behaviour reflects the usual distribution of monthly price movements for the CPI, meaning a large proportion of the monthly movements are close to zero, and the remaining price movements are, in majority, positive. This phenomenon is observed for all three levels of aggregation, as well as for the seasonally adjusted CPI (see charts 7, 8, 9 and 10).

Because of this behaviour of monthly movements, the weighted median index advances much more slowly than the official index. This behaviour is just as evident when inflation advances at annual rates of 4% to 5% as when it ranges around 2%. In the latter case, monthly movements for a great number of basic classes are nil. As a result, the weighted median method will quite often produce nil monthly movements. In the long run, the spread between the indexes can be fairly sizeable. On the base of December 1984=100, the indexes in January 1997 for the All-items CPI and the weighted median indexes for the aggregation levels of 182 basic classes, 44 aggregates and 8 major components are respectively 146.3, 117.5, 126.6 and 127.5 (see Chart 11). For the seasonally adjusted CPI, the gap is narrower: 145.9 for the seasonally adjusted All-items CPI and 136.2 for the weighted median index based on monthly movements of the seasonally adjusted eight major components (see Chart 12).

This phenomenon appears to indicate that a bias exists, but what form does it take? If the “true” nature of core inflation is well represented by a weighted median index, we find that the official index tends to overestimate it. The line of argument set out in Section 2.1 tells us that in theory, extreme movements are the result of temporary supply shocks. The rest of the movements tend to be grouped together and are possibly closer to a normal distribution.

As to the CPI excluding food and energy, Laflèche (1996) points out that it is because of the systematic exclusion of the price of all foods that the change in the CPI excluding food and energy is greater than the change in the total CPI over the observation period, since food prices increased much less quickly than the overall index from 1987 to 1992... The relative price of energy, for its part, showed no particular trend (see Chart 11).¹⁹

¹⁹ Laflèche, Thérèse (1996) “Mesure du taux d’inflation tendanciel – Première partie”, Bank of Canada, Current Analysis Division, Research Department, RM-96-33, p. 10.

Table 4 shows that the weighted median method gives a lower estimated value of the overall price movements in the population than does the weighted mean method. However, variability (standard deviation/mean) is roughly the same in the two cases.

Table 4: Comparison of the mean and standard deviation of monthly movements from January 1985 to January 1997 in the official CPI, the CPI excluding food and energy, the seasonally adjusted CPI, and weighted median indexes

Method	Level of aggregation	Mean	Standard deviation	Variability
Mean	CPI	0.26	0.32	1.24
Mean	CPI excluding food and energy	0.28	0.32	1.12
Median	182 basic classes	0.11	0.14	1.28
Median	44 aggregates	0.16	0.22	1.34
Median	8 major components	0.17	0.29	1.75
Mean	CPI, seasonally adjusted	0.26	0.28	1.07
Median	8 major components, seasonally adjusted	0.21	0.25	1.15

Two monthly movements were especially pronounced during the observation period, reflecting the introduction of the goods and services tax in January 1991 and the lowering of taxes on tobacco products in February 1994.

In the first case, the calculation of the weighted median from the 182 basic classes of the CPI reduced the monthly movement by more than half (from 2.6% to 1.2%; see Chart 7). On the other hand, when the 44 aggregates or 8 major components are used, the monthly movement is quite similar to the official movement (2.3% and 2.6% respectively; see charts 8 and 9). The introduction of the GST affected the vast majority of goods and services. However, it did not influence all of them in the same way. Most goods manufactured in Canada already had a federal tax included in their price, whereas services were exempt from taxes. Thus, some basic classes would have exhibited an increase of approximately 7% (the rate resulting from the introduction of the GST), while others would have exhibited a smaller increase since the GST was replacing the former federal tax on goods manufactured in Canada.

Unlike the introduction of the GST, the lowering of taxes on tobacco products had a very localised effect. The calculation of the weighted median easily eliminated the effect of the lowering of taxes on tobacco products. That was an extreme price movement. The monthly rate of change in the CPI was -0.8%, whereas the weighted median technique yielded a month-to-month movement of 0.2%.

3.2.2 Movement over twelve months

The weighted median method was also used directly with movements over twelve months. Such a technique does not lend itself to reconstructing an index, since sub-annual information is eliminated at the outset. With this approach, we can compare movements over twelve months using the weighted median technique with movements over twelve months according to the official measure.

The measure of movements over twelve months as calculated according to the weighted median technique follows the official movement much more closely than its monthly counterpart. Laflèche (1996) obtains similar results. Furthermore, median movements over twelve months are as likely to be higher than the official movements over twelve months as they are to be lower. A systematic downward bias does not appear to be a characteristic of the weighted median method applied to movements over twelve months. This is due to the distribution of movements over twelve months that are not systematically asymmetrical, as the monthly movements tended to be.

Once again, the weighted median technique would not have followed the downward movement of the tax on tobacco products (see charts 13 and 14). The only exception is where the eight major components are aggregated (see Chart 15). In that case, the movement over twelve months using the weighted median more closely follows the official movement during 1994.

We can also compare the movements over twelve months in the CPI with the movements over twelve months as measured by the weighted median method applied to monthly movements (Section 3.2.1). In that case, the movements over twelve months are considerably smaller than the official movements over twelve months (see Chart 16). This is not surprising since, as was shown earlier, the weighted median indexes applied to monthly movements have much lower values than those associated with the CPI.

4.0 Conclusion

An index based on the weighted median of monthly movements in the CPI yields somewhat disconcerting results. Even though some think that the official CPI does not clearly reflect the concept of core inflation, one does not necessarily expect to see such a large gap develop over time. Even where the calculation is based on the eight major components only, the weighted median index yields considerably different results than the official CPI.

A common way of estimating the trend of a series is to screen out movements that have a very high frequency (noise). If a non-linear filter (using medians since they are more robust – see Appendix 2, Smoothing) were applied to the CPI series, the estimate of core inflation would be quite different from the one obtained with the weighted median method. Such a technique would follow the general movement in the CPI while avoiding those fluctuations that do not contribute to the understanding of core inflation. This technique does not meet all the practical criteria identified by Roger (Section 1.3), but it would provide a useful basis for comparison.

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APPENDICES

Appendix 1: Distribution of percentiles for selected basic classes

When a weighted median index is calculated, each basic class obtains a percentile that depends on its price movement in a given month. By grouping the percentiles from all the months studied for a given basic class, we can learn about the behaviour of the price movements of this basic class in relation to the median movement.

The distribution of the percentiles for the basic classes is quite interesting. For a seasonal class such as oranges, the percentiles approach both 0% and 100%, since the monthly price movements for oranges tend to be either highly negative or highly positive (see Chart 17). This confirms that the monthly price movements for oranges are not particularly representative of the overall monthly movement as measured by a weighted median index. The same phenomenon is observed, although to a lesser extent, with movements over twelve months; the volatility of the price of oranges is still fairly sizeable (see Chart 18).

Some basic classes with a price collection frequency of less than once per month will be representative of the overall median monthly movement only when the inflation rate is near zero. For example, the tuition fees category, for which prices are collected once a year, will exhibit no monthly movement eleven months in twelve (see Chart 19).

By contrast, the situation is reversed when movements over twelve months are used. The movement will remain high over the entire year if, in the month of collection, a major upward movement takes place. Thus, tuition fees will only rarely be near the overall median movement (see Chart 20).

It is interesting to note that other basic classes appear to be more representative of the overall median movement, such as liquor purchased from stores (see charts 21 and 22).

Appendix 2: Various methods of estimating core inflation

Specific adjustment

The goal here is to eliminate identifiable shocks that have nothing to do with the upward pressure of demand. Adjustments are made on an ad hoc basis (e.g., introduction of the GST – goods and services tax).

Advantages

- This method will work fairly well when relevant information is quickly available on the effects of the shock (in terms of timing and magnitude) on the general movement of prices.²⁰
- The task of eliminating “undesirable” components can be better targeted. Indeed, the effect of a shock on a subcomponent can be removed without affecting the movement of prices in the rest of the component, since the latter results from “normal” market conditions.²¹
- The measure can be made available at the same time as the official inflation measure (CPI).

Disadvantages

- The method of specific adjustment... is probably better suited to dealing with generalised price level shocks than with shocks to particular prices... The more indirectly that shocks feed into the price level, the more difficult it is to make specific adjustments.²²
- There is an arbitrary element to identifying supply shocks. At what point, for example, is a shock considered to be sufficiently powerful to be given special treatment?²³

²⁰ Roger (1995), *Op. cit.*, p. 21.

²¹ Johnson, Leanne (1996) “*Measuring Inflation – A Discussion Paper*”, Australian Bureau of Statistics, Draft paper, Last update: 04/04/96, Appendix 3.

²² Roger (1995), *Op. cit.*, p. 21.

²³ Johnson (1996), *Op. cit.*, Appendix 3.

Exclusion

This method is used by a number of central banks in their efforts to identify core inflation. Exclusion does not necessarily apply to the same components from one country to another. In Canada, food and energy account for roughly 26% of the CPI basket. Referring to the New Zealand experience, Roger has the following to say about the subject:

Adjustment by exclusion or replacement: ... adjustment by exclusion lends itself to dealing with particular subcomponents of the aggregate price index whose behaviour is judged to differ frequently and significantly from the concept of trend or underlying inflation... Adjustment by exclusion, however, is not suited to purging the effects of generalised price disturbances. Nonetheless, adjustment by exclusion is the most commonly used method of defining measures of trend or underlying inflation.

In the case of food, the rationale for systematic exclusion tends to rest on their susceptibility to seasonal supply disturbances making them particularly erratic or volatile. By excluding such prices, therefore, the remainder of the CPI should be less volatile and more representative of the general trend of prices.

Although energy prices and prices essentially determined by government policy may not be highly volatile, their movements, like those of food prices, may be only loosely related to demand pressures in the economy. By excluding such prices, therefore, the remaining CPI should be more representative of inflation driven by the state of excess demand pressures in the economy.²⁴

Advantages

- This method is predictable, systematic and easy to understand.
- Because it is completely specified in advance, the exclusion method has great transparency; verification of the results by others is relatively easy; and analysis and forecasts are facilitated.²⁵
- ... may be better suited to eliminating “noise” arising from relative price disturbances...²⁶
- The measure can be made available at the same time as the official inflation measure (CPI).

²⁴ Roger (1995), *Op. cit.*, p. 22-23.

²⁵ Johnson (1996), *Op. cit.*, Appendix 3.

²⁶ *Idem*, p. 23-25.

Disadvantages

- The exclusion method does not allow for adjustments when sudden changes in supply occur that affect components not already excluded.
- There are no objective criteria for determining which components will be systematically excluded.
- When a component is excluded, we eliminate not only the “noise” associated with this component but also the contribution of this series to the medium to long-term trend.
- ... while such a measure may be credible in the sense of being immune to central bank manipulation, it may not be credible in the sense of being widely accepted as a reliable measure of the underlying inflation concept...²⁷

In the case of Australia, this approach excludes 49% of the initial basket of the consumer price index. The Australian Bureau of Statistics also sees a number of advantages and disadvantages to this official measure which are basically the same as those presented by Roger.

²⁷ Roger (1995), *Op. cit.*, p. 22-25.

Econometric model

Eckstein developed an econometric model of the US economy. In it, the measured inflation rate is divided into three components: core inflation, inflation related to supply shocks, and demand-driven inflation. Core inflation is represented as follows:

The core inflation rate, or the trend in the aggregate supply price, is the weighted average of the trend rates of increase of the rental price of capital and unit labour cost.²⁸

Advantage

- None of the preceding methods establishes any direct link with other variables of the economy. By adding a great number of variables such as the price trend expectation, employment, the unemployment rate, interest rates, investment, the price-dividend ratio, energy prices and investment demand..., Eckstein takes account of the role of inflation in the economy.

Disadvantages

- This model uses a fairly large number of variables. The results will therefore become available several periods after the reference period.
- The model is not within the grasp of the general public.

²⁸ Eckstein, Otto (1981) "Core Inflation", Prentice-Hall Inc., New Jersey, p. 13.

Smoothing

Different smoothing techniques may be used to identify the trend of a series. One of the best known is the X11-ARIMA seasonal adjustment program.

Advantages

- Easy to use.
- The measure may be made available at the same time as the official inflation measure (CPI).

Disadvantages

- The understanding of the technique is not necessarily within the grasp of the general public.
- In general, it is preferable to avoid using techniques that are based primarily on moving arithmetic means (such as X11-ARIMA). These techniques are heavily influenced by outliers (shocks). One way to get around this problem is to employ non-linear smoothing techniques using medians.²⁹
- Bryan and Cecchetti found that solutions to the problem of high-frequency noise in the price data include calculating low-frequency trends, which consequently reduces the noise. But, from a policymaker's perspective, this greatly reduces the timeliness, and therefore, the relevance of the incoming data.³⁰

This problem can be avoided, in part, by making forecasts at the end of the series. If these forecasts are used, the estimate of the trend at the end of the series will then be current. However, the estimate will be subject to revision for a period of time.

²⁹ Velleman P.F. (1980) "Definition and Comparison of Robust Nonlinear Data Smoothing Algorithms", *Journal of American Statistical Association*, September, 75 (371), p. 609.

³⁰ Bryan and Cecchetti (1993), *Op. cit.*, p. 1.

Trimmed mean

This approach looks at the distribution of price movements at a highly disaggregated level. It excludes movements that are too extreme, leaving only those that are typical for the period concerned. It re-aggregates the goods and services whose movements are typical, and the result is a measure of core inflation. This approach is fairly recent, and it appears to be attracting the interest of the official bodies of a number of countries. It is suggested by Bryan and Cecchetti.³¹

Roger explains that:

... it excludes (i.e., zero-weights) extreme, or outlier, CPI subcomponent price changes... The interpretation of the trimmed mean as a measure of underlying inflation hinges on the hypothesis that the extreme price movements excluded from the measure primarily reflect supply disturbances, while price movements closer to the centre of the price distribution primarily reflect demand pressures and inflation expectations.³²

This approach will yield different results from the official inflation measure only if the distribution of price movements of the subcomponents is asymmetrical.

Advantages

- Unlike the exclusion method, this method does not automatically exclude certain components every month.
- The calculations are simple.
- It is relatively easy to gain an intuitive grasp of this method.
- The measure can be made available at the same time as the official inflation measure (CPI).
- The trimmed mean method is noticeably less subjective than the exclusion method. The choice of the components to be excluded is less arbitrary, since it is made on the basis of their statistical behaviour.³³

³¹ *Idem*, p. 1.

³² Roger (1995), *Op. cit.*, p. 26.

³³ Johnson (1996), *Op. cit.*, Appendix 3.

Disadvantages

- As in the exclusion method, part of the information in the official measure is disregarded each month.³⁴
- This method can make it more difficult to interpret core inflation in economic terms, since the mix of components included in it is never the same from one month to another.
- Deciding on the exclusion threshold is fairly arbitrary.
- This method depends on the level of disaggregation to which it is applied. As may be imagined, results may differ if highly disaggregated levels are chosen, since there is a higher likelihood of observing greater price volatility.

³⁴ Quah, Danny and Shaun P. Vahey (1995) "Measuring Core Inflation", *The Economic Journal*, 105 (September), Royal Economic Society, Oxford, p. 1132.

Weighted median

Bryan and Pyke suggested this method in 1991. It is similar to the preceding one. Both are based on the observation that the movement of prices of the different CPI components is asymmetrical.³⁵ The weighted median method takes the median price movement of the subcomponents of the official measure (CPI). As Bryan and Cecchetti explain, the weightings are interpreted as follows:

... in computing the histogram for inflation in each month, we assume that the weight represents the percentage of the distribution of all prices that experienced that amount of inflation.³⁶

Advantages

- The weighted median method uses all the subcomponents of the CPI rather than eliminating some of them, as the trimmed mean method does.³⁷
- The calculations are simple.
- In dealing with the effects of outliers, methods based on medians are generally more robust than methods based on arithmetic means.
- The measure may be made available at the same time as the official inflation measure (CPI).
- Evidence suggests that periods where we observe significant deviations of the mean from the median inflation rate, are often periods where price or supply shocks are known to have occurred (Ball and Mankiw, 1992). The weighted median... may, therefore, be very effective in removing the volatility of such shocks.³⁸

Disadvantages

- This method depends on the level of disaggregation to which it is applied. As may be imagined, results may differ if highly disaggregated levels are chosen, since there is a higher likelihood of observing greater price volatility.
- The use of the median is less intuitive than the use of the arithmetic mean. It may be more difficult to gain public acceptance of this method.

³⁵ Bryan and Cecchetti (1993), *Op. cit.*, p. 1.

³⁶ *Idem*, p. 10.

³⁷ Roger (1995), *Op. cit.*, p. 28.

³⁸ Johnson (1996), *Op. cit.*, Appendix 3.

Appendix 3: List of goods and services corresponding to CPI levels of aggregation

List of 182 basic classes in the 1992 basket

	Code	Name	1992 Weight
1	11010101	Fresh or frozen beef	1.03
2	11010102	Fresh or frozen pork	0.33
3	11010103	Other fresh or frozen meat (excluding poultry)	0.12
4	11010201	Fresh or frozen chicken	0.48
5	11010202	Other fresh or frozen poultry	0.11
6	11010301	Ham and bacon	0.32
7	11010302	Other processed meat	0.62
8	11020101	Fresh or frozen fish (including portions and fish sticks)	0.19
9	11020102	Canned or other preserved fish	0.10
10	110202	Other seafood	0.12
11	11030101	Fresh milk	0.72
12	11030102	Butter	0.13
13	11030103	Cheese	0.61
14	11030104	Ice cream and related products	0.15
15	11030105	Other dairy products	0.24
16	110302	Eggs	0.16
17	11040101	Bread, rolls and buns	0.60
18	11040102	Biscuits	0.30
19	11040103	Other bakery products	0.34
20	11040201	Rice (including mixes)	0.07
21	11040202	Breakfast cereal and other cereal products	0.35
22	11040203	Pasta products	0.14
23	11040204	Flour and flour based mixes	0.09
24	11050101	Apples	0.17
25	11050102	Oranges	0.13
26	11050103	Bananas	0.13
27	11050104	Other fresh fruit	0.37
28	11050201	Fruit juices	0.35
29	11050202	Other preserved fruit and fruit preparations	0.18
30	110503	Nuts	0.07
31	11060101	Potatoes	0.12
32	11060102	Tomatoes	0.12
33	11060103	Lettuce	0.09
34	11060104	Other fresh vegetables	0.54
35	11060201	Frozen and dried vegetables	0.11
36	11060202	Canned vegetables and other vegetable preparations	0.22
37	11070101	Sugar and syrup	0.08

List of 182 basic classes in the 1992 basket (continued)

	Code	Name	1992 Weight
38	11070102	Confectionery	0.28
39	11070201	Margarine	0.11
40	11070202	Other edible fats and oils	0.06
41	11070301	Coffee	0.17
42	11070302	Tea	0.06
43	110704	Condiments, spices and vinegars	0.37
44	11070501	Soup	0.16
45	11070502	Infant and junior foods	0.08
46	11070503	Pre-cooked frozen food preparations	0.17
47	11070504	All other food preparations	0.54
48	110706	Non-alcoholic beverages	0.59
49	1201	Food purchased from table-service restaurants	3.19
50	1202	Food purchased from fast food and take-out restaurants	1.43
51	1203	Food purchased from cafeterias and other restaurants (Dec. 1994=100)	0.85
52	2101	Rent	6.98
53	2102	Tenants' insurance premiums	0.11
54	2103	Tenants' maintenance, repairs and other expenses	0.11
55	2201	Mortgage interest cost	5.70
56	2202	Replacement cost	3.62
57	2203	Property taxes (including special charges)	3.07
58	2204	Homeowners' insurance premiums	0.84
59	2205	Homeowners' maintenance and repairs	1.46
60	2206	Other owned accommodation expenses (Dec. 1994=100)	1.23
61	2301	Electricity	2.67
62	2302	Water	0.42
63	2303	Gas	0.79
64	2304	Fuel oil and other fuel	0.57
65	310101	Telephone services	1.93
66	310102	Postal services and other communications services	0.16
67	310201	Child care	0.81
68	310202	Domestic services	0.25
69	310301	Detergent and soap	0.38
70	310302	Other household chemical products	0.40
71	310401	Paper supplies	0.63
72	310402	Plastic and foil supplies	0.15
73	310501	Pet food and supplies	0.48
74	310502	Seeds, plants and cut flowers	0.28
75	310503	Other horticultural goods	0.08
76	310601	Other household supplies	0.21

List of 182 basic classes in the 1992 basket (continued)

	Code	Name	1992 Weight
77	310602	Other household services (Dec. 1994=100)	0.30
78	32010101	Upholstered furniture	0.48
79	32010102	Wooden furniture	0.58
80	32010103	Other furniture (Dec. 1994=100)	0.46
81	32010201	Window coverings	0.21
82	32010202	Bedding and other household textiles	0.32
83	32010203	Area rugs and carpets	0.07
84	32020101	Cooking appliances	0.18
85	32020102	Refrigeration and air conditioning appliances	0.24
86	32020103	Laundry and dishwashing appliances	0.19
87	32020104	Other household appliances	0.22
88	32020201	Kitchen utensils	0.10
89	32020202	Tableware and flatware	0.09
90	32020301	House and yard tools (Dec. 1994=100)	0.46
91	32020302	Other household equipment (Dec. 1994=100)	0.37
92	3203	Services related to household furnishings	0.31
93	410101	Women's coats and jackets	0.37
94	410102	Women's dresses	0.30
95	410103	Women's suits, skirts and pants	0.62
96	410104	Women's blouses, sweaters and other tops	0.50
97	410105	Women's active sportswear	0.14
98	410106	Women's underwear, sleepwear and hosiery	0.47
99	410201	Men's coats and jackets	0.24
100	410202	Men's suits and sport jackets	0.30
101	410203	Men's pants	0.36
102	410204	Men's sweaters and shirts	0.40
103	410205	Men's active sportswear	0.10
104	410206	Men's underwear, sleepwear and hosiery	0.17
105	410301	Children's outerwear	0.08
106	410302	Children's pants and dresses	0.20
107	410303	Children's sweaters, shirts and blouses	0.09
108	410304	Children's active sportswear (Dec. 1994=100)	0.05
109	410305	Children's underwear, sleepwear and hosiery	0.09
110	4201	Women's footwear (excluding athletic)	0.35
111	4202	Men's footwear (excluding athletic)	0.25
112	4203	Children's footwear (excluding athletic) (Dec. 1994=100)	0.09
113	4204	Athletic footwear	0.24
114	4301	Leather accessories	0.16
115	4302	Watches	0.08

List of 182 basic classes in the 1992 basket (continued)

	Code	Name	1992 Weight
116	4303	Jewellery	0.31
117	4304	Other accessories (Dec. 1994=100)	0.21
118	4401	Clothing material and notions	0.15
119	4402	Laundry service	0.15
120	4403	Dry cleaning services	0.24
121	4404	Other clothing services	0.10
122	51010101	Purchase of automobiles	4.52
123	51010102	Purchase of trucks and vans (Dec. 1988=100)	1.97
124	510102	Rental and leasing of automotive vehicles	0.42
125	510201	Gasoline	3.78
126	51020201	Automotive vehicle parts and supplies	0.78
127	51020202	Automotive vehicle maintenance and repair services	1.32
128	51020301	Automotive vehicle insurance premiums	2.51
129	51020302	Automotive vehicle registration fees	0.28
130	51020303	Drivers' licences	0.09
131	51020304	Parking fees	0.15
132	51020305	All other automotive vehicle operating expenses	0.09
133	520101	City bus and subway transportation	0.39
134	520102	Taxi and other local and commuter transportation	0.14
135	520201	Air transportation	0.65
136	520202	Rail, bus and other inter-city transportation	0.10
137	61010101	Prescribed medicines	0.39
138	61010102	Non-prescribed medicines	0.22
139	610102	Other health care goods	0.08
140	610201	Eye care	0.34
141	610202	Dental care	0.57
142	610203	Other health care services (Dec. 1994=100)	0.18
143	620101	Personal soap	0.11
144	620102	Toilet preparations and cosmetics	1.03
145	620103	Oral-hygiene products	0.15
146	620104	Other personal care supplies and equipment	0.36
147	6202	Personal care services	0.94
148	710101	Sporting and athletic equipment	0.43
149	710102	Toys, games and hobby supplies	0.42
150	710103	Computer equipment and supplies (Dec. 1994=100)	0.45
151	710104	Photographic equipment	0.06
152	710105	Photographic services and supplies	0.32
153	710106	Other recreational equipment and services (Dec. 1994=100)	0.19
154	710201	Purchase of recreational vehicles	0.76

List of 182 basic classes in the 1992 basket (concluded)

	Code	Name	1992 Weight
155	71020201	Fuel, parts and supplies for recreational vehicles (Dec. 1994=100)	0.17
156	71020202	Insurance, licences and other services for recreational vehicles (Dec. 1994=100)	0.18
157	710301	Audio equipment	0.27
158	710302	Audio discs and tapes	0.35
159	710303	Video equipment	0.48
160	710304	Rental of videotapes and videodiscs (Dec. 1988=100)	0.25
161	710305	Purchase of videotapes and videodiscs (Dec. 1994=100)	0.11
162	710306	Other home entertainment services and equipment	0.09
163	71040101	Hotels and motels	0.57
164	71040102	Other traveller accommodation (Dec. 1994=100)	0.43
165	710402	Travel tours	0.66
166	710501	Spectator entertainment (excluding cablevision)	0.48
167	710502	Cablevision (including pay TV)	0.57
168	710503	Use of recreational facilities and services	0.84
169	720101	Tuition fees	0.86
170	720102	School textbooks and supplies (Dec. 1994=100)	0.29
171	720103	Other lessons, courses and education services	0.21
172	720201	Newspapers	0.31
173	720202	Magazines and periodicals	0.20
174	720203	Books (excluding textbooks) and other printed matter	0.23
175	810101	Served beer	0.57
176	810102	Served wine (Dec. 1994=100)	0.18
177	810103	Served liquor	0.21
178	810201	Beer purchased from stores	0.99
179	810202	Wine purchased from stores	0.47
180	810203	Liquor purchased from stores	0.53
181	8201	Cigarettes	2.18
182	8202	Other tobacco products and smokers' supplies (Dec. 1994=100)	0.33

Appendix 3: List of goods and services corresponding to CPI levels of aggregation

List of 44 aggregates

	Code	Name	1992 Weight
1	1101	Meat	3.00
2	1102	Fish and other seafood	0.42
3	1103	Dairy products and eggs	2.01
4	1104	Bakery and other cereal products	1.89
5	1105	Fruit, fruit preparations and nuts	1.40
6	1106	Vegetables and vegetable preparations	1.20
7	1107	Other food products	2.67
8	12	Food purchased from restaurants	5.46
9	21	Rented accommodation	7.20
10	2201	Mortgage interest cost	5.70
11	2202	Replacement cost	3.62
12	2203	Property taxes (including special charges)	3.07
13	22XX	Homeowners' insurance premiums + Homeowners' maintenance and repairs + Other owned accommodation expenses (Dec. 1994=100) (2203+2204+2205)	3.53
14	23	Water, fuel and electricity	4.45
15	3101	Communications	2.10
16	3102	Child care and domestic services	1.06
17	3103	Household chemical products	0.78
18	3104	Paper, plastic and foil supplies	0.78
19	3105	Other household goods and services	1.35
20	3106	Other household supplies and services	0.51
21	3201	Household furnishings	2.12
22	3202	Household equipment	1.85
23	3203	Services related to household furnishings	0.31
24	4101	Women's clothing	2.41
25	4102	Men's clothing	1.57
26	4103	Children's clothing	0.51
27	42	Footwear	0.93
28	43	Clothing accessories and jewellery	0.76
29	44	Clothing material, notions and services	0.64
30	5101	Purchase and rental of automotive vehicles	6.92
31	510201	Gasoline	3.78
32	510202	Automotive vehicle parts, maintenance and repairs	2.11
33	510203	Other automotive vehicle operating expenses	3.13
34	52	Public transportation	1.29
35	61	Health care	1.76

List of 44 aggregates (concluded)

	Code	Name	1992 Weight
36	62	Personal care	2.59
37	7101	Recreational equipment and services (excluding vehicles)	1.87
38	7102	Purchase and operation of recreational vehicles	1.12
39	7103	Home entertainment equipment and services	1.54
40	7104	Travel services	1.66
41	7105	Other recreational services	1.89
42	72	Education and reading	2.10
43	81	Alcoholic beverages	2.96
44	82	Tobacco products and smokers' supplies	2.51

Appendix 3: List of goods and services corresponding to CPI levels of aggregation**List of 8 major components**

Code	Name	1992 Weight
1	Food	18.04
2	Shelter	27.58
3	Household operations and furnishings	10.35
4	Clothing and footwear	6.82
5	Transportation	17.22
6	Health and personal care	4.35
7	Recreation, education and reading	10.17
8	Alcoholic beverages and tobacco products	5.47

Appendix 4: Study charts

Chart 1: Distribution of unweighted monthly price movements for January 1985 for the 182 basic classes

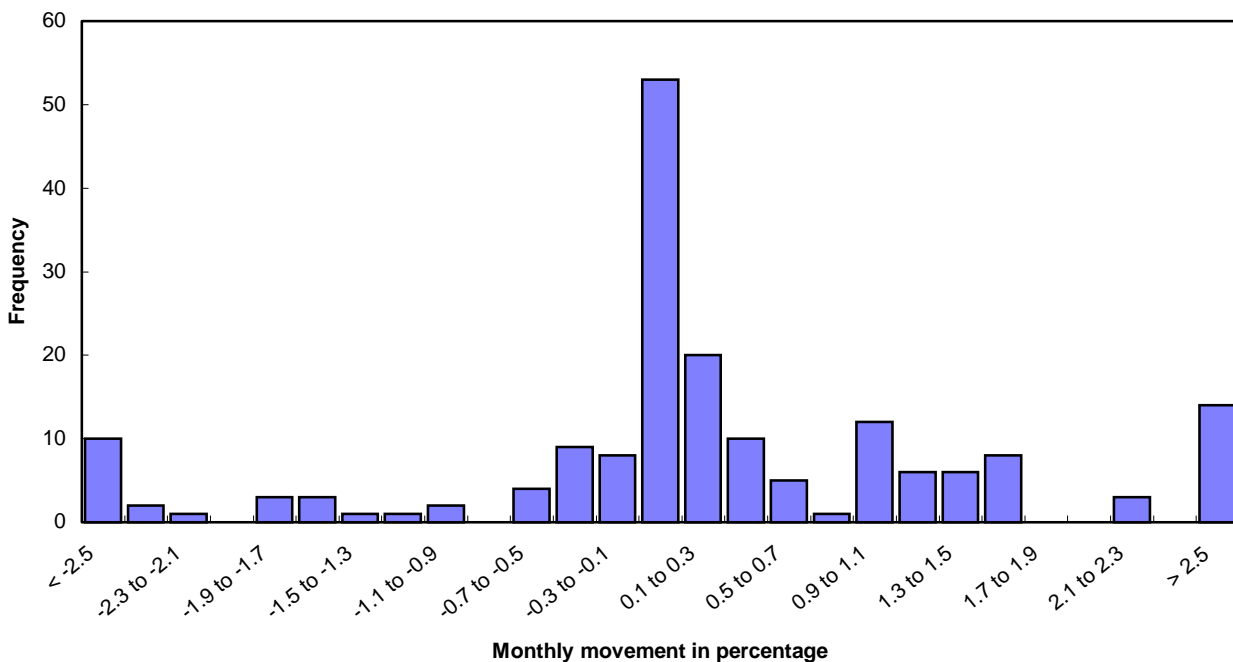


Chart 2: Distribution of unweighted monthly price movements for July 1985 for the 182 basic classes

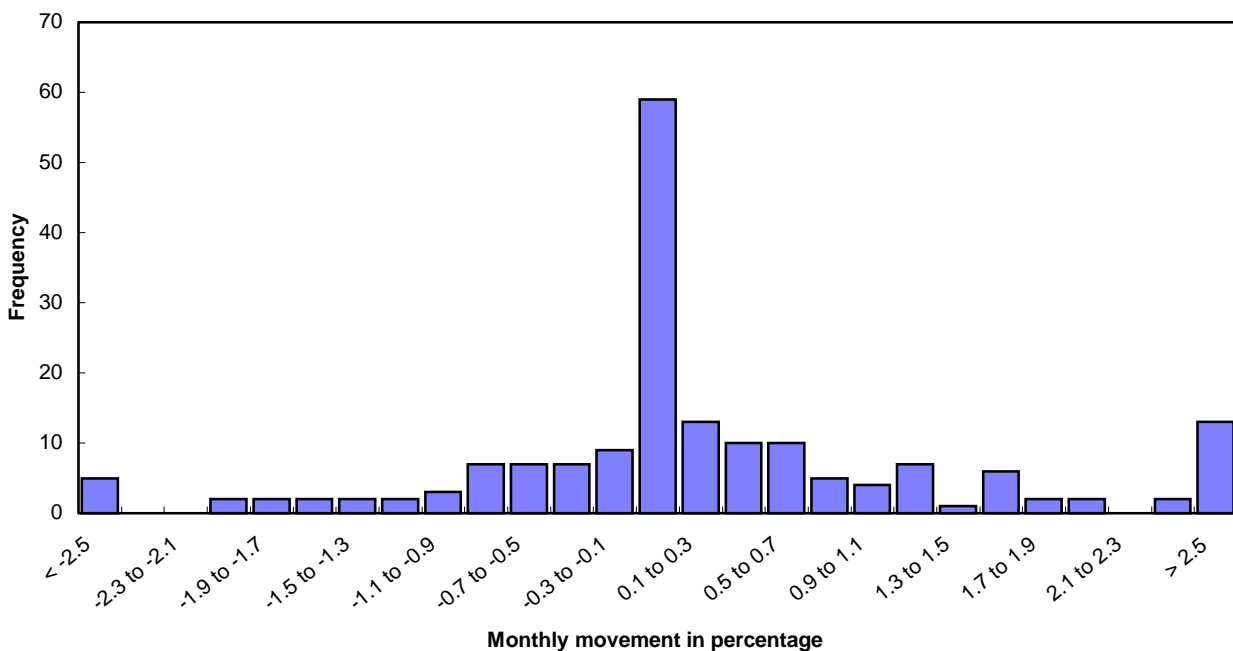


Chart 3: Distribution of unweighted monthly price movements for January 1997 for the 182 basic classes

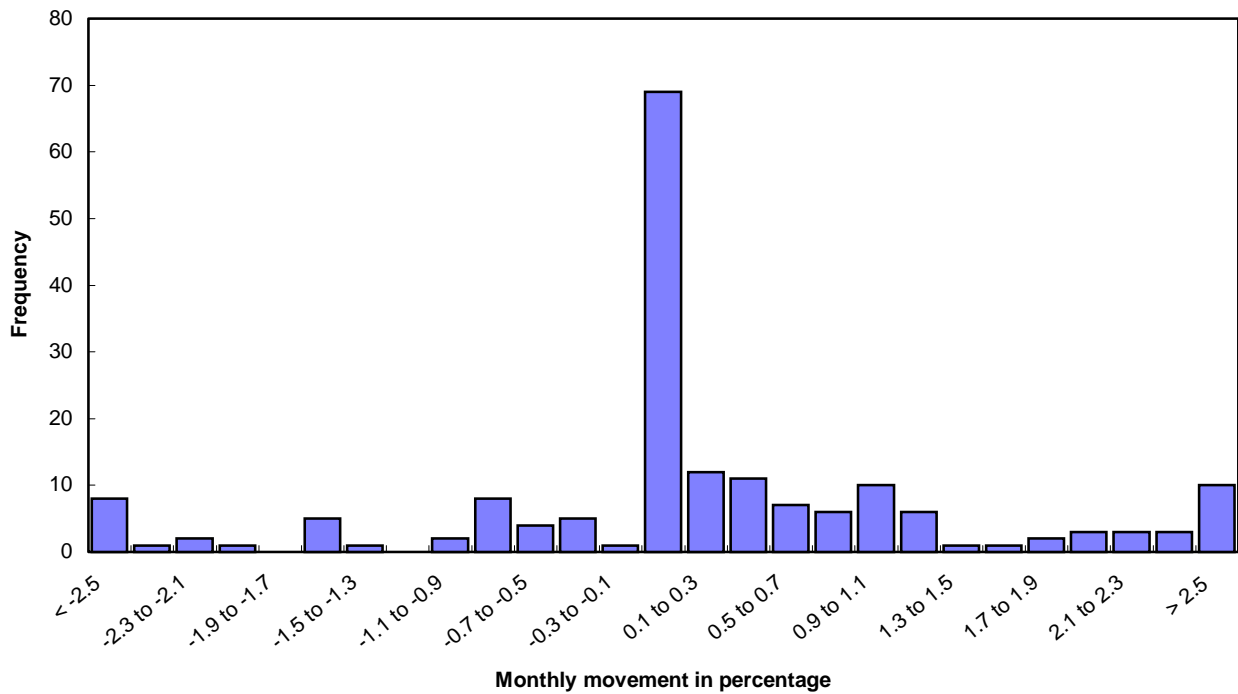


Chart 4: Distribution of unweighted price movements over 12 months for January 1986 for the 182 basic classes

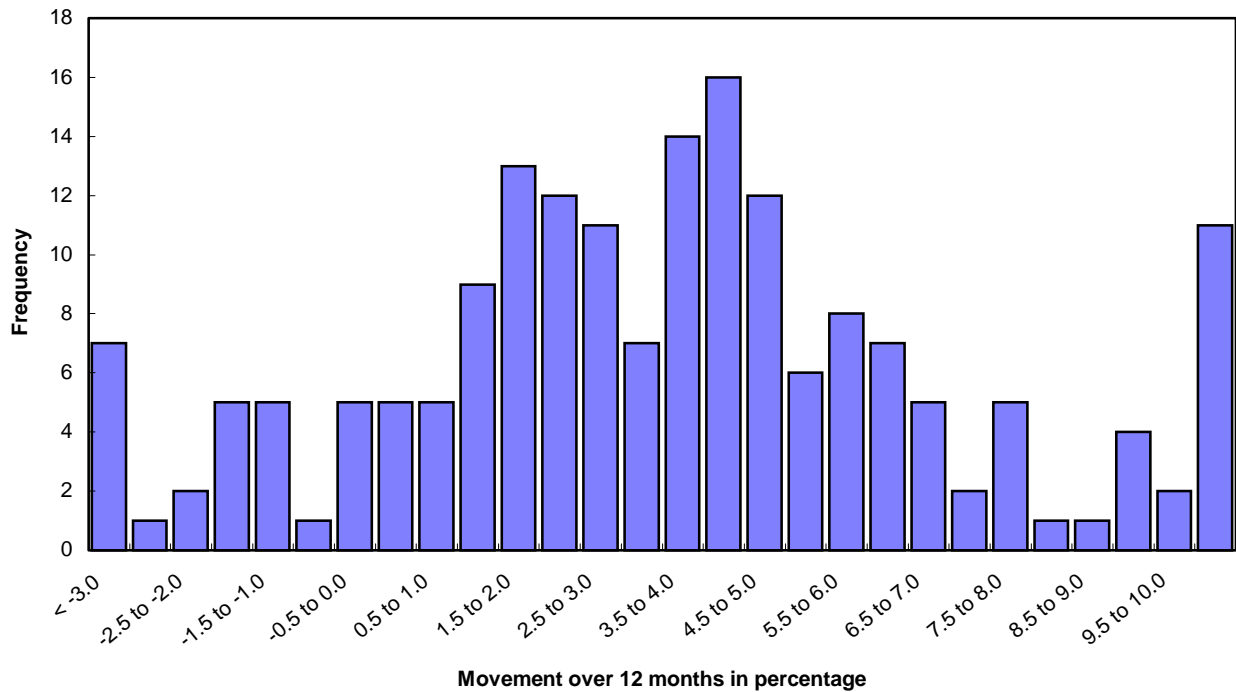


Chart 5: Distribution of unweighted price movements over 12 months for July 1986 for the 182 basic classes

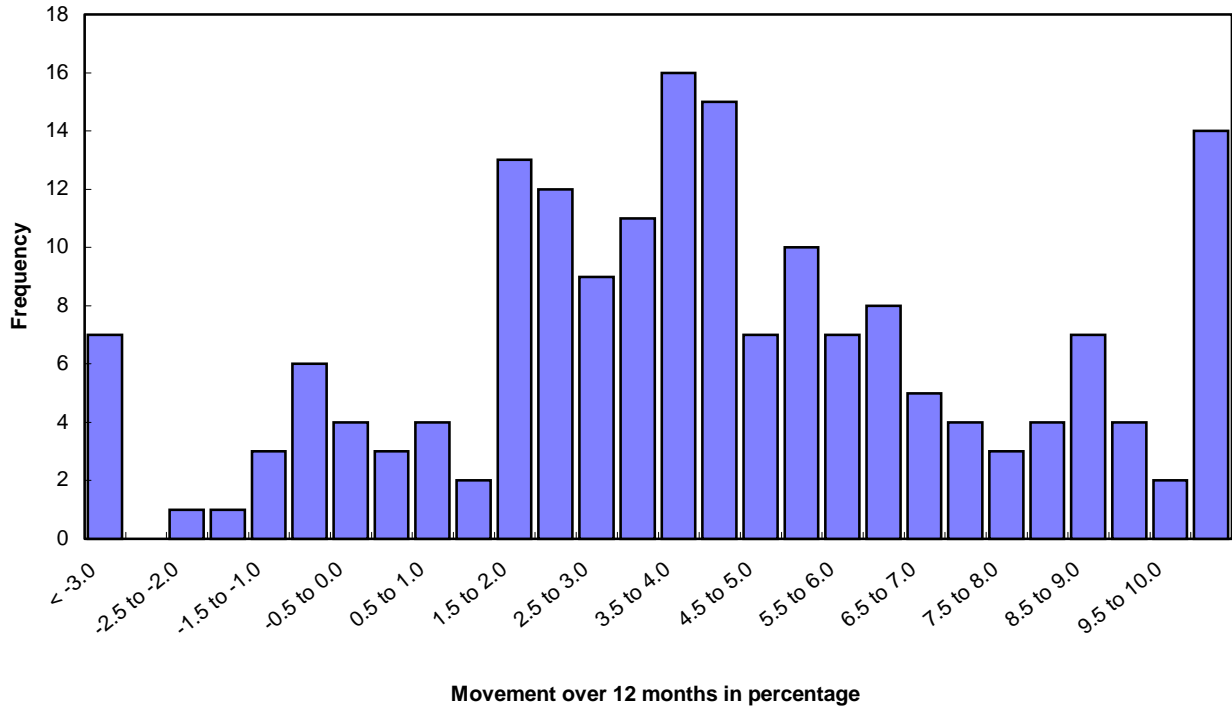


Chart 6: Distribution of unweighted price movements over 12 months for January 1997 for the 182 basic classes

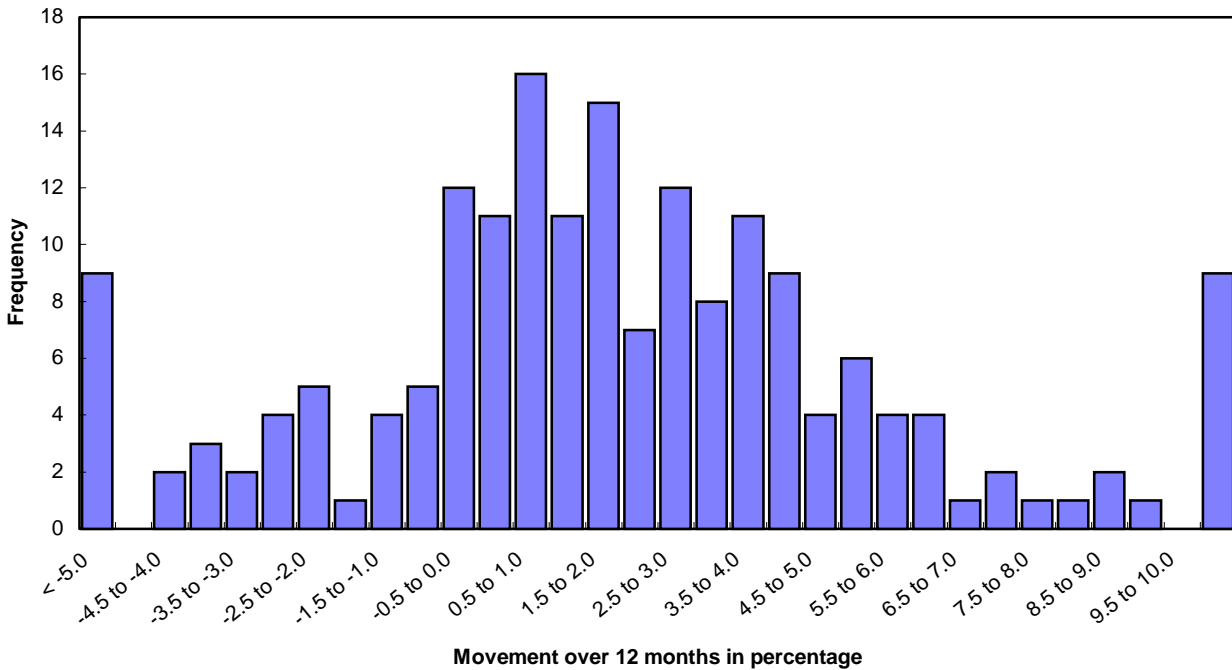


Chart 7: Monthly movements of the All-items CPI and of a weighted median index, 182 basic classes

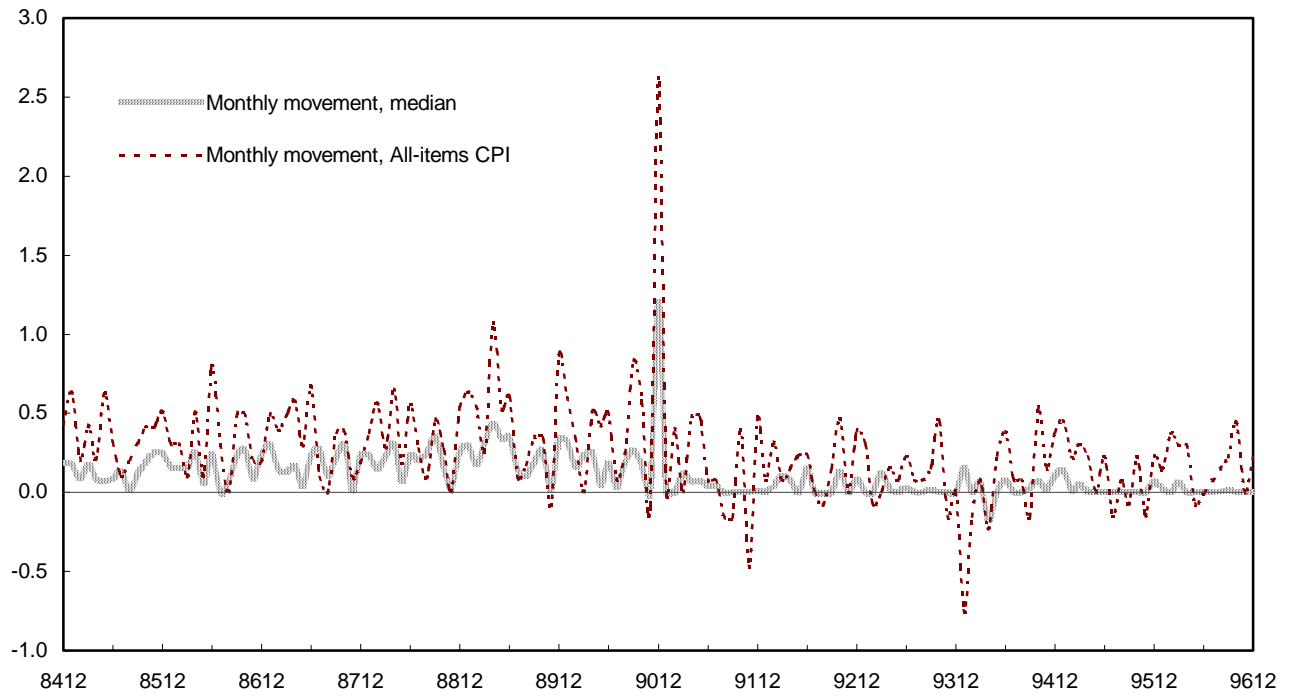


Chart 8: Monthly movements of the All-items CPI and of a weighted median index, 44 aggregates

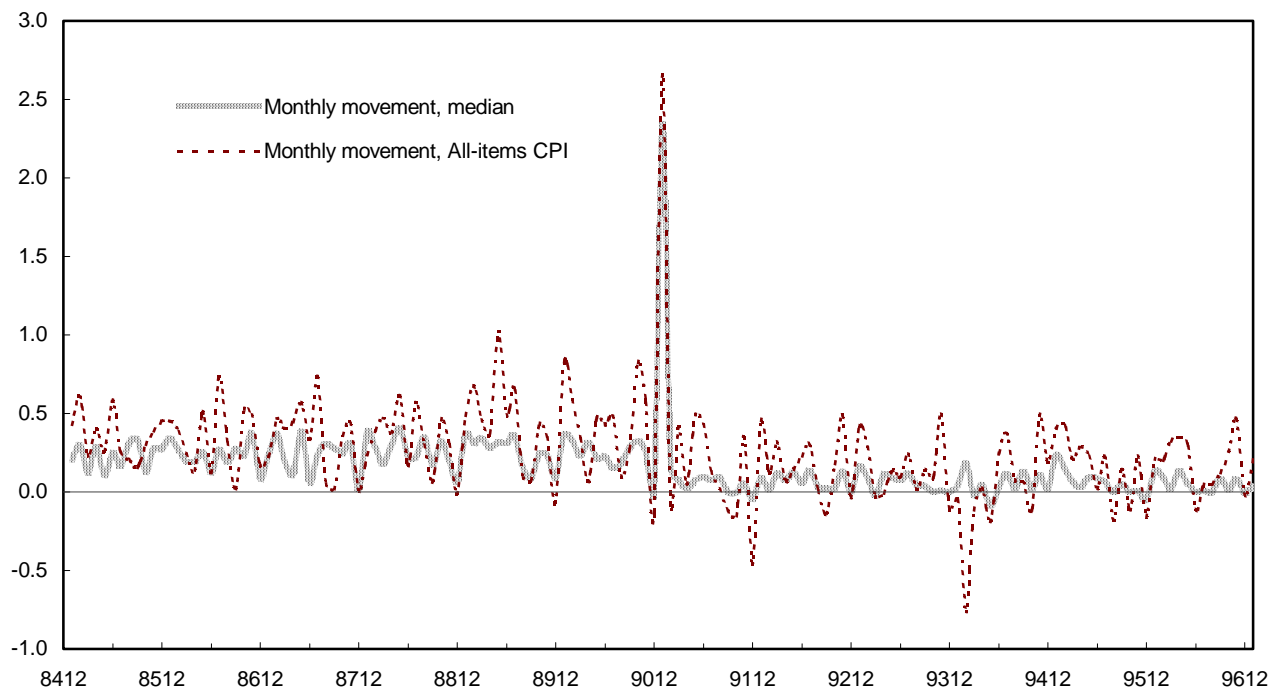


Chart 9: Monthly movements of the All-items CPI and of a weighted median index, 8 major components of the CPI

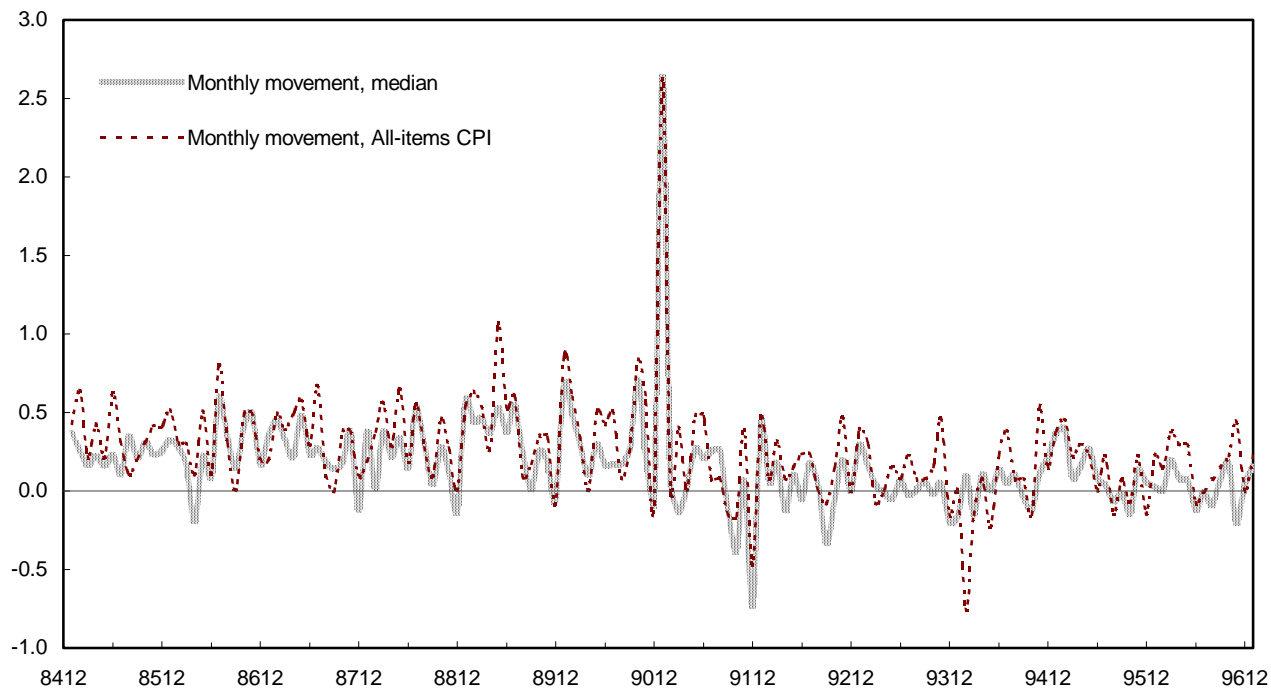


Chart 10: Monthly movements of the seasonally adjusted CPI and of a weighted median index, 8 major components, seasonally adjusted

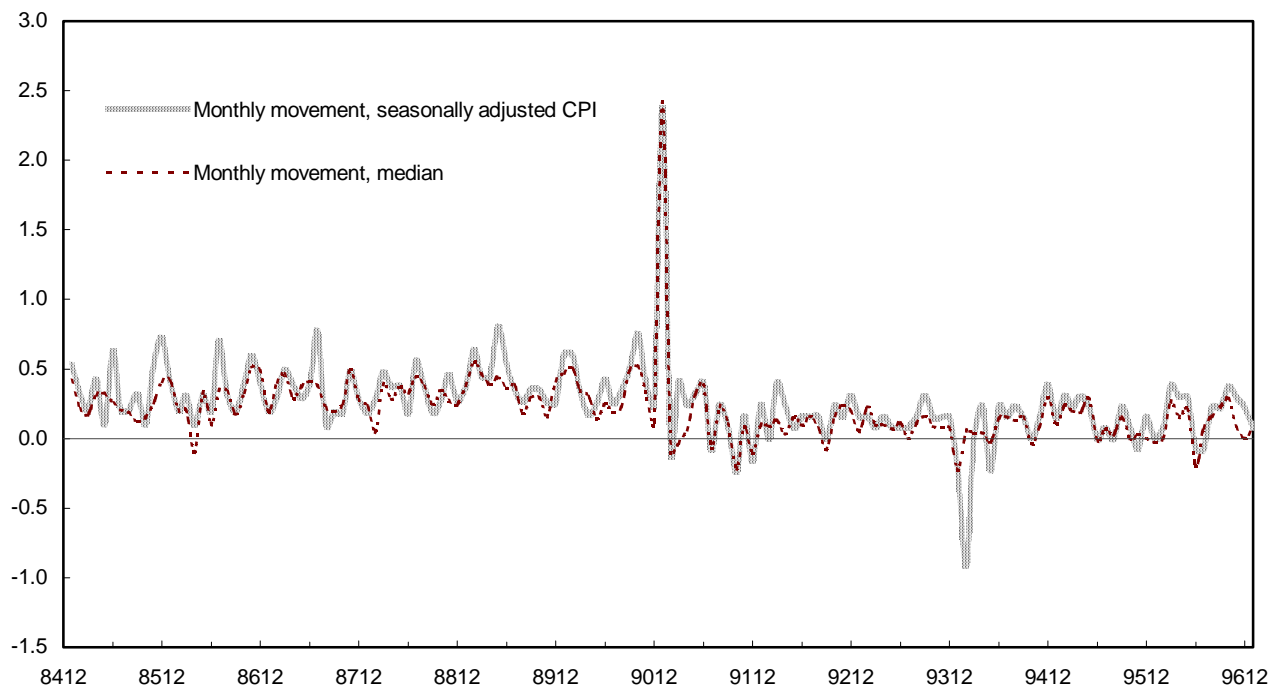


Chart 11: All-items CPI, CPI excluding food and energy, and weighted median indexes for the 182 basic classes, 44 aggregates and 8 major components, December 1984=100

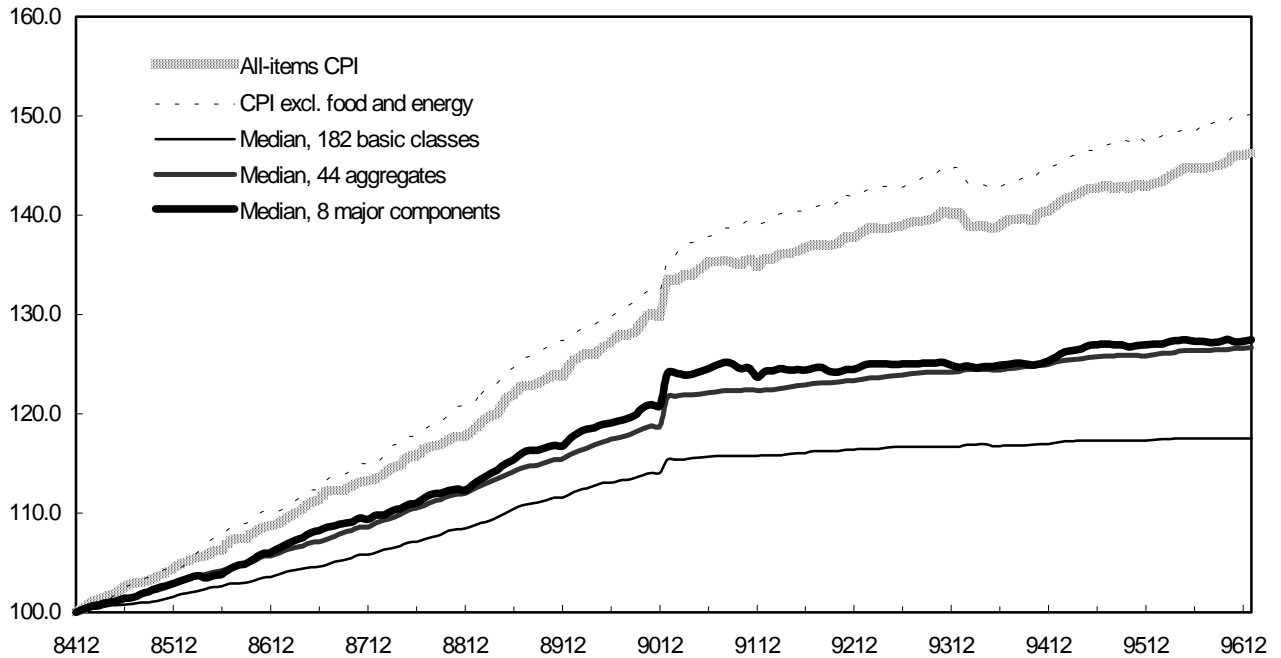


Chart 12: Seasonally adjusted All-items CPI and seasonally adjusted weighted median index, 8 major components

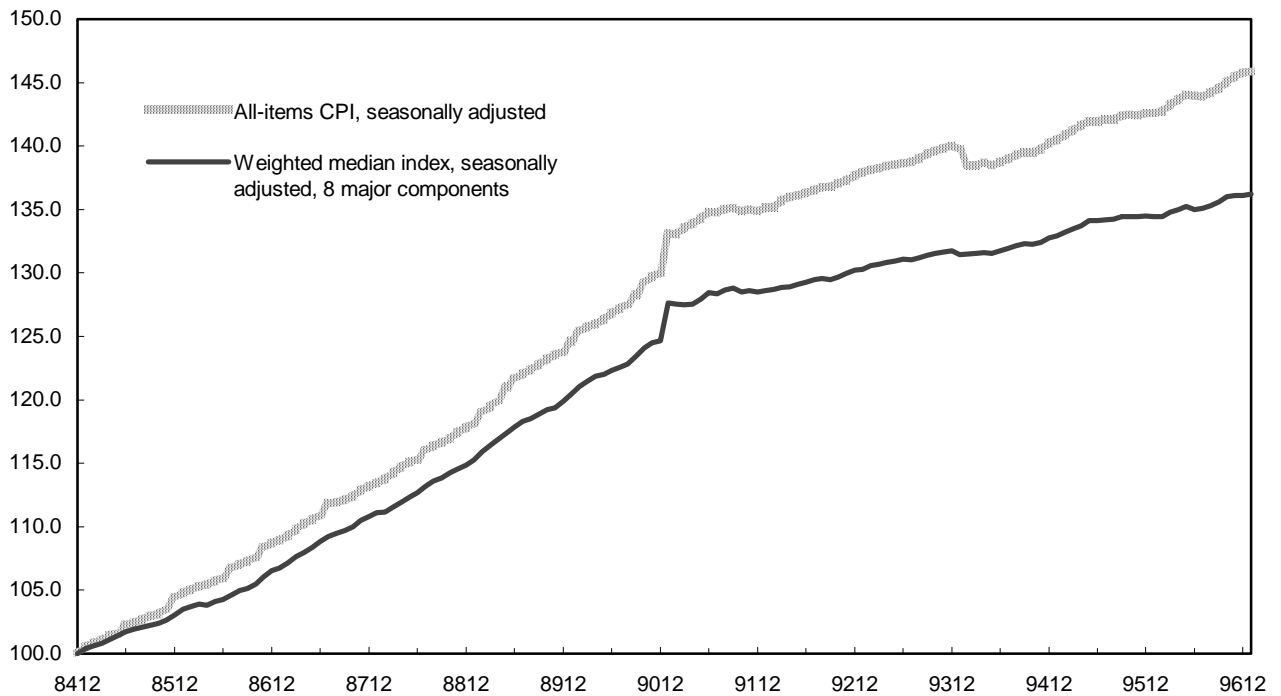


Chart 13: Movements over 12 months of the All-items CPI and of a weighted median index, 182 basic classes

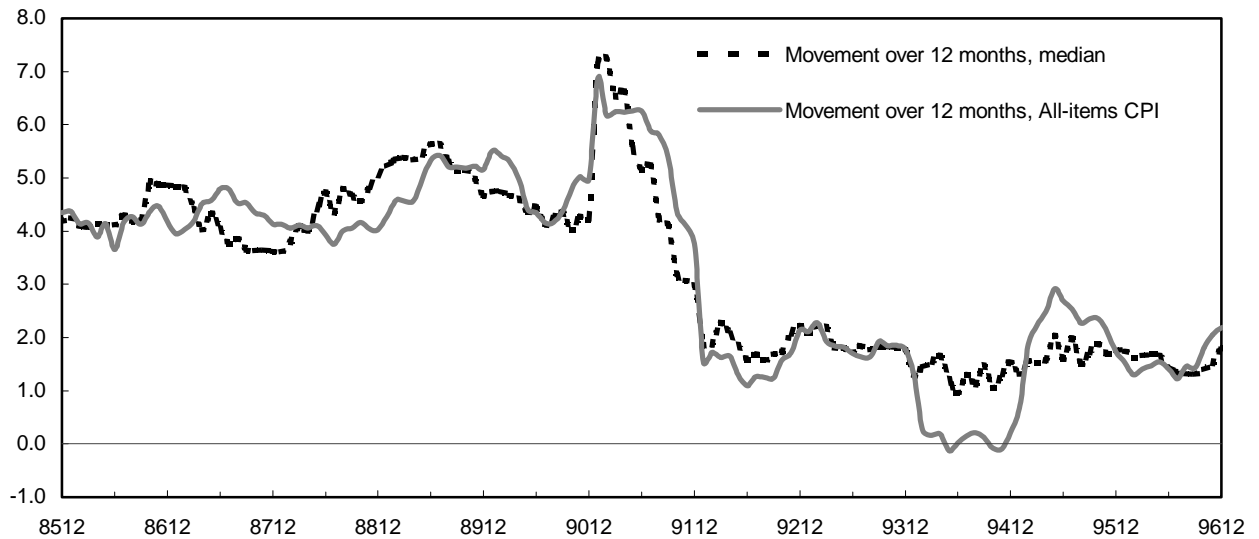


Chart 14: Movements over 12 months of the All-items CPI and of a weighted median index, 44 aggregates

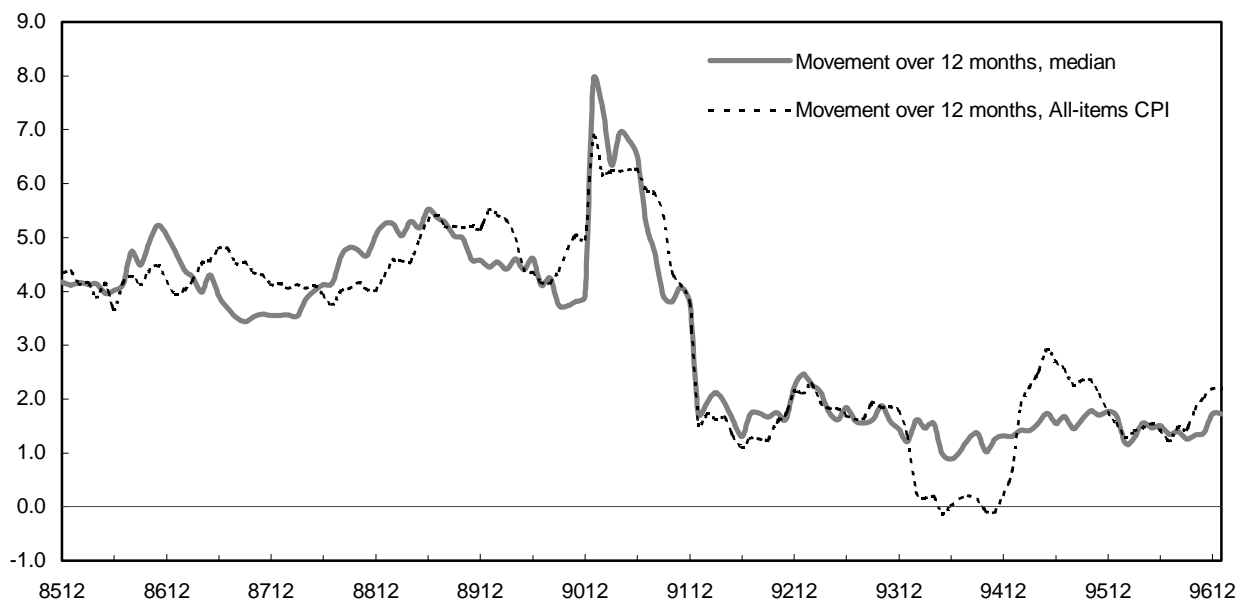


Chart 15: Movements over 12 months of the All-items CPI and of a weighted median index, 8 major components of the CPI

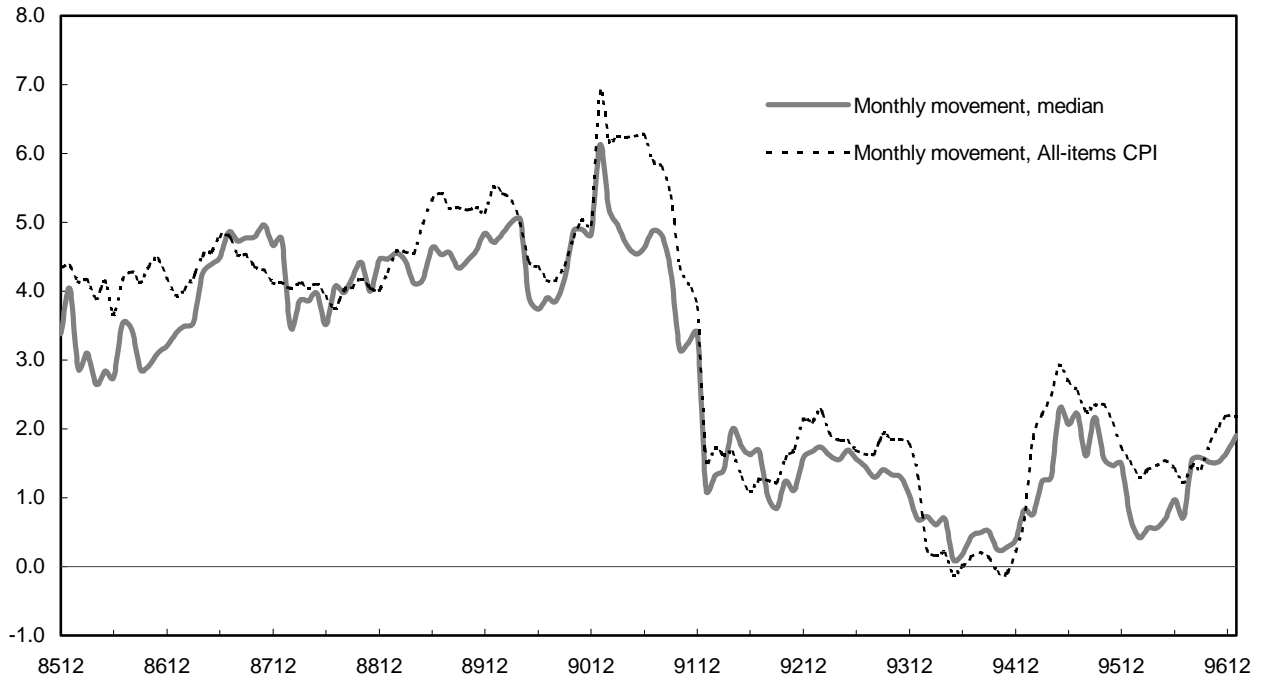


Chart 16: Movements over 12 months of the All-items CPI and of a weighted median index calculated from monthly movements, 182 basic classes, 44 aggregates and 8 major components

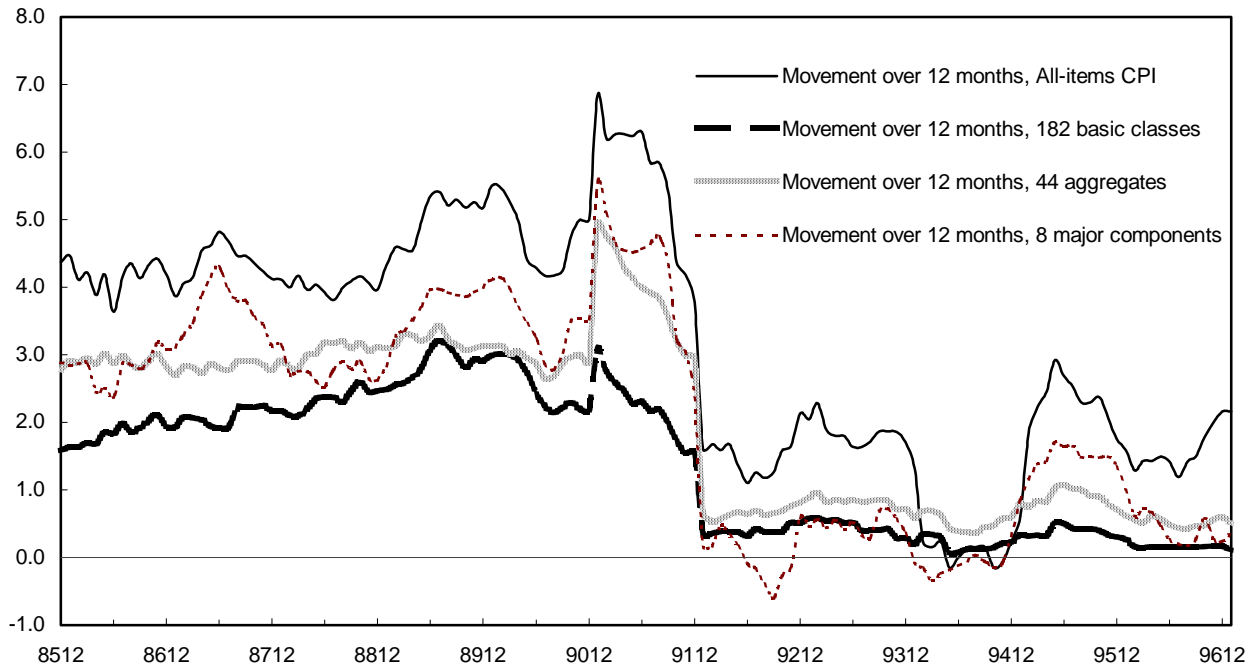


Chart 17: Distribution of percentiles of monthly price movements of the ‘Oranges’ class for each month from January 1985 to January 1997

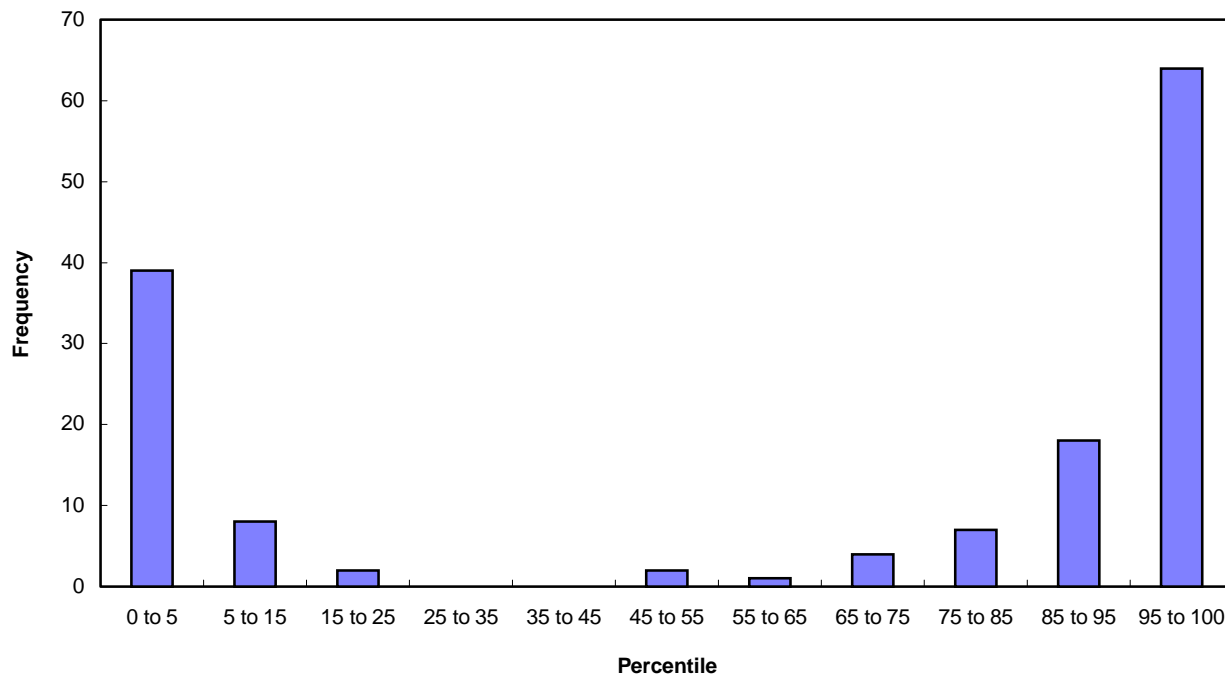


Chart 18: Distribution of percentiles of price movements over 12 months of the ‘Oranges’ class for each month from January 1985 to January 1997

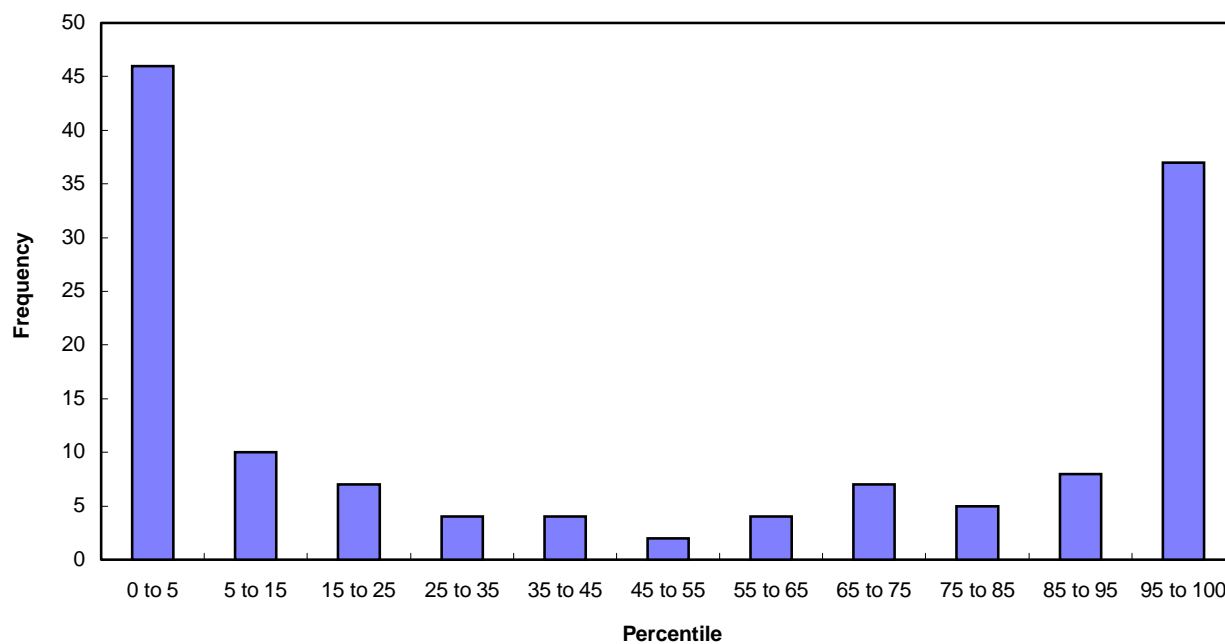


Chart 19: Distribution of percentiles of monthly price movements of the ‘Tuition fees’ class for each month from January 1985 to January 1997

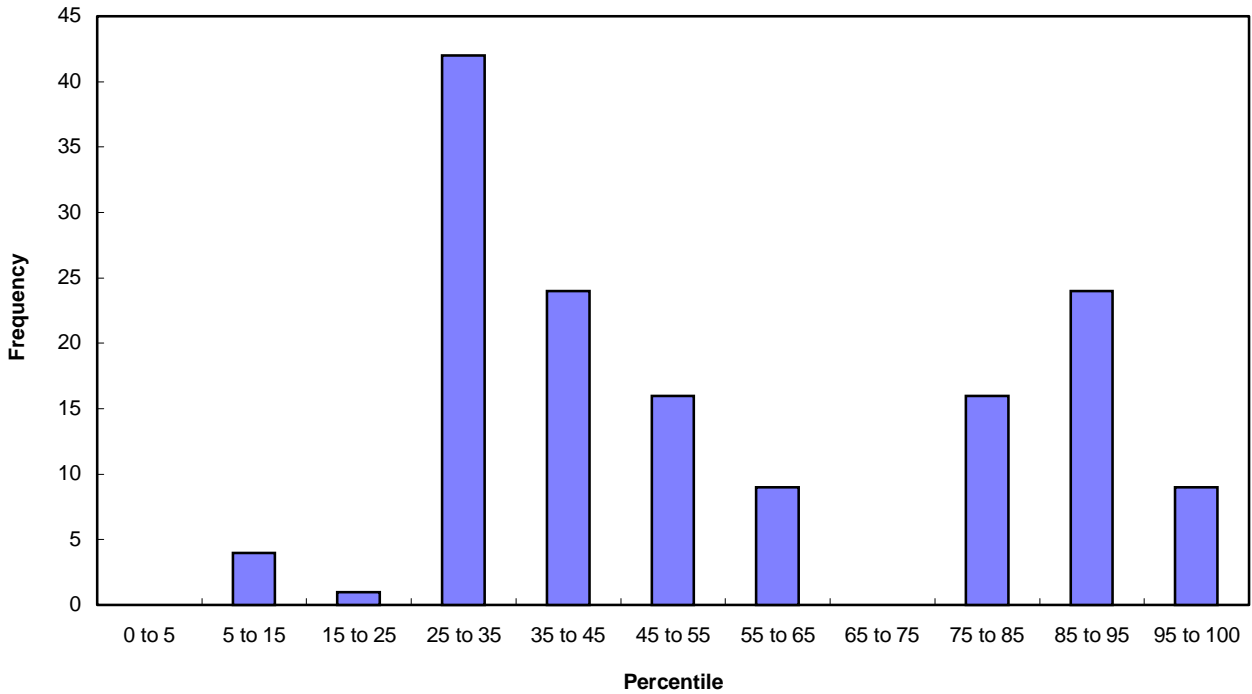


Chart 20: Distribution of percentiles of price movements over 12 months of the ‘Tuition fees’ class for each month from January 1985 to January 1997

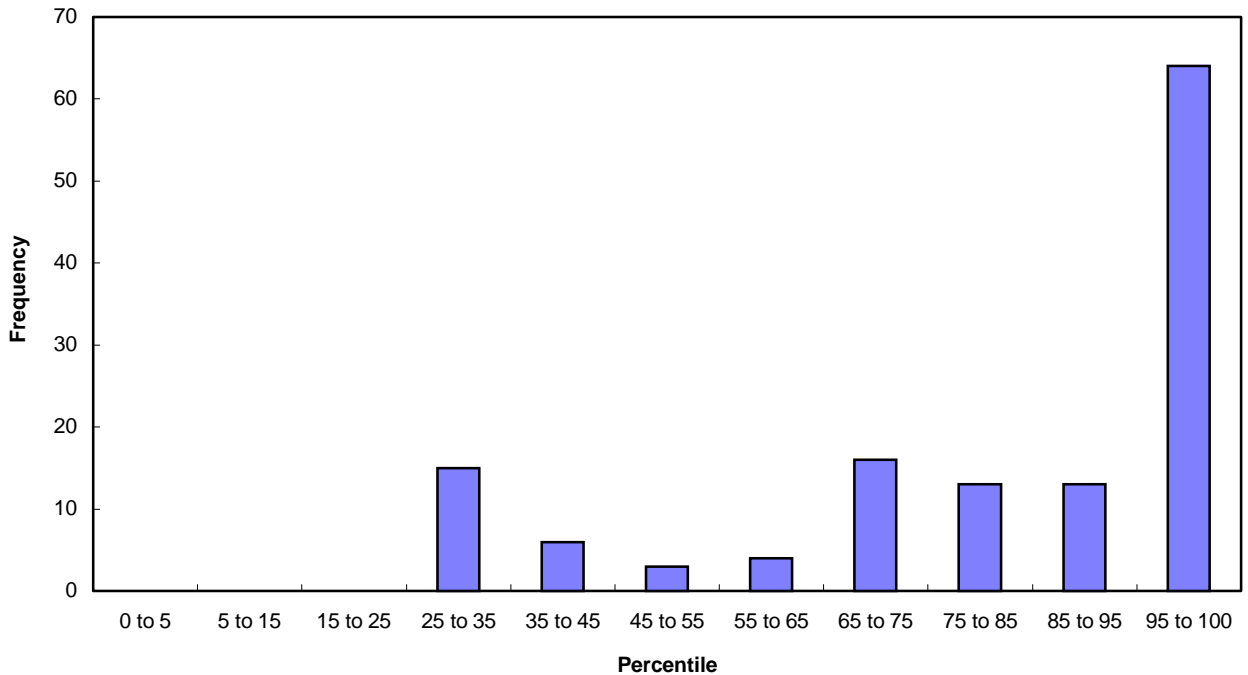


Chart 21: Distribution of percentiles of monthly price movements of the ‘Liquor purchased from stores’ class for each month from January 1985 to January 1997

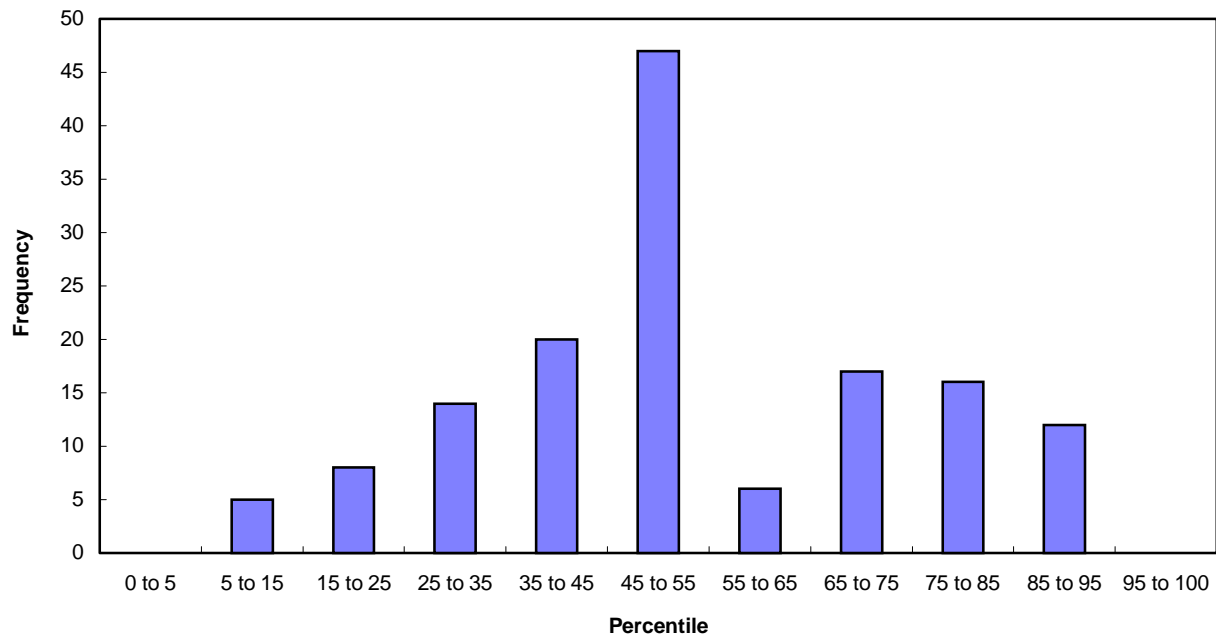


Chart 22: Distribution of percentiles of price movements over 12 months of the ‘Liquor purchased from stores’ class for each month from January 1985 to January 1997

