

Challenges for measuring inflation in a digital world from a monetary policy perspective

Doris Ritzberger-Grünwald, Fabio Rumler¹

Refereed by: Bernhard Goldhammer, ECB

Apart from having been a major driver of subdued inflation developments in most industrialized countries in the past 10–15 years, recent key megatrends in the retail industry, such as globalization and digitalization, also pose a number of new challenges for measuring inflation. This article discusses possible effects of growing Internet use on prices, inflation and official price statistics. There is some evidence that the growing importance of e-commerce in recent years has had a dampening effect on both online and offline prices, although this effect is likely to be small and only temporary until the spread of the internet has stabilized.

To account for the changing consumption habits resulting from web retailing, the methods and procedures for inflation measurement have to be adjusted to the new conditions. Systematically collecting data from online retailers (through web scraping) in addition to monitoring prices at brick-and-mortar stores and expanding monitoring to include smaller towns and rural areas would reflect new consumption habits and improve the representativeness of the price index. The use of scanner data directly obtained from retailers, furthermore, would allow for a joint analysis of prices and quantities sold, which in turn helps reduce the substitution bias present in conventional price statistics.

At the same time, a long-standing issue remains to be solved in inflation measurement: Although the costs of owner-occupied housing account for a considerable share of the total cost of living of households, they are still not included in the consumer price indices of European countries due to methodological complexities. In this respect, experimental evidence indicates that – under normal circumstances – including these costs in official price statistics will most likely not change the euro area inflation figures by much.

JEL classification: E31, C43

Keywords: digitalization, inflation measurement, owner-occupied housing, scanner data

The Eurosystem's primary objective of maintaining price stability, as stipulated in Article 127 of the Treaty on European Union, sounds rather simple and straightforward. Ultimately, it took a couple of years to arrive at a common and stable understanding of the best definition of price stability. The initial definition agreed at the start of monetary union was: "Price stability must be maintained according to the Eurosystem's published definition, so that year-on-year increases in the Harmonized Index of Consumer Prices (HICP) for the euro area are below 2%." A review of the monetary policy framework a few years on brought a less prominent role for the reference value and a balanced role for the two pillars of analysis (i.e. monetary and economic analysis)² as well as a fine-tuning of the price stability definition. To make clear that "below 2%" does not include zero or values close to

¹ Oesterreichische Nationalbank, Department of Economic Analysis and Research, doris.ritzberger-gruenwald@oenb.at; Economic Analysis Division, fabio.rumler@oenb.at (corresponding author). The views expressed in this paper are exclusively those of the authors and do not necessarily reflect those of the OeNB or the Eurosystem. The authors would like to thank the members of the ESCB Working Group on General Economic Statistics (WGGES), in particular, Karin Wagner (OeNB) for helpful comments and valuable suggestions and Raphael Neuwirth for research assistance as well as Ingeborg Schuch and Anita Roitner for language support.

² To analyze the prospects and risks for price stability, the ECB uses a two-pillar strategy. The first pillar consists of the economic analysis, which examines movements in output and demand, unemployment, price and cost indicators, etc. The second pillar is monetary analysis, which considers the supply and demand for monetary aggregates and credit. The ECB evaluates and cross-checks the information from these pillars to formulate its monetary policy decision.

zero, the target for inflation was redefined in May 2003 as allowing euro area HICP inflation rates of “below, but close to 2% over the medium term.”

The concept of aiming at inflation rates of “below, but close to 2% over the medium term” was praised but also criticized right from the beginning. Praised by those who appreciated the inherent flexibility giving the Governing Council of the ECB some leeway in its decision-making, and criticized by those who would have preferred a more precise benchmark for measuring the achievement of or failure to achieve the price stability objective.

As long as the inflation rate of the euro area hovered around 2%, in the years before the financial crisis, there was relatively little debate about the definition of price stability. After 2008 and during the financial and economic crisis, the debate intensified, becoming more muted only when the HICP dropped into negative territory and fueled fears of ending up in a deflationary spiral (as was the case in 2009 and again in 2015). The definition of price stability was hotly debated in particular during the period when inflation rates continued to remain persistently low after years of monetary policy accommodation, including the implementation of a set of nonstandard monetary policy measures with a view to spurring inflation. After all, euro area inflation had reached only 0.5% on average by 2016 despite all those measures.

Economists inside and outside the Eurosystem have tried to establish why inflation reacted so slowly to the vast amount of liquidity which was poured into the market. One stream of arguments focused on the transmission channel, which did not seem to work properly: Trust in the functioning of the money market was still missing, banks had to recapitalize and were hesitant to lend, and firms and households were highly leveraged and also not in a position to take up new loans. As a result, credit growth, investment and consumption were low even despite negative interest rates.

Another stream of arguments put the blame on structural changes which may have altered the inflation process. Globalization may have increased competition, and digitalization, shopping online in particular, may have eroded the traditional price-setting mechanism, dampening price increases as well. In addition, measurement issues came up, as it was believed that online prices were not being taken into account properly.

The various Eurosystem working groups that dealt with this topic ultimately provided good reasons against opening Pandora’s box and changing the price stability goal in times when it was difficult to reach. Moreover, euro area inflation did bounce back eventually and has reverted to a level of 1.7% in 2018. Thus, renewed compliance with the price stability goal has come within reach, also supported by rising energy prices. As a result, the ECB’s Asset Purchase Programme (APP) was terminated in December 2018, with high levels of liquidity provision to be retained for the time being through the reinvestment of maturing bonds. In other words, the HICP measurement debate has lost some steam in the euro area recently – but this notwithstanding, the question as such remains and continues to be high on the agenda of others and in other countries.

The inflation measurement debate actually dates back to the 1990s. The literature of the 1990s, most prominently the report of the Boskin Commission (1996), identified four major sources of bias in inflation measurement:

- the bias resulting from the use of a fixed-weight index formula (product substitution bias),

- the bias due to missing or inappropriate quality adjustment of prices (quality change bias),
- the bias resulting from a delayed consideration of new products (new product bias),
- the bias due to insufficient consideration of changes in the retail structure (outlet substitution bias).

The Boskin Commission (1996) estimated that due to these biases annual inflation in the U.S. was overstated by about 1.1 percentage points.

In the meantime, new statistical methods have been introduced to reduce or even eliminate these biases. Statistics Austria, for instance, has been updating the composition and the weights of its consumption baskets at annual intervals since 2010, with a view to reducing new-product and product-substitution bias. Furthermore, Statistics Austria has been frequently adjusting the structure of the surveyed outlets to reflect the actual outlet preference of consumers, given the rising importance of discounters and online sellers, and has introduced various methods for adjusting prices for quality changes, like hedonic regressions.

However, given new trends like globalization and digitalization, new challenges have appeared in inflation measurement in the past 10–15 years. In section 1 of this article, we will discuss how the rise of the Internet, and the possibility of purchasing goods and services online (also across borders) in particular, have affected prices and inflation. Furthermore, a rather long-standing, but still unresolved issue in inflation measurement is the integration of the costs of owner-occupied housing (OOH) into official price statistics. Even though OOH accounts for a considerable share of the total cost of living of households, it is mostly not included in the consumer price indices of European countries, which will be discussed in section 2. In section 3, we will analyze how the availability of new data sources through digitalization affects the measurement of inflation and make a few suggestions for future improvements. Section 4 concludes.

1 The effects of e-commerce on prices and inflation

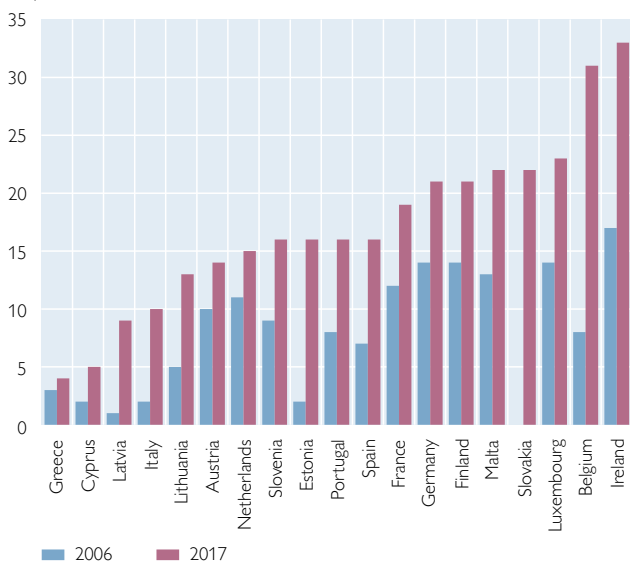
In this section, we will discuss only the direct effects of digitalization on prices as a result of the rise in sales of goods and services through the Internet, neglecting possible indirect effects of the advancement of IT on the cost structure of companies and total industries.³

Over the past 10 years, the share of electronic sales to consumers and businesses in the total turnover of enterprises has increased in all euro area countries, but still varies significantly across them (see chart 1, left panel). In 2017, the highest shares of electronic sales were reported by enterprises in small and open economies like Ireland, Belgium, Luxembourg, Slovakia, Malta and Finland, followed by companies in Germany, France, Spain and Portugal. At the same time, the shares of electronic sales were still comparatively low in Greece, Cyprus, Latvia and Italy, with values below 10%. The lower shares of e-commerce in these countries may be partly explained by a considerably larger share of small and medium-sized enterprises, which tend to generate a smaller share of their turnover from web sales than larger firms. In the 2006–2017 period, digital sales soared above all in countries that joined the euro area later than its founding members; namely in Estonia, Lithuania,

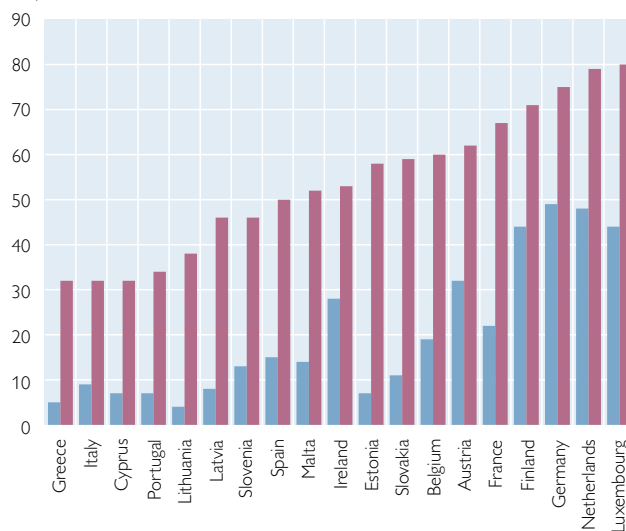
³ Other effects resulting from IT advancements that may eventually feed into prices include the impact that progress in IT is likely to have had on firm productivity and labor markets (see Coffinet and Perillaud, 2017).

E-commerce by enterprises and individuals**Internet sales (excluding sales by financial institutions)**

% of total turnover

**Individuals ordering goods and services online**

% of all individuals



Source: Eurostat.

Latvia, Cyprus and Slovakia, which – according to Eurostat information not shown in the chart – have seen a significant expansion in high-speed Internet coverage and where digital sales started from low levels in 2006. This compares with a relatively small increase in the share of digital sales for Austria in the past 12 years, namely from 10% in 2007 to 14% in 2017.

Turning to the customer perspective of e-commerce, the share of individuals using the Internet to obtain information on goods and services and make purchases online has increased considerably over the past 10 years (see chart 1, right panel). By 2017, the share of individuals who had bought and ordered goods and services online during the past 12 months exceeded 40%, except in Greece, Italy, Cyprus, Portugal and Lithuania. In most euro area countries, this percentage at least doubled between 2006 and 2017. In terms of the percentage of people purchasing goods online, Austria is among the top six countries in the euro area, reaching a share of 62% in 2017.

The growth in e-commerce can have direct effects on prices through two major mechanisms (Coffinet and Perillaud, 2017). First, compared to the standard brick-and-mortar-based distribution channels, e-commerce provides scope for cost savings (e.g. lower costs for logistics, marketing, etc.) in the wholesale and retail markets, which both traditional and online retailers can pass on to their customers. Second, e-commerce can lower prices because of increased competition among suppliers, as customers can easily search the Internet for the best bargain and thus force both traditional and online suppliers to keep their prices low. Increased competition among online retailers also affects price setting in classical brick-and-mortar stores, putting downward pressure on prices in the whole retail sector. However, the effect on prices is likely to be only temporary until the spread of e-commerce and conditions on online markets have stabilized (Meiyers, 2006). Furthermore, including

digitally-traded goods and services in inflation measurement would affect inflation only to the extent that online prices change at different rates compared to the prices of offline-traded goods and services.

Available empirical evidence on the existence of measurement errors in consumer price indices due to the incomplete coverage of online sales is still scarce and inconclusive. Comparing online and offline prices for household appliances in 21 EU countries, Duch-Brown and Martens (2014) find that online prices are on average lower than offline prices. At the same time, there is a large degree of heterogeneity across products, with some products even showing higher prices online than offline. From the cross-section of prices, they estimate the price elasticity of demand for each product and find that the elasticity of online prices is generally more pronounced than for offline prices, indicating that product substitution is probably stronger on online markets. Lorenzani and Varga (2014) estimate that a further increase in e-commerce will lower price increases in the retail sector by 0.5 percentage points per year in the EU-27. Newer evidence from a cross-country study based on 56 large multi-channel retailers (Cavallo, 2017) as well as from online shopping platforms in the U.S. and U.K. (Gorodnichenko et al., 2014) suggests that differences in online and offline prices are negligible and thus do not affect inflation. In contrast, evidence from millions of online transaction prices in the U.S. supplied by Adobe Analytics suggests that the inflation rate of products sold online is somewhat smaller than that of the same products sold offline (Goolsbee and Klenow, 2018).

As of December 2018, a new EU regulation (2018/302) outlawed geoblocking in e-commerce, i.e. preventing online customers from shopping in other EU countries at the same conditions as local costumers. With the possibility of unrestricted online trade within the whole EU, competition on online markets is expected to intensify further, possibly leading to a further reduction in prices in cross-border e-commerce. However, according to consumer protection organizations, the effect should not be huge because there are still a number of exceptions from the new regulation, in particular for electronic products where online trade is quite strong. Moreover, the new regulation does not imply an obligation for online sellers to ship their goods to all EU countries, which in reality still acts as a barrier to free online trade in the EU.

2 Integrating the costs of owner-occupied housing into the HICP

The inclusion of owner-occupied housing (OOH) into the HICP is a widely debated and still unresolved issue. So far, housing expenses are included in the consumer price indices of euro area countries predominantly in the form of direct rents paid. The weights of rents in the HICP, however, vary considerably across countries (ranging from below 1% in Slovenia to more than 10% in Germany in 2018). The housing expenses of house owners are not included in the HICP of the euro area countries. In the U.S., where such expenses are included in the CPI in the form of imputed rents, they have the highest weight of all product groups in the U.S. CPI (22%).

A crucial question in the debate about including the costs of OOH is whether housing should be treated as a consumption good or an investment good. If housing is treated as a consumption good it would need to be included, as the HICP has to capture all goods and services (above a certain threshold) that are acquired and consumed by households. However, in many cases properties and houses are bought

with an investment motive, which implies that these homes should be considered investment goods. It is precisely on account of this argument that OOH has been excluded from the HICP in the past.

Eurostat started publishing separate owner-occupied house price indices (OOHPI) in 2016, based on EU regulation 2016/792 on harmonised indices of consumer prices and the house price index. This regulation states in Article 2(9) that “changes in the transaction prices of dwellings new to the household sector...” – which corresponds to the net acquisition approach – should be used to calculate the OOHPI. This approach captures the transaction costs of property purchases plus purchase-related expenditures plus maintenance and major repairs. The OOHPI indices are calculated on a quarterly basis. Ultimately, including an OOHPI in the HICP would be problematic for three reasons. First, the quarterly OOHPI frequency would have to be converted somehow to the monthly frequency of the HICP. Second, land prices, which have an asset price element and should therefore not be part of the HICP, are implicitly included in the OOHPI. Third, the net acquisition approach, which would need to be used for HICP purposes as required by the respective provisions, is quite complex and entails a number of computational difficulties. Other approaches are the rental equivalence approach, as used in Japan and the U.S. and the user-cost approach, as used in Canada and Sweden; but they are at odds with the HICP legal framework.⁴

For these three reasons, OOH has not been included in the HICP in the past. In the light of methodological improvements concerning OOH in the past years, the European Commission reviewed the arguments underlying the decision to exclude OOH from the HICP during 2018. After consulting Eurostat and the ECB, the Commission issued its final decision in November 2018, confirming the exclusion of OOH from the HICP of euro area countries due to the three counter-arguments mentioned before (European Commission, 2018). At the same time, the Commission emphasized that although “the OOHPI is *currently* not suitable for integration into the coverage of the HICP... the Commission will pursue the methodological work required for the integration of the OOHPI *in the future*.” We understand from this that efforts to integrate OOH into official price statistics are ongoing, which is why we do not come back to this issue in our suggestions for improvements of inflation measurement in the next section.

Still, the question remains as to whether this decision by the Commission means that the HICP without OOH is severely biased. At the ECB, the effect of including OOH in the HICPs of individual euro area countries has been estimated in an internal exercise. These estimations reveal that annual growth rates of the HICP estimated with and without OOH would differ only marginally. The average and the maximum absolute impact of including OOH on annual HICP inflation in the euro area over the 5-year period considered in the exercise (Q1 2011 to Q4 2015) is less than 0.05 percentage points and 0.2 percentage points, respectively (see

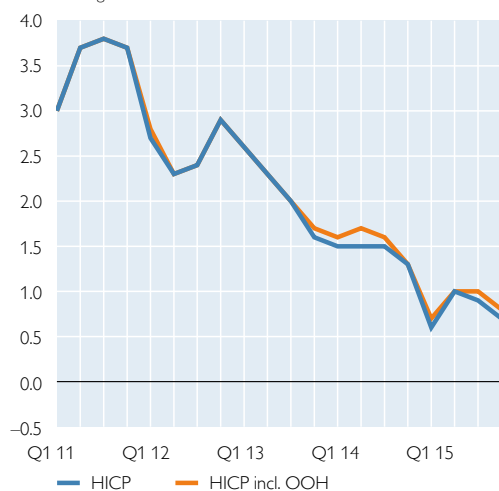
⁴ *The user-cost approach measures the changes in the cost to owner-occupiers of using the dwelling and includes repairs and maintenance, insurance, fees, mortgage interest and depreciation. It is less suitable for the inclusion in the HICP because it uses imputed cost measures and it includes interest payments which are directly influenced by monetary policy. The rental equivalence approach relies on the imputed price for the use of the owner-occupied dwelling that is equivalent to the rental price of the dwelling. However, this approach is also not suitable for the HICP because it follows a notional concept by using imputed rather than transaction prices, which would be required for the HICP.*

Chart 2

HICP including and excluding OOH

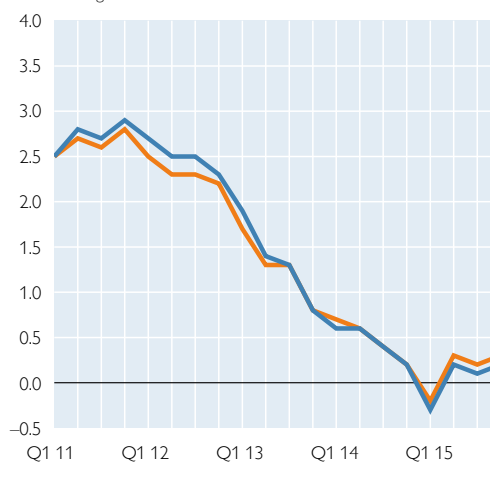
Austria

Annual change in %



Euro area

Annual change in %



Source: Eurostat and internal ECB estimates.

chart 2). For Austria, the impact over the same period is 0.0 percentage points on average, the maximum absolute impact being 0.1 percentage point. Larger impacts have been reported for countries with periods of more dynamic house price developments. In Spain, for instance, where a strong decline in house prices occurred from 2011 to mid-2013, the impact of including OOH in the HICP on annual inflation is on average -0.4 percentage points, with a maximum absolute impact on annual inflation in 2012 of -1.2 percentage points.

3 Suggested improvements for inflation measurement in the future

The changes in the behavior of consumers induced by the Internet but also the availability of new digital data require modifications in the methods and procedures for measuring inflation to increase the quality and representativeness of price statistics. These include measures which have been discussed in the literature and are already in the pipeline in a number of countries, but also new measures that help to improve price statistics. Accordingly, national statistical institutes (NSIs) should:

1. Use scanner data from supermarkets and specialist retailers in inflation measurement.
2. Include web-scraped data from online retailers in price statistics.
3. Expand the regional dimension of price data and publish regional inflation rates.
4. Publish timely flash estimates of monthly HICP inflation rates.

We will now discuss each of these suggestions in turn.

3.1 Collecting scanner data allows for a joint analysis of prices and quantities sold

Scanner data are data obtained by scanning the bar codes of individual products at electronic points of sale in retail outlets. They usually provide detailed information on the prices, quantities, characteristics and values of goods sold. To use scanner data in inflation measurement, they have to be released by the retailers who own

them. Yet retail chains may be reluctant to share their scanner data due to confidentiality and competition concerns. There would be a chance to include an obligation for retail companies to provide scanner data for statistical purposes (subject to confidentiality) in the new CPI regulation that is currently under review in Austria. In some European countries, notably in Belgium, Iceland, Italy, Luxembourg, the Netherlands, Norway, Slovenia and Switzerland, scanner data from supermarkets and specialist retailers are already used in inflation measurement, at an experimental level and for cross-checking the prices that are collected at brick-and-mortar stores.

The big advantage of scanner data is that they include actual transaction prices, which capture price rebates at the customer level (which may be different from posted prices), and quantities sold. This makes it possible to measure product substitution when relative prices of products change and, as a result, to reduce the product substitution bias mentioned above. By their nature of large and comprehensive data sets, scanner data would also improve the representativeness of price statistics as they allow price developments for individual products to be averaged over different varieties as well as over a number of days within the observation period (rather than just on due dates). They also come with the promise of making the collection of prices in stores less important in the future, thus reducing the costs of inflation measurement.

For economic research, scanner data are especially valuable as they allow researchers to estimate demand elasticities of individual products and to analyze the importance of sales prices in retailing. However, a drawback of scanner data is that they require large computing and time resources for storage, cleaning and processing. Furthermore, the best index calculation formula to integrate scanner data into the HICP is still not agreed upon (see Eurostat, 2017).

3.2 Collecting online retailing prices (web scraping) reflects the rising importance of e-commerce

Web scraping denotes the automatic download of (large quantities of) data from the Internet for the purpose of data analysis. In the context of price data, this means scraping the websites of online retailers at high frequencies (at daily intervals or even more frequently) to collect the prices of the products offered. Automatic retrieval of price data from the websites of online sellers requires a special software but also regular interactive maintenance of the automatic downloads to deal with changes in the addresses or designs of sellers' websites.

Given that e-commerce has gained significant importance in many countries, as shown above, online prices should be included in inflation measurement to the extent goods and services are purchased online (in Austria roughly 14% in 2017). In Austria, the prices of some goods and services are already collected on the Internet (including e.g. electricity, flight tickets, cigarettes), but they are retrieved from the suppliers' websites on a case-by-case basis. The prices charged by online retailers, which – due to the large quantity required – would have to be downloaded automatically, have not been included in Austrian price statistics so far.

Web-scraped data share some of the advantages of scanner data in inflation measurement. Including them would enhance the representativeness of price statistics by accounting for the changing consumption habits of households, who are buying increasing amounts of goods and services online. It would also allow to calculate and analyze price trends at a higher frequency than with data normally collected

on due dates.⁵ However, there are legal limitations to web scraping as the firewalls of online retailers may identify web-scraping activities as intrusion and block any further access and download. Another limitation for the use of web-scraped data in the HICP is that no weighting information can be inferred from the data as quantities purchased are usually not available.

In fact, Statistics Austria is currently undertaking a pilot project to include web-scraped data in official price statistics. The plan is to systematically download data from the websites of food stores, consumer electronics retailers and drugstores, using an automatic procedure programmed in the statistical software R. In order to overcome the legal problems, Statistics Austria intends to seek an agreement with the retailers for setting up a procedure in which their access is identified as an official download for the purpose of price statistics and limited to hours with usually low customer activity (late evenings and night hours) so as not to affect website performance. Apart from Statistics Austria, statistical institutes in Belgium, Germany, the Netherlands and the U.K. are experimenting with the use of web-scraped data in inflation measurement, but – to the best of our knowledge – web-scraped data have been included in CPI calculations in a regular and significant fashion only in the Netherlands.

3.3 Collecting prices in small and rural communities increases CPI/HICP representativeness

Depending on the nature of the product, NSIs survey the products and services included in the HICP either centrally (on the Internet or by direct inquiry) or locally in retail and service outlets. For instance, public fees, regulated prices of public utilities but also airfares and prices of public transport are mostly collected from the Internet, while the prices of most durable and nondurable goods are collected locally in retail outlets.

The regulation governing the Austrian CPI and HICP (Verordnung über die Erstellung von Verbraucherpreisindizes – Federal Law Gazette Part II No. 457/2015) stipulates that the prices of the locally surveyed products are to be collected only in 20 major cities of Austria. This is due to historical practice and serves to contain the costs of price collection, which are borne by the municipalities.

The Austrian CPI regulation is currently being revised. In this context, it would be advisable to increase the number of cities and towns where prices will be collected in the future. This would provide a more representative picture of price developments in Austria, as small towns and rural areas are not covered by the collection framework so far. This is particularly troublesome as a significant part of GDP in the service sector is generated in rural tourist areas.⁶

From both the perspective of economic research and of monetary policy the coverage of smaller communities in price statistics would allow us to assess regional price trends and to learn from local developments about global issues. Furthermore, regional price data, which would also be more easily (and less costly) available from

⁵ *The Billion Prices Project* conducted by the MIT uses web-scraped data from 11 countries to calculate daily consumer prices indices. For more information see: <http://www.thebillionpricesproject.com/>.

⁶ In Roitner and Rumler (2017) it is argued that the strong tourism industry in Austria is one of the factors why the weight of accommodation and catering services in the Austria HICP is comparatively larger than in other euro area countries. This difference is expected to grow even further if rural tourist areas will be included in the price collection for the Austrian CPI/HICP.

the new digital data sources, allow analyzing interesting research questions such as price trends in border regions, differences in price dynamics in small vs. large towns, in rural vs. urban areas, in rich vs. poor areas, etc. As a result, regional inflation rates (for individual provinces) could be published by Statistics Austria to complement the data available for regional macroeconomic analysis.

3.4 Publishing flash estimates of monthly HICP inflation rates

All euro area NSIs produce flash estimates of monthly inflation rates shortly after the collection of prices has been finished and report the results to Eurostat. These estimates are basically the results of a preliminary calculation of HICP inflation rates before the data have been double-checked. Eurostat then constructs a flash estimate for the euro area by aggregating national flash estimates and publishes it regularly on the last working day of the month. The official final inflation rates are published in the middle of the following month but only rarely deviate from the flash estimate (and normally by no more than 0.1 percentage point).

The publication of the national flash estimates is voluntary and remains in the responsibility of the NSIs. Currently, all NSIs in the euro area with the exception of those in Belgium, Estonia, Ireland, the Netherlands and Austria publish their flash estimates on their websites or allow publication by Eurostat. With the implementation of new price collection methods like scanner and web-scraped data in inflation measurement, the production of early estimates of inflation should become easier and less time consuming, which would allow the flash estimates to be available in a better quality and facilitate publication. Thus, given that inflation figures are almost never revised, the OeNB would highly welcome if Statistics Austria were to start publishing monthly flash estimates like other countries do, for three reasons. Monthly flash estimates would (i) inform the general public about the latest price trends in a timely way, (ii) facilitate the forecasting process of inflation in the short run by providing additional observations, and (iii) remove the asymmetric information lag of national inflation rates within the euro area.

4 Conclusions

The changes in the retail sector induced by digitalization, the rise of e-commerce in particular, over the last 10–15 years have had a noticeable effect on retail prices and on the sales performance of retail companies. There is some evidence that the growing importance of e-commerce has had a dampening effect on both online and offline prices, although this effect is likely to disappear once the spread of e-commerce has stabilized. To account for the changing shopping habits of consumers resulting from digitalization, the methods and procedures for measuring inflation have to be adjusted to the new conditions. In addition, digitalization stimulates the availability of new (digital) data sources which should be exploited for inflation measurement. Collecting data from online retailers (through web scraping) in addition to monitoring brick-and-mortar stores as well as expanding monitoring to include smaller towns and rural areas (in addition to the 20 largest cities) would not only reflect more recent consumption habits but also improve the representativeness of the price index. Using scanner data directly obtained from retailers would furthermore allow for a joint analysis of prices and quantities sold, thus allowing the substitution bias present in conventional price statistics to be estimated and reduced.

Various NSIs in the EU have already undertaken preparatory work to include scanner and web-scraped data in inflation measurement and these activities will most likely be extended in the future. If the remaining challenges concerning the use of these data sources (such as high attrition rates and the need for big-data know-how) can be overcome, the regular calculation of inflation rates could be based to a significant extent on scanner and web-scraped data. This would reduce the need for price collection in conventional stores to a large extent and, as a result, increase the efficiency and the quality of inflation measurement in the future.

Apart from the new challenges for inflation measurement posed by digitalization and globalization, a rather long-standing and widely debated issue remains unresolved: the costs of owner-occupied housing are still not included in official price statistics even though they account for a large share of total household expenses. The main reason is that none of the approaches at hand to calculate/estimate the regular costs of house owners for living in their houses is completely compatible with the legal HICP framework. Efforts are ongoing at Eurostat – in cooperation with the ECB and the European Commission – to pave the way for eventually integrating OOH into the HICP, but so far, no satisfactory solution has been found. Especially from a policymaker’s perspective, including the costs of OOH in inflation measurement would be desirable as they are more directly affected by monetary policy decisions (through interest payments on mortgages) than any other component in the HICP, even though experimental evidence would imply that including these costs in official price statistics will most likely not change the euro area inflation figures by much.

References

- Boskin M., E. Dulberger, R. Gordon, Z. Griliches and D. Jorgenson. 1996.** Towards More Accurate Measure of the Cost of Living. Final Report to the Senate Finance Committee from the Advisory Commission to Study the Consumer Price Index. Washington DC.
- Cavallo, A. 2017.** Are Online and Offline Prices Similar? Evidence from Large Multi-Channel Retailers. In: *American Economic Review* 107(1). 283–303.
- Coffinet, J. and S. Perillaud. 2017.** Effects of the Internet on Inflation: an Overview of the Literature and Empirical Analyses. Unpublished manuscript.
- Duch-Brown, N. and B. Martens. 2014.** Consumer Benefits from the EU Digital Market: Evidence from Household Appliances Markets. JRC Technical Reports. Digital Economy Working Paper 2014/03.
- European Commission. 2018.** Report from the Commission to the European Parliament and the Council on the Suitability of the Owner-Occupied Housing (OOH) Price Index for Integration into the Harmonised Index of Consumer Prices (HICP) Coverage. <http://ec.europa.eu/transparency/regdoc/rep/1/2018/EN/COM-2018-768-F1-EN-MAIN-PART-1.PDF>.
- Eurostat. 2017.** Harmonised Index of Consumer Prices. Practical Guide for Processing Supermarket Scanner Data. European Commission, Eurostat. September 2017. <https://circabc.europa.eu/sd/a/8e1333df-ca16-40fc-bc6a-1ce1be37247c/Practical-Guide-Supermarket-Scanner-Data-September-2017.pdf>.
- Goolsbee, A. and P. Klenow. 2018.** Internet Rising, Prices Falling: Measuring Inflation in a World of E-Commerce. NBER Working Papers 24649. May.
- Gorodnichenko, Y., V. Sheremirov and O. Talavera. 2014.** Price Setting in Online Markets: Does it Click? NBER Working Papers 20819. August.

- Lorenzani, D. and J. Varga. 2014.** The Economic Impact of Digital Structural Reforms. European Commission Economic Papers 529. September.
- Meijers, H. 2006.** Diffusion of the Internet and Low Inflation in the Information Economy. In: Information Economics and Policy 18(1). 1–23.
- Roitner, A. and F. Rumler. 2017.** Worauf lässt sich der persistente Inflationsabstand Österreichs zum Euroraum und zu Deutschland zurückführen? Box 1 in Inflation Aktuell – die Inflationsanalyse der OeNB Q4/17.