

The measurement of inflation in Austria: a historical overview

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Calculation of the first price indices at the international level began as early as the start of the 18th century. In Austria, consumer price indices (CPIs) have been consistently available since 1800. Though simple, the indices followed today's basic structure, and chaining the various generations of indices allows for conclusions to be drawn on inflation rate trends, adjustments for inflation and indexation for a period now spanning more than 200 years. This article covers a historical period extending from the first calculations of inflation to the complex criteria that determine inflation measurement in Austria today. A historical analysis of the trend in Austrian household expenditures as a key determinant of the basket-of-goods structure of price indices illustrates the long-term shift in spending from basic necessities to upscale goods and services. In 2016, Austrian households are spending only around 25 % of their total expenditure on basic necessities. Over the past 100 years, the number of items in the basket of goods and services has increased 40-fold (from 20 to approximately 800 items), and the number of price reports that are included in the monthly inflation calculations has risen from fewer than 100 to more than 40,000 in 2016. Another point of focus is the causes of measurement inaccuracies – which have always existed in the calculation of inflation – and the methods for correcting them. Austria's accession to the EU and, subsequently, Economic and Monetary Union (EMU) with its supranational monetary policy instigated a process of restructuring and, more importantly, harmonizing inflation measurement. The Harmonised Index of Consumer Prices (HICP), which has been computed since 1996 to supplement the national indices, is now the primary indicator of inflation under the Eurosystem's monetary policy strategy. Finally, this article concludes with a discussion of the measurement factors required to be used in the calculation of the Austrian CPI and HICP under EU law as well as the conceptual differences still existing between these two inflation parameters.

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The rate of inflation is a defining factor in the economic cycle and in economic policymaking. It serves as a central indicator of monetary policy in its function as a measure of monetary depreciation, as a point of reference in wage setting, as an adjustment factor for a variety of fees and rates, as an indexing tool for both commercial and private contracts and as a deflator for a number of price-adjusted calculations of economic indicators (such as economic growth). The measurement of inflation has therefore always required the highest possible degree of professionalism and precision.

The most comprehensive description of inflation measurement is the *Consumer price index manual – Theory and practice* (CPI manual; ILO et al., 2013). Compiled by various international organizations and institutions, the approximately 550-page manual comprises an extremely in-depth analysis of all aspects of the complex calculation of inflation rates as performed by national statistical offices. The guidance provided in this manual is based on knowledge and experience reaching back to the start of price measurement in the 18th century, which over the ensuing years and decades was gradually devel-

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oped further, improved, backed by scientific methodology, subsequently harmonized and anchored in law at national and EU level.

This article, which has been kept technically simple, offers an overview of the development of inflation measurement and the main instruments for measuring inflation in Austria over the past approximately 300 years. Section 1 covers the origins of inflation measurement in an international context and introduces the different schools of thought relating to the index concepts. Section 2 deals with the start of inflation rate calculation in Austria and provides an overview of the price indices created to date. Section 3 goes into the shifts that have occurred in spending patterns in a comparison covering 150 years. Section 4 constitutes the heart of this study and describes the major features of the price indices used in Austria in the 20th and 21st century. Section 5 references the *Boskin Report* published in the U.S.A. in the mid-1990s and comprises an analysis of sources of error and measurement difficulties in the calculation of inflation with regard to the Austrian CPI and HICP. Section 6 focuses on the harmonization process in inflation measurement in the context of Economic and Monetary Union (EMU) and the euro area and on the associated implications for the Austrian price indices. Section 7 summarizes the core messages of the study and offers a brief assessment of the direction that the measurement of inflation is currently taking.

1 Inflation measurement: origin and schools of thought

1.1 G. R. Carli: one of the fathers of inflation measurement

In 1764, the Seven Years' War had just ended, the first Vienna *Bancozettel* (which later became the government

paper money *Wiener Währung*) were being issued, and Archduke Joseph II was elected King of the Romans in Frankfurt. This was also the year in which the influx of precious metal imports from the New World led Italian economist Gian Rinaldo Carli to begin his deliberations on price fluctuations, resulting in his attempt to index the upward movement of prices in 1500 and 1750. To do so, he selected three products that were both significant and typical of the Italian economy and way of life at that time: wine, wheat and olive oil. He then determined their prices in the two years to be compared and calculated the average price index of the three goods. Aside from minor flaws (the basket of goods was too small, and the goods were not weighted), the results obtained by Carli made him one of the first scientists to have successfully indexed price trends. However, Diewert (1988) mentions William Fleetwood, the English Bishop of Ely, as being the first person to have computed a price index with constant weighting, which Fleetwood described back in 1707 in his book, *Chronicon preciosum*. Fleetwood compared the prices of items in a basket of goods (including wheat, beer and clothing) from 1707 with the prices from 1440. But the father of indexed figures, according to Diewert (1988), is Joseph Lowe, a Scottish journalist and political economist who made crucial advances in index theory at the start of the 18th century. Nicolas Dutot (1738) and William Stanley Jevons (1863) likewise developed index formulas that are still in use today.

Some 100 years after Carli (i.e. around 1875), Ernst Louis Étienne Laspeyres and Hermann Paasche, both German economists and statisticians, created indices with weights (consumption) for calculating price changes in Germany. Later, so-called “superlative

indices” were calculated as well (an overview is available e.g. in the 2013 CPI manual or from Hoffmann (1998)).

1.2 Consumer price index (CPI) and cost-of-living index (COLI): the CPI concept has prevailed in practice

Economic theory has developed rather clear concepts of how the purchasing power of money should be measured. Indices are intended to reflect changes in the expenses incurred in maintaining a certain standard of living. From a historical perspective, the measurement of inflation has followed two distinct schools of thought regarding index theory: the cost-of-living index (COLI) concept and the consumer price index (CPI) concept.

The COLI embodies an economic concept that takes a benefit-based approach. It assumes that consumers will maximize benefits and minimize costs when choosing between different combinations of goods and services. A COLI reflects the minimum costs necessary to realize an equal benefit at prices p_0 and p_1 relative to the quantity consumed. Hence, the COLI measures the changes over time in the costs incurred by a representative household in purchasing a bundle of goods without sacrificing any benefits. The pool of representative goods and services is constantly being adapted to reflect current consumption patterns, and it also allows for consideration of the effects of substitution by households. However, the statistical implementation of this highly complex concept would involve having to collect data on consumer spending on a constant basis, which would require major resources.

Under the COLI approach, the bundle of goods changes in line with the changes in relative prices. Since both the bundle of goods and the re-

lated prices change, the COLI is less suited than other methods to providing information on inflation.

In the case of the CPI (also referred to as a “direct index” in the literature), the quantity (expenditure weights) is kept constant and only the change in price is observed, meaning that the CPI is not only more transparent, but also easier to interpret. CPIs – to stay with the officially known indices – are differentiated by whether they follow the Paasche method or the Laspeyres method. Laspeyres compares a basket of goods in the base period with prices in the reporting period and the base period, and Paasche takes the basket of goods in the reporting period and compares it with the prices in the reporting period and the base period (ILO et al., 2013). The Paasche approach, however, has the disadvantage that no or hardly any historical price data are available for many of the current goods that must be included in a present-day consumption model. Moreover, the necessity of having to make backward projections of consumption patterns that are always kept up to date requires constant revision of the index series, which is laborious and difficult to interpret. However, the main reason that the Paasche index model is avoided is that it is hardly possible to redesign the basket of goods each year. The Laspeyres approach, on the other hand, has the disadvantage that maintaining a constant basket over many years – as was the case until the end of the 1990s – does not reflect current consumption patterns and can therefore lead to an overestimation of inflation.

Economic science was long unable to provide a clear answer regarding the correct approach and the exact methods of collecting price data and determining changes in prices as well as regarding the frequency of adjusting

the weights. Both COLIs and CPIs have their strengths and weaknesses in measuring inflation trends and both include potential (mostly technical) bias factors that could effect a distortion in the inflation rate. In considering these advantages and disadvantages and – most significantly – the practicality of calculating and interpreting the inflation rate, the “pure price concept” developed by Laspeyres – now with annual updates to consumption patterns – has prevailed, which ensures that only changes in prices affect the rate of inflation.

Price indices are therefore defined as follows: A price index is an indicator representing the change in certain representative prices. It indicates how the prices of the goods and services included in a typical household’s consumption basket have changed. The price index acts as a measure of the level of inflation or deflation in an economy as a whole or in parts of the economy. A reference point (base 100) is defined for the index, and that reference point is used for all subsequent indices.

2 Price series have existed in Austria since the 15th century, and price indices since 1800

Among the many innovations that occurred in the era of Holy Roman Empress Maria Theresa was an official determination of prices in Austria, an endeavor that some individual cities had already undertaken earlier. Pibram (1938) prepared data on prices in Vienna and Klosterneuburg between 1470 and the end of the 18th century. Emmerig (2015) offers an extensive overview of the literature describing prices and

wages in Austria since the 12th century. The first price indices calculated in Austria from the 1920s offer much more recent information; subsequent backward calculations extended back to 1800. Historical trends in the various price indices are well documented in publications by Statistics Austria (and its predecessor institutes²).³

Price indices are available from Statistics Austria for the entire period from 1800 to the present, and consumption patterns have been tracked from the start of the 20th century to the present (table 1). Those two elements were combined to create a variety of price indices, from which the inflation rates for Austria were derived. The indices were chained to provide continuous data up to the present.⁴ First, section 3 delves into the changes in household spending patterns in Austria, and section 4 then discusses selected aspects of the respective indices.

3 Household spending patterns: long-term shift from basic necessities to luxury items

To calculate price indices, it is necessary to collect reliable information on household consumption patterns. The household consumption surveys carried out periodically in Austria offer information on household spending and also serve to establish the contents and structure of the baskets of goods used to calculate the indices. An important source of historical data is the first consumer survey carried out between February 1912 and March 1914 among working class families in Vienna. The methods used hardly differed from pres-

² *Statistische Zentralkommission (Central Statistical Commission), Bundesamt für Statistik (Federal Statistical Office), Österreichisches Statistisches Zentralamt (Austrian Central Statistical Office). To avoid using varying designations, this article uses the present designation, i.e. Statistics Austria, except for bibliographical references.*

³ *Österreichisches Statistisches Zentralamt (1979a, 1979b, 1990).*

⁴ *Antonowicz et al. (2016, p. 88–89) for an illustrated representation of inflation rates since 1800.*

Table 1

Price indices in Austria since 1800

Index/type of household	Publisher	Calculation period
Index of food costs necessary for four weeks in Vienna	Central Statistical Commission	January 1921 to January 1925
Index of increases in the necessary total spending of a Vienna family	Central Statistical Commission	January, March, June, October, December 1921
Index of the cost of living for one person in Vienna based on weekly consumption	Joint Committee	January 1922 to January 1926; subsequent backward calculation to 1914 by the Federal Statistical Office
New index of changes in the cost of living in Vienna	Federal Statistical Office	January 1926 to December 1938
Consumer price index – backward calculation in 1979	Austrian Central Statistical Office	1800 to 1914 (annually only)
Index of retail prices	Austrian Central Statistical Office	1914 to 1959 (monthly)
Cost-of-living index April 1938 = 100 for a four-member working class family in Vienna Cost-of-living index April 1945 = 100	WIFO (Austrian Institute of Economic Research)	April 1946 to February 1959
CPI 1958 I – average working class household CPI 1958 II – four-member working class household	Austrian Central Statistical Office	to end-1965
CPI 1966, 1976, 1986, 1996, 2000, 2005, 2010, 2015 – average household	Austrian Central Statistical Office, from 2000 onward Statistics Austria	every 10 years, or every 5 years from 2000 onward
HICP 1996, 2000, 2005, 2010, 2015 – average household	Statistics Austria	every 5 years

Source: Reports from the Central Statistical Commission (1921), reports from the Federal Statistical Office (1922), *Statistische Nachrichten* (1925, 1926, 1938), and various CPI revision brochures from Statistics Austria and its predecessor institutions (*Österreichisches Statistisches Zentralamt*, e.g. 1977, 1987, 1997; *Statistics Austria*, 2001, 2011).

ent-day surveys as households had to keep a record of accounts even back then⁵. Each household received 20 crowns (the equivalent of approximately EUR 105 in 2016) for participating, making the survey considerably more well paid in relative terms than, for instance, the most recent such survey conducted in 2009/10, in which participating households received coupons worth EUR 50 (Statistics Austria, 2013). However, back then the data collection period comprised two years compared with just two weeks for the 2009/10 survey and the 2014/15 survey (for which the results are not yet avail-

able). The information presented in table 2 for the period from 1912 to 1955 was taken from various publications, and the more recent information came from the various CPI revision brochures (references see table 2). The data on food expenses prior to 1912 was derived from the dual-volume publication (Austrian Central Statistical Office, 1979a and 1979b) issued to commemorate the 150th anniversary of the Austrian Central Statistical Office in 1979.

A comparison of the data over the 150 years since 1869 shows a decrease in the originally high share of goods required to meet basic necessities in favor

⁵ Today for purposes of household consumption surveys, Austrian households may choose between keeping traditional household accounts and online accounts (approximately 10% of households decide in favor of keeping online household accounts).

of more “elastic” items. Consumer spending thus follows Engel’s law⁶, which states that as prosperity increases through steady economic growth and rising per capita incomes, the proportion of income spent on basic necessities (such as food, shelter, lighting and heating) decreases, while that spent on goods with a high level of income elasticity increases. This trend has been particularly evident since 1955 with “necessities” spending being replaced more and more by “luxuries” spending. However, the shift also reflects the transition from an industrial society to a service-based society in which spending on services is making up an increasingly greater portion of household budgets. Basic necessities currently account for a share of only around 25% in household spending, i.e. the relation between spending on basic necessities and nonessential items is 1:3.

One major exception to this rule is housing expenses, which since the 1960s⁷ have risen steadily in proportion to household incomes. Limited real estate and increasingly higher standards of housing quality as well as imbalances in supply and demand and dynamic price trends have all contributed to this effect.

The following additional trends in household spending patterns become apparent in a long-term comparison (tables 2 and 3):

- In the late 19th and early 20th centuries, Austrians spent around 60% of their income on food. That figure

dropped below 50% in 1935, and in the 1980s food accounted for approximately one-fourth of household spending. In the 2000s, the proportion of food spending declined again to around 12% (or approximately 15% when including alcohol – i.e. beer and wine – and tobacco).

- Expenses for clothing previously made up a greater proportion of household budgets (between 10% and 15%), whereas in 2016 only around half as much (6%) is being spent on this item.
- Spending on education/culture and transportation (including tourism) has risen steadily, increasing from approximately 5% at the end of the 1960s to 13% (education/culture) and 17% (transport and tourism), respectively, in the mid-1990s. Leisure and tourism services have continued to increase sharply in significance up to the present day (accounting for approximately 26% of the HICP and 22% of the CPI in 2016).
- In 2016, Austrian households are spending 53% of their budgets on goods and 47% on services. The primary items of expenditure are: food (11%) and “shelter, water, energy” (CPI: 18%; HICP: approximately 14%). Spending on energy alone accounts for 8%. With respect to individual products and services, a high proportion is spent on meat (3%), rent (5%) and vehicle purchases (4%).

⁶ In 1857, statistician Ernst Engel established that the percentage of income spent on food decreases as income increases. This effect, which has been confirmed for Austria as well, is known as Engel’s law (very generally, in economics the statistical relationship between changes in income and the resulting changes in spending in a specific necessities category is called the Engel curve).

⁷ The relatively low figure of 5% of total expenses for shelter in 1955 compared with the preceding decades could be related to the fact that the 1955 survey was the first one to compile spending data for all of Austria, whereas the previous data was restricted to Vienna.

Table 2

Change in consumer spending in Austria from 1869 to 1994

Consumption group	1869 ¹	1885 ²	1912/14	1926 ³	1935	1946	1955	1964	1974	1984	1994
	%										
Food and beverages	54.9	58	59.4 ³	55.2	48.1	45.3	46.8	37.1	29.2	23.3	21.7
Tobacco			1.5		1.9	8	7.6	2.0	2.6	2.5	1.7
Shelter	20.1	17	14.8	8.6	12.8	9.9	5.0	7.4	9.1	13.1	16.5
Lighting and heating		4	4.6		5.6	3.8	5.3	5.6	5.3	5.4	5.3
Furnishings and household equipment			4.6				5.9	5.9	12.0	7.6	8.3
Clothing	12.5	15	9.3	22.3	9	5	13.1	12.7	12.9	10.7	8.7
Residential cleaning, etc.							2.2	2.7	1.9	1.4	1.5
Body and health care		7	2.8	13.9	18.9	28.9	3.1	4.5	5.1	6.0	6.3
Education, leisure activities			7.7				6.8	8.3	9.2	14.3	13.4
Transportation							4.2	10.8	12.7	15.8	16.9

Source: Vienna Chamber of Labour (1955); Bundesamt für Statistik (1925, 1938); Österreichisches Statistisches Zentralamt (1977, 1979a, 1979b, 1987, 1997); for footnotes 1 and 2: Österreichisches Statistisches Zentralamt (1979b).

¹ Four-member working class family in Vienna.

² Five-member carpenter family in Vienna.

³ Consumer spending according to the 1926 COLI.

Table 3

Breakdown of consumption expenditure in the Austrian CPI and HICP from 2000 to 2016

COICOP ¹ consumption groups	2000		2005		2010		2015		2016	
	CPI	HICP	CPI	HICP	CPI	HICP	CPI	HICP	CPI	HICP
	%									
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Food and nonalcoholic beverages	13.61	13.11	12.23	13.04	12.01	12.75	11.78	11.67	11.70	11.34
Alcoholic beverages, tobacco	3.16	3.98	2.86	3.06	3.04	2.99	3.95	3.85	3.80	3.74
Clothing and footwear	6.97	8.27	5.46	6.35	6.14	5.64	5.91	7.19	5.70	7.15
Housing, water, electricity, gas and other fuels	17.92	13.93	17.92	14.58	18.65	14.55	18.48	14.18	18.40	14.13
Furnishings, household equipment and routine household maintenance	8.82	9.00	8.39	7.38	8.00	8.10	7.64	7.61	7.50	7.43
Health	3.51	1.91	4.64	4.07	4.44	5.38	4.81	5.08	4.90	5.21
Transport	14.26	14.52	15.13	15.14	13.78	14.16	13.33	14.50	13.20	14.42
Communication	3.09	3.21	2.66	2.65	1.81	2.13	2.22	2.19	2.20	2.12
Recreation and culture	11.99	11.63	12.42	11.24	12.13	11.37	11.43	11.18	11.40	10.99
Education	0.76	0.74	1.10	0.97	1.28	0.86	1.28	1.15	1.30	1.14
Restaurants and hotels	6.80	14.33	7.28	14.74	8.72	15.06	9.51	14.27	10.30	15.15
Miscellaneous goods and services	9.12	5.38	9.91	6.78	10.00	7.02	9.68	7.14	9.60	7.20

Source: Statistics Austria.

¹ COICOP: Classification of Individual Consumption by Purpose.

Note: Since 2000, the COICOP expenditure classifications have been used due to a change in the classification of consumption groups.

4 Price indices in the 19th, 20th and 21st centuries: the basket of goods grows, and survey and calculation methods improve

The major expansion in both industrial goods production and innovative spirit is reflected doubly in the relevant bas-

kets of goods and the proportions of income spent on the various items in the baskets. On the one hand, the number of representative goods and services has been added to constantly, with a basket of goods containing a mere 20 items in 1921, and 801 (CPI) or 789 (HICP) in

2016 (tables 4 and 6), and on the other hand, the composition of the baskets has changed dramatically, which has also necessitated ongoing adjustments in the individual household surveys (replacing old items with new items, particularly as a result of rapid changes in quality criteria). This made it more difficult, at times, to make consistent comparisons of price indices and ensure their continuity over several decades – a shortcoming that long-term index and inflation research still faces, albeit in a less severe form.

This section outlines the various price indices in terms of selected features of their index methodology and changes in the structure of the relevant baskets of goods. The indices are listed in chronological order (whereby the first backward calculation to 1800 did not take place until the 1970s).

4.1 Backcasting consumer price indices from 1800 to 1914

Price series for individual cities in the various Austrian provinces have existed since the 14th century, and quite extensive literature is available on the subject. At the beginning of the 18th century, even official price statistics were still collected unsystematically. It was not until the mid-19th century that interest in price series became greater in connection with the 1873 World Fair and the transition to a gold-backed currency in 1892. Initial attempts to calculate aggregated price indices using price data for a small number of products from the Habsburg monarchy's markets also originated in that period. Not until during and after World War I (WW I), however, did statisticians begin constructing backcasted indices of retail and consumer prices in Austria

(Mühlpeck et al., 1979), for which the survey among Vienna households of 1912–14 served as the basis for weighting consumer spending. All of those indices evidenced deficiencies, however (e.g. an insufficient timeline, a limited basket of goods restricted to food, etc.), meaning that a gap exists in the indices for the 19th century.

To commemorate the 150th anniversary of the Austrian Central Statistical Office in 1979, a team of statisticians set about to calculate and document a CPI index for the period from 1800 to 1914. They gathered and organized the available data from the 19th century, using price data for the cities of Vienna, Graz, Linz and Innsbruck (including data for different goods and consumption groups) for the entire backward calculation period. All in all, 13,000 prices for nearly 40 goods were processed. Missing prices were extrapolated or replaced with prices from nearby cities (as in the case of Linz with data from Wels). Divergent quantities were standardized, and the prices were converted, as a rule, to crowns and hellers. The survey of 1912–14 was used here as a weighting model for the entire backward calculation period, which appeared reasonable in light of the minimal changes in consumer spending at that time (as documented in various 19th century sources). 1914 prices were set at 100 and taken as the index base. Price levels turned out to have increased from 62 to 100 over the course of the 19th century, which corresponds to an inflation rate of only approximately 1/2% per year. It must be taken into account, however, that prices were relatively high in 1800 given that they originated in the time of the War of the Second Coalition be-

tween Austria and France, and 1914 prices had not yet been impacted by the impending WW I.⁸

With respect to the basket of goods compiled on the basis of consumer surveys of Vienna working class households in 1912, the question arises as to whether that basket is representative of the entire period from 1800 to 1914, especially with regard to the population outside of Vienna. On the one hand, statistics on food consumption between 1780 and 1910 indicate little change in per capita consumption patterns. However, by 1910 sugar was already quite important (per capita consumption of around 18 kg per year), whereas it was nearly unknown in 1800 (annual consumption < 1 kg per capita). In addition, rent expenses are also likely to have accounted for a greater proportion of spending in 1912 than in 1800.⁹ The possible deficiencies in the index – a nonrepresentative basket of goods and lack of data on underlying regional consumption habits – led Cvrcek (2013) to calculate regional historical cost-of-living indices for the territory of the Habsburg monarchy from 1827 to 1910 (on the basis of various consumer goods available in that period and their prices). Cvrcek demonstrated that regional price levels differed greatly, although they became more similar over the course of the century, following similar trends and converging near the end of the observation period. When comparing the CPI with the COLIs used in Cvrcek's study for (present-day) Austria, it ensures that the rates of inflation show a similar progression with respect to both

parameters – an indication that the backcasted CPI is a sound indicator of inflation in the period, despite the reservations mentioned.

Together with the retail price indices available from 1914 onward, a continuous price index – featuring chains of subsequent generations of indices (which is no easy matter given the multiple changes in currency) – is therefore available for Austria. This made it possible to calculate fluctuations in monetary values for a continuous period from 1800 onward as well as to resolve questions about indexing and adjustments for inflation in the 19th century.

4.2 Differing indices from 1921 to 1938

In 1921, the Central Statistical Committee for the first time recognized the necessity of calculating an index in light of the scarcity of food and rapid inflation prevalent in Austria at that time. Due to the especially difficult living circumstances and massive increases in inflation, a number of different consumer price indices were created at short intervals (table 1). The fundamental problem of the first official indices was that apart from the basket of goods to be determined for a household, prices and price trends varied tremendously – in part due to state subsidies – and the Vienna prices were normally used in the calculations (Klezl, 1925; Suppanz, 1976). Thus, the first indices were not at all representative of the rest of Austria. Not until 1958 did the indices of consumer prices change to include regional data collected outside of Vienna. The basket used for the start of index calculation in 1921 only

⁸ The index resulting from the backward calculation to 1800 does not consider the fact that hyperinflation in the Napoleonic era around 1800 had rendered paper money virtually worthless (Jobst and Kernbauer, 2016, p. 29, who refer to a 12-fold increase in prices at the beginning of the 19th century, which was not reflected in the index). The index taken from Mühlpeck et al. (1979) states all prices in either silver or crowns.

⁹ See Österreichisches Statistisches Zentralamt (1979a, p. 669; 1979b, p. 130–132).

included food and fuels, with expenditures such as countryside sojourns, baptisms and funerals added later.

The first index in 1921 was established to depict “food costs necessary for four weeks in Vienna.” The goal was to measure price movements at the minimum subsistence level, i.e. food prices. The basket of goods represented the subsistence necessary to supply a 70 kg man with approximately 3,000 calories consisting of 70 g of protein per day. It varied from month to month depending on the availability of goods for the population. The index used the official prices for rationed food quantities and the prices on the free market and the black market for other goods.

In March 1921 the Central Statistical Commission calculated a new index of increases of the necessary total spending of a Viennese family. This index was published for several months in 1921 (table 1).

In January 1922, the Federal Statistical Office created an “index of the cost of living for one person in Vienna based on weekly consumption,” which was calculated until December 1925. Starting in 1926 – once the economic situation in Austria had largely normalized again – that index was replaced with a COLI that remained in use until 1938.

4.3 RPI 38, COLI 38 and COLI 45 – inflation parameters for the post-WW II period

The 1938 retail price index (RPI)¹⁰ was calculated in the post-World War II (WW II) period between July 1948 and February 1959 after the supply of goods had largely normalized again and state food rationing and price fixing had been lifted. However, the index

was computed on a 1938 basis since it was still based on pre-WW II consumption patterns. For the first time, the basket of goods included household items (silverware) and writing materials (ink, pencils, paper) as well as train fares and postal expenses.

The COLI representing the expenses of a four-member working class family in Vienna (a price index as described in section 1.2; see WIFO, 1949) was the direct predecessor of the later CPIs. WIFO calculated the COLI between 1946 and February 1959 using two different base periods.¹¹ The basket of goods underlying the index was likewise based on surveys of the household budgets of working class Vienna families from before WW II (specifically, from 1935) and was broken down into nine primary groups. Especially in the immediate post-war period, the WIFO was skeptical about the index being a suitable representation of costs given that it initially underestimated the change in the cost of living, which at that time was very difficult to quantify, and overestimated the price increases that occurred after currency reform in 1948 and the wage-price-agreements between 1947 and 1951 (WIFO, 1949).

4.4 CPI I 58 and CPI II 58 – price data also collected from the provincial capitals

Starting in March 1959, the COLIs were replaced by the new CPI series and index calculation was well documented from that time onward. The 1954/55 consumer survey provided information on the distribution of spending for both indices. The index itself was calculated on the basis of 1958 prices using two different sets of data – one for an average household

¹⁰ *March 1938 = 100.*

¹¹ *COLI 38: April 1938 = 100; COLI 45: April 1945 = 100.*

Table 4

Number of indexed items in the Austrian CPI from 1800 to 1986

Consumption groups	1800– 1914 ¹	1921 ²	1921 ³	1922 ⁴	1925 ⁵	1938 RPI	1945 COLI	1958 CPI	1966 CPI	1976 CPI	1986 CPI
Total	38	20	40	24	44	54	83	197	253	582	615
Food and beverages	24	18	16	16	25	27	31	64	76	147	149
Tobacco	2	0	0	0	6	4	2	7	7	85	79
Construction, rent and maintenance of residential housing	1	0	1	1	1	0	1	3	5	25	28
Lighting and heating	5	2	5	4	4	4	6	10	10	11	13
Furnishings and household equipment	0	0	0	0	0	6	10	29	36	43	41
Clothing and personal care	3	0	10	3	3	3	16	27	35	44	50
Residential cleaning, laundry and dry cleaning	0	0	2	0	0	0	1	12	12	11	9
Body and health care	1	0	4	0	2	1	2	16	23	24	31
Leisure and education	1	0	1	0	2	6	10	19	30	71	85
Transport	1	0	1	0	1	3	4	10	19	121	130

Source: Statistics Austria. Österreichisches Statistisches Zentralamt (1977, 1979b, 1987, 1997).

¹ Backward calculation from 1979 using data from the 1912–14 consumer survey.

² Index of food costs necessary for four weeks in Vienna.

³ 1921: Index of increases in the necessary total spending for a Vienna family.

⁴ 1922: Index of the cost of living for one person in Vienna based on weekly consumption.

⁵ New index of changes in the cost of living in Vienna.

(CPI I) and one for a four-member working class family (CPI II). New to this index was, however, that in addition to Vienna and the Austrian provincial capitals at the time, price data were extended to include Wiener Neustadt and St. Pölten, which remained the case until 1976. Starting in 1958, the execution of price surveys was based on an agreement between the Austrian Central Statistical Office and the participating municipal governments, with the reporting cities receiving compensation for their assistance. Retail establishments took part on a voluntary basis. From 1966 onward, consumer price statistics were generally governed by the Federal Statistics Act of 1965 (Federal Law Gazette No. 91/1965).

4.5 CPI 66 to 96 – three-fold increase in the number of items in the basket of goods

The consumer survey of 1964 provided the foundation for the first general in-

dex that was representative of all household sizes, all income levels and all social groups existing in the medium- to large-sized municipalities in Austria. A total of 253 goods and services typical of the period were tracked each month. These included some rather innovative products such as the portable typewriter – the precursor of today's laptops and notebooks – the Puch moped and the legendary VW Beetle (now replaced by the VW Golf and the VW Polo or revived in a much improved technical and qualitative form) as well as eau de Cologne. With regard to cigarette brands, the Austria 3, Austria C and Smart Export brands were at their peak and could be purchased for a price of between 25 and 30 Austrian groschen per piece.

Consumer surveys were carried out in ten-year intervals after the 1964 survey, which was followed by the 1974 and 1984 surveys from which the 1976 and 1986 generation of consumer

Comparison of CPI II, COLI and RPI from 1938 to 1958

The analysis of post-war price trends is based on the RPI 38 (1938 = 100) and COLIs 38 and 45 (1938 resp. 1945 = 100). The inflation trends depicted by these three indices can be compared using the CPI II 58, which like the COLI was based on a four-member Vienna family in terms of household size and had been calculated backward by the Austrian Central Statistical Office using a Paasche index. The RPI restricted spending patterns to those of an average adult in a low-income household. Noteworthy in this context is that the RPI and COLI series were based on extrapolations of the cost portions (quantity times price) of 1935 consumption patterns, but the CPI II was based on the 1954/55 consumer survey (fixed consumption patterns). In light of that difference and assuming a uniform base of 1954 = 100, we derive the trends shown in the table below. All three indices more than quadrupled between 1938 and 1951. While the CPI II with its varying index formulas only rose 4.4-fold, the RPI and COLI (Laspeyres indices) increased 4.9-fold.

Period	CPI II ¹	COLI ²	RPI ²
	1954 = 100		
April 1938	16.2	14.7	14.7
1950	71.4	68.2	67.8
1951	88.1	87.1	86.5
1952	100.6	101.9	98.2
1953	97.2	96.5	97.5
1954	100.0	100.0	100.0
1955	101.4	100.8	102.5
1956	104.8	104.3	105.4
1957	107.2	106.6	109.7
1958	108.1	109.0	110.9
	Change in %		
1938–51	443.8	492.5	488.4
1951–54	13.5	14.8	15.6
1954–58	8.1	9.0	10.9

Source: Austrian Central Statistical Office, 1959.

¹ 1938–54 according to Paasche, from 1954 onward according to Laspeyres.

² 1938–58 according to Laspeyres.

price indices emerged. From 1976 onward, all cities with more than 20,000 inhabitants (20 municipalities surveyed) were included (the number of retail establishments reporting grew from 1,350 to approximately 3,500; see table 5). Spending patterns were further refined, and approximately 600 goods and services were represented in the CPI 76 – twice as many as ten years prior. The subsequent CPI 86 did not contain significantly more index items (615), despite the fact that its composition indicated a further shift in spending toward services

(tables 2 and 4). This trend continued unabated in the decade between 1986 and 1996 and resulted in another increase in the number of products relevant to spending patterns and inflation measurement.

Starting in 1997, the Austrian CPI was converted to a 1996 = 100 basis. The weighting was based on the 1993/94 consumer survey, in which around 6,600 households participated by recording all of their household spending for an entire month. The weighting structure of the CPI 96 was based on monthly expenditures of

Table 5

Selected figures on the Austrian CPI index elements from 1959 to 2010

	1959	1966	1976	1986	1996	2000	2005	2010
Consumer survey								
<i>Number</i>								
Participating households	3,989	7,304	6,674	6,599	6,604	7,098	8,400	6,500
<i>EUR</i>								
Monthly index-relevant expenditures per household	166	325	711	1,482	2,351	2,376	2,676	2,873
Index structure								
<i>Reporting units</i>								
Retail establishments	n.a.	1,350	3,500	3,600	4,200	3,500	3,700	3,700
Price reports per month	n.a.	n.a.	30,000	33,000	40,000	39,000	41,400	41,400
<i>Number</i>								
Number of municipalities from which regional prices were collected	10	10	20	20	20	20	20	20

Source: Statistics Austria.
Note: n.a. = not available.

32,300 Austrian schillings; (around EUR 2,400) – the budget for an average 2.9-person household (or 1.8 income recipients in statistical terms).

The basket used for the CPI 96 comprised 710 goods and services. Approximately 40 items had been removed and 165 were added. The number of items under monthly observation increased to around 40,000 in some 4,200 retail establishments (table 5).

An interim index (the predecessor of the HICP) in line with EU standards was calculated for the first time in January 1996 (section 6). Starting in 1997, an improved version of the HICP was calculated by Statistics Austria in parallel to the CPI. Thus from 1996 onward, two official inflation rates were available for Austria. However, the HICP found little public use due, in part, to the publication policy of Statistics Austria, which tended to favor the detailed results of the CPI in its monthly press releases. In addition, the HICP incorporated new spending categories, specifically the Classification of Indi-

vidual Consumption by Purpose (COICOP) structure already used for the national accounts. Under the new nomenclature, household consumption was broken down into 12 primary groups, 40 groups of goods, and 106 categories. The categories are broken down further by the individual EU Member States, depending on their consumption habits, and represent the level of the indexed items.

4.6 CPI 2000 and HICP 2000 – divergent design concepts

At the beginning of 2001, the index series was adjusted for the sixth time since 1945 to reflect current spending patterns and reset to a 2000 = 100 basis. The transition to five-year intervals instead of the earlier decade-long jumps was based on international recommendations, due above all to the high momentum and constant innovation existing in today's fast-paced product markets. More than 7,000 households provided information on their monthly spending behavior in different months

Table 6

Indexed items in the Austrian CPI and the HICP from 1996 to 2016

COICOP consumption groups in the CPI and the HICP	1996		2000	2005	2010	2016	
	CPI	HICP	CPI	CPI	CPI	CPI	HICP
	Number						
Total	710	678	812	770	791	801	789
Food and nonalcoholic beverages	125	125	127	129	128	128	128
Alcoholic beverages, tobacco	75	75	78	10	10	10	10
Clothing and footwear	47	47	57	66	62	62	62
Housing, water, electricity, gas and other fuels	44	44	50	49	48	48	47
Furnishings, household equipment and routine household maintenance	64	64	74	75	72	72	72
Health	19	8	30	33	36	37	37
Transport	129	122	144	141	166	175	170
Communication	18	18	13	12	11	11	11
Recreation and culture	96	93	113	117	113	113	109
Education	7	4	12	13	15	15	15
Restaurants and hotels	32	31	40	47	51	51	50
Miscellaneous goods and services	54	47	74	78	79	79	78

Source: Statistics Austria.

Note: Since 1996, the COICOP expenditure classifications have been used due a change in the classification of consumption groups. HICP index items are reported for the year of introduction (1996) and for 2016.

over one year. This survey and other sources (box 2) were used to filter out more than 800 typical household consumer products to be used as the basis for the CPI and the HICP. Additions were necessary in the area of transportation and leisure activities in particular, in which an especially wide range of new offers were available. For the first time, the basket of goods and services included Internet fees, DVD players, CD-ROMs and computer printers as well as domestic help, child daycare and attorneys' fees.

The revision of the consumer price index and its conversion to a 2000 = 100 basis in 2001 had an equal impact on the CPI and the HICP due to the numerous new regulations at EU level. Statistics Austria therefore undertook extensive documentation of the differences between the two inflation parameters for Austria (Statistics Austria, 2001) and

presented a detailed comparison of the two concepts as well as the index calculations. The CPI and the HICP differ in terms of the following criteria:

1. Consumer spending: residents concept (CPI) versus domestic concept (HICP)¹², with the major difference being that the HICP also accounts for spending by foreign tourists in Austria;
2. Items included in the basket of goods and services: pursuant to EU regulations, the HICP does not include owner-occupied housing, gambling or parafiscal levies, for which reason the two indices have a different number of items and divergent weights for consumption groups;
3. Treatment of insurance policies: gross concept (CPI) versus net concept (HICP), i.e. the latter index takes insurance payouts to house-

¹² Residents concept: consumer spending by residents of Austria; domestic concept: all consumer spending in Austria.

holds into account, which leads to a much lower net expenditure weight for the HICP than the CPI;

4. Averaging methodology: arithmetic mean (CPI) versus geometric mean (HICP) used for the index numbers¹³ at the level of the elementary index (e.g. long-grain rice in Linz);
5. Weighting adjustment: every five years for the CPI versus annual weight checks and adjustments in the form of a chain index for the HICP (see below for details).

The Laspeyres formula, the survey methods (including the cities and the retail establishments included in the price surveys), and the quality adjustment methods (section 5) remained the same for the two indices. The geometric averaging procedure (2005) and the chain index (2010) used in the HICP were later also incorporated into the national CPI.

The 2005 CPI and HICP revisions, whose expenditure weights were based on the 2004/05 consumer surveys, added brokerage account fees and flat-screened TVs to the basket of goods and services, and the previous 56 varieties of cigarettes were combined into two items (cigarettes and cigars; see table 6). Tobacco spending no longer reached the threshold relevant for the CPI and was therefore not represented in the index.

4.7 The 2015 CPI and HICP: current inflation parameters

At the start of 2016, the CPI and the HICP were converted to a 2015 = 100 basis.¹⁴ The following section therefore deals with measurement criteria that have not yet been mentioned in this study and which are regarded as state of the art at present.

The provisions relating to consumer price statistics (CPIs) are anchored in the 2000¹⁵ Federal Statistics Act and other special regulations¹⁶. The HICP is governed by a number of EU regulations (section 6), with Regulation EC No 2494/95 supplying the framework until end-2016. In May 2016, *Regulation (EU) 2016/792 of the European Parliament and of the Council of 11 May 2016 on harmonised indices of consumer prices and the house price index, and repealing Council Regulation (EC) No 2494/95* was adopted, repealing the previous regulation with effect of January 1, 2017.

The Austrian CPI (and the HICP) is currently based on approximately 40,000 individual prices from 3,700 retail establishments for around 800 products and services each month. By comparison, approximately 1.5 million individual prices are compiled per month for the aggregate euro area HICP.

¹³ The averaging methodology concerns the question of how prices are determined at the lowest level, i.e. the elementary index. In Austria, the prices for a certain good or index position (e.g. long-grain rice in Linz) in a certain city make up the regional elementary aggregate level. Around 16,000 elementary indices exist with respect to the 800 indexed items and 20 cities covered. Austria has used the index number method (arithmetic mean of the individual index numbers) since 1976 (before which the average price method was used). According to empirical studies carried out prior to designing the HICP, the HICP utilizes the geometric mean of the individual index numbers, which is better suited to depicting price trends.

¹⁴ Aside from the expenditure weights and the index items, it has not yet been possible to integrate any additional data or information from the 2014/15 CPI and HICP revision and conversion to a 2015 = 100 basis. The data from the 2014/15 consumer survey will not be available until the fall of 2016.

¹⁵ Most recently amended in Federal Law Gazette No. 40/2014.

¹⁶ Federal Law Gazette II No. 351/2003. Most recently amended in Federal Law Gazette No. 457/2015.

4.7.1 Not all prices are alike

Price data are generally collected in the first week of the month, or in the third week of the month for selected goods (energy, seasonal merchandise). Quarterly microcensus data are taken for rents and the percentage change in rent prices indicated by the microcensus is incorporated into the CPI. The prices collected are the prices paid by households for the acquisition (monetary transaction = purchase) of individual goods and services. The monetary transaction is the deciding factor, i.e. the process by which a good or service changes possession in return for money. The actual purchase price includes all taxes applicable to the product and takes any rebates, discounts and special benefits into account insofar as they are received by the consumer. Taxes include transportation taxes and excise duties (e.g. motor vehicle, insurance and fuel taxes) and value added tax. The HICP excludes parafiscal fees (while the CPI includes the engine-based car insurance tax). Subsidies, refunds and state grants are considered “negative” taxes and are deducted from the price. Transfers, gifts and savings are not taken into consideration because they do not involve monetary transactions. The prices are also not impacted by the type or timing of payment.

EU Regulation 2602/2000 governs the consideration of price reductions in HICP calculation:

“Unless otherwise stated purchaser prices used in the HICP shall in general take account of reductions in prices of individual goods and services if such reductions:

(a) can be attributed to the purchase of an individual good or service;

(b) are available to all potential consumers with no special conditions attached (non-discriminatory);

(c) are known to the purchaser at the time when they enter into the agreement with the seller to purchase the product concerned; and

(d) can be claimed at the time of purchase or within such a time period following the actual purchase that they might be expected to have a significant influence on the quantities purchasers are willing to purchase.”

Item (b) in particular has become more important in recent years given the proliferation of retail customer loyalty campaigns (Fluch et al., 2010). Such campaigns are excluded from current price measurement regulations because they are subject to the condition that a customer card be issued and because the conditions are applicable to individuals only. One particular issue in trying to include customer loyalty campaigns lies in the difficulty of identifying the campaign price and quantifying its relative importance for the market as a whole. If, in an extreme case, a good or service were to be purchased exclusively at the reduced price based on all consumers possessing a customer card, then that price would be the representative price and should be included in the index. The difficulty in quantification lies in determining which price is paid most often for a certain product. The use of scanner data¹⁷ in index calculation, which is currently in preparation in Austria, could effect a change in the collection of price data since scanner data reflect the prices actually paid, including prices that are reduced due to customer loyalty programs.

Certain sectors pose a particular challenge for inflation measurement;

¹⁷ Scanner data are already included in the current HICP calculations in other countries such as Belgium, Denmark, the Netherlands, Norway and Switzerland.

these include tourism (e.g. airplane travel), residential rents, the communications sector (e.g. mobile phone fees) and the educational and health care sectors as well as social institutions (e.g. retirement home fees, etc.). These sectors demand particularly close attention due to their wide range of pricing modalities and the difficulty of identifying quality changes where rates change quickly (box 4).

4.7.2 Criteria for retail establishments

The following criteria apply to the retail establishments from which price data are obtained: they must be representative of as well as relevant to their sector (i.e. have a certain market share) and be regionally significant. All store categories must be included (small, large, specialty shops, supermarkets, discounters, catalogs, online shops, etc.).

Approximately 90% of the price data for CPI and HICP calculation are collected at the level of the 20 Austrian regions and 10% are collected directly from Statistics Austria (nationwide rates and fees, prices for especially complex products such as electronic equipment).

4.7.3 Basket of goods and services updated annually

Short product cycles, constant product innovation, the tendency of consumers to adapt rapidly to new products and take a critical view of “outdated” baskets – all of which lead to distorted inflation rates and do not adequately document current consumer spending patterns – make it necessary to update consumer spending data in the CPI on

an ongoing basis. A so-called “chain index” makes this possible for the HICP and, since 2010, for the CPI as well. The weights are adjusted annually and a standard procedure (weighting update) is applied to update prices to reflect the level recorded in December of the preceding year¹⁸. Every five years, consumer surveys and other sources of data (box 2) are used to perform an extensive revision of the goods and services included in the basket, with around one-fourth of all index items being affected by the changes. The 2010 revision, for instance, involved adding 80 new goods and services, leaving out 59, and substantially adjusting the description of 50 (table 7). Standard filter coffee makers were replaced by pod coffee makers in 2010, for example. GPS navigation devices, wood pellets and admission to thermal baths were also newly added. By contrast, unleaded regular gasoline, color film and wall-to-wall carpeting were eliminated since those products fell below the necessary threshold of 0.1% of household spending.

The inflation rate calculated for Austria (no regional indices are published) is available around two weeks after the end of the reporting period and is published by Statistics Austria. The inflation rates for all EU Member States are published by Eurostat on the same day. Approximately 120 indices of goods categories (plus special groups) are calculated in addition to the overall CPI and HICP. Statistics Austria additionally calculates and publishes special price indices (including a micro and a mini basket, an energy price index and a passenger vehicle index)¹⁹.

¹⁸ The weights are adapted annually, i.e. the monthly indices for a given year are based on the previous year's weighting structure, which is updated to reflect December levels and is “chained” to previous months via the month of December.

¹⁹ These indices aggregate index items from the various consumption groups: the passenger car index, for instance, tracks price trends such as automobile, tire and gasoline purchases as well as car repairs and insurance, etc. Until end-2015, a separate price index for retired households was calculated, but has been discontinued since.

Table 7

Annual revision of the basket of goods and services for Austria: from the 2005 CPI to the 2010 CPI

Basket of goods and services 2005 (770)	New items (80)	Removed items (59)	Substitute items (50)	Basket of goods and services 2010 (791)
	Criteria: <ul style="list-style-type: none"> Increasing sales significance New or additional purpose >0.1% of consumer spending Examples: <ul style="list-style-type: none"> Pork loin GPS navigation devices Wood pellets Gardening services Coffee shop breakfasts University courses 24-hour care 	Criteria: <ul style="list-style-type: none"> Sales decline Insufficient demand Examples: <ul style="list-style-type: none"> Blast-furnace coke Wall-to-wall carpeting Coffee filters Unleaded regular gasoline Color film Permanent waves 	Criteria: <ul style="list-style-type: none"> Increasing sales significance Same purpose Examples: <ul style="list-style-type: none"> Pork ham instead of processed sandwich meat Rum instead of brandy Pod coffee machines instead of filter coffee machines Wheeled suitcases instead of hard-shell suitcases 	

Source: Statistics Austria.

Box 2

Derivation of expenses for the CPI and HICP baskets of goods and services: Consumer surveys and other sources

Since the 1960s, the index baskets of goods and services have depicted the consumption of all households based on an average Austrian household. Since every household has its own individual consumption patterns, it would of course be quite unlikely in the real world to encounter a household precisely like the one underlying the calculation of inflation. For example, an individual household will not use all types of energy at the same time, but will have expenses for either gas, district heating or wood in addition to electricity. By the same token, few households will have expenses for both a rental home and an owner-occupied home. The index nonetheless includes those expenses on a proportionate basis. Comprehensive consumer surveys form the basis for the detailed breakdown of household spending but do not always supply reliable data, however. The data could be distorted due to recordkeeping errors, changes in spending behavior as a result of recording expenses, and the “whitewashing” of figures (data are not entered correctly in the household accounts – e.g. expenses for alcohol). Therefore, plausibility checks are carried out by comparing the data on private consumption from the national accounts and taking that data for the (detailed) weighting of the relevant index items. Other key sources of data are administrative institutions (e.g. the Austrian Association of Social Insurance Providers for health care data, and agencies supplying tourism and car registration statistics), microcensus surveys providing data on costs for shelter and surveys by market research institutes and polling organizations. Finally, the CPI also includes expenses for assisted living (e.g. retirement homes). Those expenses are not derived from consumer surveys but come from other sources (social security funds).

5 Ambiguities in inflation measurement in light of the Boskin Report on the U.S. CPI

5.1 Causes of measurement inaccuracies in the calculation of inflation

Computing the rate of inflation involves complex survey and calculation processes that represent potential sources of error with regard to executing field work and price surveys, determining and updating the basket of goods and services, deriving expenditure weights, selecting retail establishments, establishing conventions for adding new products and handling quality changes, calculating accurate prices (in view of fictitious prices such as rebates), dealing with seasonal goods and other particularly significant expense groups such as rent, and allowing for substitution effects based on consumer demand (in the case of goods and retail establishments).

The general public has become much more aware of inflation measurement since the mid-1990s, when central banks began making price stability and low inflation rates a key objective. A low rate of inflation has always been one of the main criteria for admission to EMU. Studies carried out prior to monetary integration show that the inflation measurement methods used up to that time could result in a distortion – predominantly a significant overstating – of the upward movement in prices.

In this context, the *Boskin Report* (Boskin and Dulberger, 1996, 1997)

received particular attention. The report was entitled “Toward a More Accurate Measure of the Cost of Living” and was presented to the U.S. Senate Finance Committee by a scientific committee made up of renowned U.S. university professors led by Michael J. Boskin for the purpose of describing measurement errors in the U.S. CPI. According to the report, the inflation rates reported for private consumption in the U.S.A. at that time exceeded the “true” rate of inflation by 1.1 percentage points per year, with a fluctuation margin of between 0.8% and 1.6%. The *Boskin Report* identified four potential sources of error that could lead to overestimation of the inflation rate. In the case of the U.S., 0.6 percentage points were attributable to insufficient depiction of changes in the quality of new products, 0.4 percentage points to substitution effects resulting from changes in buying behavior in the selection of products, and 0.1 percentage points to the selection of retail establishments.

Although the report’s findings were disputed among experts and cannot be transposed 1:1 to other countries (since different measurement concepts are applied), at the time they were cause for intense discussion and resulted in the initiation of similar studies.²⁰

5.2 Methods of minimizing sources of error

A more general description of how measurement errors can be minimized when calculating inflation is given in

²⁰ Studies were also carried out for Canada (1997) and the U.K. (1995); see Hoffmann (1998, p. 7) for an overview. The margin of measurement error was less than 1 percentage point per year for both countries at the time (Canada: 0.5 to 0.7 percentage points; U.K. 0.35 to 0.8 percentage points). A study by the Deutsche Bundesbank found that the overstating bias was around 3/4 of a percentage point for the German CPI (Hoffmann, 1998). The majority of that error was caused by difficulties in measuring quality. There are no scientific studies on measurement errors in the CPI inflation rate for Austria; cautious estimates (from experts at Statistics Austria) referred to 0.1 to 0.3 percentage points.

the following subchapter (for some topics with special reference to current Austrian practice).

5.2.1 Consideration of quality changes

Nearly all goods are subject to qualitative changes resulting from changes in model, equipment or workmanship; price comparisons over time are only useful for homogeneous goods. Due to the inevitability of changes in the supply of goods and, increasingly, in services as well, price series for old and new models (or old and new rates or fees) must frequently be chained for price calculation purposes.

One of the most difficult practical considerations in the preparation of indices is how to assess whether a subsequent model is a higher-quality product or merely another product with the same features (a “type change”) as well as how to differentiate between price and quality changes and the resulting impact on inflation.

This is especially important for index concepts that follow the Laspeyres approach and, strictly speaking, always observe price trends for the same product. In such cases, the key consideration is which portion of a change in price is relevant to inflation and which is not. Various methods have been developed (Statistics Austria, 2011; ILO et al., 2013; Eurostat, 2016) for the purpose of facilitating such assessments and have to be applied in the harmonized calculation of inflation rates across the EU (box 3).

5.2.2 Timely inclusion of new goods and services

A problem arises when new goods have already achieved a certain market share but do not appear in the index, despite having caused drastic price reductions once they entered into mass production. The difficulty in including such

goods in the index is a frequent lack of reliable, recent statistics documenting their demand, which even if available may not allow for separation of the demand portion attributable to the commercial sector and that attributable to the household sector. Two legislative changes have contributed to an improvement in measurement accuracy. First, baskets of goods and services are now adjusted at shorter intervals than in the past, and second, the EU has legislated that any new goods representing 0.1% of consumer demand must be included in the HICP. Statistical offices are required to use recent statistics to conduct ongoing reviews of the significance of new consumer products for the price index.

5.2.3 Accounting for changes in demand habits...

The *Laspeyres effect* describes a phenomenon in which consumer demand increases when a product registers a below-average increase in price, or even a drop in price, and tends to decrease when goods become more expensive. It was long not possible to account for such changes in demand habits in the index given the necessity of compromising between accuracy and practicality in the constant observation of price trends. This has become easier now that baskets of goods and services are being adapted more frequently. The more often a basket is updated, the less prevalent the substitution effect is.

5.2.4 ... and for switching retail establishments

In Austria, local authorities in the 20 cities reporting price information are responsible for the selection of reporting retail establishments. The obligation of the establishments to cooperate in price sampling is set forth in Article 7 of Regulation (EU) No 2494/1995

Methods of adjusting for quality in the Austrian CPI and HICP

In Austria, a committee of experts (CPI working group)¹ offers advice and decides on a case-by-case basis on whether quality changes or changes in type have occurred. Application of the basic rule – “a quality change exists if an essential product feature has changed, and a type change exists if only accessory features (that are insignificant for the price) have changed” – is not always possible, however. Making an objective assessment of quality changes requires detailed discussion as well as various aids (surveys of sector experts, inquiries to manufacturers, decomposing the item into its price-determining features). The database set up by Eurostat, which specifies criteria and provides examples, serves as another aid in decision making. A subjective assessment of changes in quality, i.e. a consumer assessment and an assessment of the benefits gained – although likewise theoretically significant – is difficult to measure statistically and must rely on features such as improved safety, more efficient application, and the like.

In addition to direct price comparisons (where no essential quality features have changed), both implicit and explicit methods are used to make quality adjustments to the Austrian price index (Statistics Austria, 2011). Implicit methods measure changes in price between two consecutive price observation points on the basis of price changes in similar models during the same period. Explicit methods assess quality differences using observable differences in product features; these are the methods most frequently applied to calculation of the Austrian CPI and HICP. The following is a simplified explanation of the types of explicit quality assessment methods used:

Option cost method (with 50% rule): Substitute item B includes a feature that could only be purchased as an option separately from item A in period t . The quality adjustment between item A and item B equals half of the price of the separate option.

Expert assessment: Manufacturers, consumers and experts make a subjective, graduated estimate of the quality change and degree of price change.

Hedonic calculations: A regression model in which the item is broken down into its constituent features serves to determine which features are responsible for the price difference.

The option cost method is used in Austria e.g. for cars and personal computers. The hedonic method is used for books and SD memory cards. In addition, expert assessments from the CPI working group are often taken into account. Since the figures calculated are only an indication of quality changes rather than exact monetary amounts, they are only considered in the context of a larger system. Price differences are broken down into five levels ranging from no quality difference (type change S, or Q0), Q1 (one-quarter of the price difference is quality related), Q2 (one-half of the price difference is quality related), and Q3 (three-quarters of the price difference are quality related) to the price difference equaling the quality difference (Q4). Thus either the entire price difference, a portion of the difference or no price effect are factored into the inflation rate. In Austria, quality adjustments are made for approximately 3% of all goods and services each year.

With regard to the implicit methods, overlap pricing is of some significance when substituting products in the context of a complete revision of the basket of goods and services. Overlap pricing is used when item A and substitute item B are both on the market for at least one period t (overlap period), with the quality adjustment of B in the period $t+1$ (when only B is available) being equal to the price difference between A and B in period t (Statistics Austria, 2011).

¹ A Statistics Austria committee composed of experts from various institutions (ministries, Chamber of Labour, Austrian Economic Chambers, WIFO, OeNB).

and in Article 5 of the new Regulation (EU) 2016/792, which for the first time requires the provision of scanner data where available. Regional selection committees endeavor to acquire the most market-relevant sector representatives for the sampling. However, sometimes retail establishments are resistant to supplying a price-surveying organization with information on the prices quoted to each customer. Thus it does not appear to be generally assured that *market leaders* or discounters whose *value for money* or price adjustment strategies and price trends differ from those of other retail establishments will be included in the CPI and HICP. Moreover, since total revenues are not used as a price-weighting factor, the price of an item is calculated from the unweighted average of all prices reported. It is therefore of particular relevance that a representative selection of retail establishments and types of establishment be made.

5.2.5 Eliminating sources of errors in field work

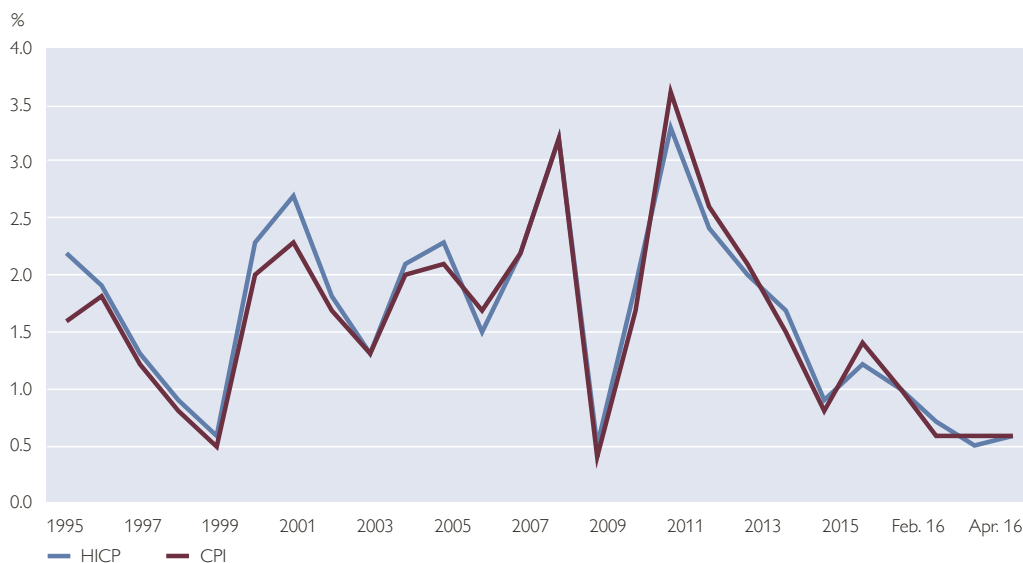
The majority of price data comes from survey institutions, and the field work carried out to collect the price data is prone to error. However, sampling errors are not likely to be especially prevalent among those official price data collectors using computer-assisted technologies (Austria is currently in the process of transitioning to tablets for price data collection). Where data are collected by temporary staff that have received training in collection methodology, but have less experience, the provincial CPI administration and Statistics Austria have to ensure that the downstream control mechanisms and plausibility checks are sufficient to identify any inaccuracies.

6 EMU: harmonized inflation measurement becomes state of the art

A low rate of inflation has always been one of the main convergence criteria

Chart 1

CPI and HICP inflation rates in Austria



Source: Statistics Austria.

Box 4

HICP inflation measurement governed by more than 20 EU regulations, but a consolidated legal basis is being implemented

In 1994, an EU-level working group was set up to develop a harmonized consumer price index. The working group was composed of representatives from all statistical offices plus selected central banks and specialists in the field. In 1995, Council Regulation (EC) No 2494/95 was enacted. The regulation governs the objectives and definition of the HICP and lists comparability requirements in addition to setting the initial minimum standards for index criteria and specifying the procedure for publishing the HICP across the EU. Another 22 regulations (Eurostat, 2016a) cover the entire methodology by refining the preparation and calculation methods specified in the framework regulation; certain aspects of HICP preparation (e.g. weighting) were specified multiple times over the years based on practical experience gathered during HICP preparation. Moreover, the new Regulation 2016/792 and the implementing regulation to be adopted in 2017 consolidate and update the HICP-relevant regulations in effect today. The regulations are supplemented by recommendations, e.g. on rents, telecommunications, and health care (Eurostat, 2016b). They describe procedures for preparing the HICP and go beyond the statutory requirements, so they are not legally binding.

The original HICP calculations did not include data on owner-occupied housing, which is particularly difficult to compare due to the different methods by which the national CPIs deal with this item. Treatment of owner-occupied housing was not legally regulated until 2013, when Regulation (EU) No 93/2013 defined criteria for creating price indices for owner-occupied housing. The price index for owner-occupied housing tracks price trends in all direct and indirect components of real estate transactions and therefore supplements the HICP as a key indicator for estimating price trends at the consumer level.¹ In addition to the main index, there are two separate subindices: “Purchase of new homes” and “Purchase of existing housing stock.”

The primary factors relevant to preparation of the Austrian index are presented in sections 4.6 and 4.7, which also discuss selected, legally binding aspects of HICP index preparation as well as the differences between calculating the HICP index and the national CPI.

¹ The European Commission will publish a report by end-2018 on the inclusion of this index in the HICP (Regulation (EU) No 2016/792, recital 10, p. 2).

for Member States to participate in EMU. Many aspects of inflation measurement in the EU Member States were nonhomogenous (methodology, collection, determination of the basket of goods and services, delineation of consumption groups e.g. with respect to the inclusion of owner-occupied housing), meaning that the inflation rates calculated were only comparable to a limited extent. For this reason, a working group headed by Eurostat was established at the beginning of the 1990s and tasked with creating an HICP for the EU (box 3). The working group later began incorporating findings from the *Boskin Report* and other studies into the HICP concept and

developed EU-wide guidelines for improving comparability as well as helping to minimize possible sources of error (Fluch, 1999; Hackenberg-Vögl, 1999). This gradually led to the development of an HICP manual based on EU regulations that serves as a theoretical and practical guide for measuring inflation in the EU Member States (Eurostat, 2016c).

Ever since the start of monetary union, the HICP has acted as the primary indicator of inflation for the ECB and the Eurosystem in setting monetary policy. The HICP is a key part of monetary policy strategy and provides information on the stability of the euro. The Eurosystem aims to maintain the

annual HICP inflation rate at near or below 2% in the euro area.

The calculation and publication of inflation rates and the categorization of consumption groups and subgroups ensures that the information on price trends is sufficiently detailed and current. HICP statistics also allows monetary policymakers to undertake current analyses of core inflation indicators (total inflation excluding volatile goods such as fuels, seasonal foods and tourism services) and to prepare monthly flash estimates as well as projections of euro area inflation.

Now, after approximately 20 years, the HICP has achieved recognition as a reliable tool for measuring the inflation rate in the EU and the euro area. As mentioned above, the methods for calculating the HICP have been applied to some aspects of the calculation of national CPIs, which continue to exist in nearly all EU Member States, including Austria. Some conceptual differences between the HICP and the CPI (see section 4.6 and Fluch and Rumler, 2005) remain unchanged, but cause only minimal deviations of 0.1 percentage point to 0.2 percentage points in the inflation rates depicted by the two indices for Austria (Auer and Pesendorfer, 2016).

7 Summary and outlook

A CPI measures changes in the prices of goods and services that households consume. The calculation of price indices at international level began as early as the beginning of the 18th century. In Austria, consumer price indices have been consistently available since 1800. Though simple, the indices followed today's basic structure, and chaining the different price indices allows for conclusions to be drawn on inflation rate trends, adjustments for inflation and indexation for a period now spanning more than 200 years. It was not until

1921 that official statistics reporting began in the wake of high inflation or hyperinflation in Austria. Various indices were calculated (predominantly for Vienna only), with backward calculations extending back to 1914 in some cases. The historical series from 1800 to 1914 are based on backward calculations from the late 1970s, which were prepared using 19th century price records for Austria's main cities and applied a household spending model similar to that used in 1912 for the first modern consumer survey. In the inter-war period as well as in the years up to 1959, various types of cost-of-living indices and retail price indices were computed to serve as parameters for changes in inflation. Two World Wars, severe living conditions for the population, state control (price fixing, rationing) and repeated currency substitutions posed great challenges for the calculation of price indices at that time. CPIs similar to today's HICP – though less sophisticated in their methodology and measurement accuracy – were not available until the 1958 consumer price index. The CPI 58 was prepared by the Austrian Central Statistical Office based on the spending patterns of all Austrian households of the 1955 consumer survey.

In the 15 generations of CPIs calculated for Austria since 1800 (and HICPs since 1996), drastic changes have occurred in household consumption patterns, the composition of the basket of goods and services, the criteria for price data collection and index construction methods, all of which are key elements of a CPI. Whereas the first price indices were still characterized by the predominance of basic necessities, consumption patterns are vastly different today. The proportion of basic necessities has declined significantly and luxury items have increased to account

for some 75% of the basket of goods and services in 2016. The coverage of the basket was also greatly expanded. The first international scientists dealing with price indices used only very few (three to five) goods, and the 1922 COLI included 40 goods. By 1959, the basket already included 197 items, and by 2000 the number of goods and services in the basket had quadrupled. Since then, the number of items in the basket has been relatively stable at around 800.

The same applies to the construction of the respective generations of indices. The historical indices from the 19th and early 20th century include 13,000 individual prices for the calculated years from 1800 to 1914. By 1959, some 5,000 prices were being recorded each month, and in 2016, the CPI and HICP are calculated on the basis of approximately 40,000 individual prices. A similar momentum was seen in the retail establishment samples drawn in the same period with an increase from approximately 1,300 to more than 4,000. Computer-assisted processing and control mechanisms have replaced complicated procedures for maintaining price lists and manual processing, and tablets are now being used to facilitate field work.

As shown in various studies, measurement distortions affecting the accuracy of inflation calculations can arise from the following index factors: the frequency of weight adjustments, the tempo at which new goods achieve market and demand relevance for households and are included in the calculation of inflation, and the precision with which quality changes are included. The quality of inflation measurement has improved steadily, however, thanks to the findings from the *Boskin Report*, extensive work in the EU to harmonize the HICP, the precise analysis of infla-

tion rates by the central banks, innovative index producers, critical use of consumer price indices, the accompanying scientific work on price indices and the use of comprehensive statistical instruments. Today's calculations of inflation rates in the form of national CPIs and HICPs have without a doubt reached a high level of acceptance among monetary and economic policymakers due to their high quality, quick availability and the disaggregated data preparation.

Inflation measurement will nonetheless continue to face the following challenges:

- The fast pace of product cycles and heterogeneity of offers on the market, with their complex pricing packages and fee systems, will demand more attention than in the past with respect to making quality adjustments.
- The increase in online shopping by consumers and rapid price adjustments due to technical integration – daily or even hourly pricing (dynamic system pricing) in online shops – will alter price data collection methods such that price registration systems will have to become more flexible rather than relying on just one or two price data collection dates each month. This will necessitate additional field work.
- The massive increase in customer loyalty programs has resulted in fictitious prices as well as constant sale prices in nearly all consumer segments – this having become the rule rather than the exception – will require strategies for identifying the most frequent prices actually paid by customers and including them in the sample. It remains to be seen if Statistics Austria's transition to using scanner data for some sectors, which is currently in the preparatory stages, will succeed in supplying price data

that are more realistic than the displayed prices or list prices currently used for inflation measurement.

- The preparation of special indices has proven useful and should be continued. Back between 2002 and 2005, when the published inflation rate diverged from the perceived rate of inflation after introduction of euro cash, price statisticians in Austria developed special baskets of goods and services and indices capable of making more precise calculations of infla-

tion rates that better corresponded to the perceived prices for household items. The calculation of individual rates of inflation for households²¹ using special tools is another innovation worth mentioning, since this allows consumers to estimate the changes in their personal buying power. This can help alleviate the criticized discrepancy between macroeconomic inflation and individual perceptions of inflation.

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²¹ *Statistics Austria offers a tool for calculating personal inflation rates: www.statistik.at/persoentlicher_inflationsrechner.*

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