INTERNATIONAL JOURNAL OF ECONOMICS AND FINANCE STUDIES
Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111
Received: 11.0.2026 | **Accepted:** 20.03.2026 | **Published Online:** 15.04.2026

-RESEARCH ARTICLE-

THE BEHAVIOR OF GERMAN ONLINE PRICES FOR FOOD AND BEVERAGES ON THE AMAZON WEB PAGE IN THE PERIOD 2020-2022 – A CASE STUDY

Petr Wawrosz
Department of Economic Theories, Faculty of Economics and Management, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague 6, Czech Republic
ORCID: https://orcid.org/0000-0001-8283-4428
Email: wawrosz@pef.czu.cz

Dita Drozdová
Department of Economic Theories, Faculty of Economics and Management, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague 6, Czech Republic
ORCID: https://orcid.org/0009-0008-5192-3848
Email: drozdovad@pef.czu.cz

Robert Laskowski
AMVisor GmbH, Villa Wiede, Neefestr. 23, 09119 Chemnitz, Germany
ORCID: https://orcid.org/0000-0002-6234-9465
Email: rlaskowski@amvisor.com

Karel Šrédl
Department of Economic Theories, Faculty of Economics and Management, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague 6, Czech Republic
ORCID: https://orcid.org/0000-0002-5807-0015
Email: sredl@pef.czu.cz

Lucie Severová
Department of Economic Theories, Faculty of Economics and Management, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague 6, Czech Republic
ORCID: https://orcid.org/0000-0003-4666-6281
Email: severova@pef.czu.cz

Citation (APA): Wawrosz, P., Drozdová, D., Laskowski, R., Šrédl, K., Severová, L., Svoboda, R. (2026). The Behavior of German Online Prices for Food and Beverages on the Amazon Web Page in the Period 2020-2022 – A case study. *International Journal of Economics and Finance Studies*, 18(01), 219-242 doi: 10.34109/ijefs.202618111

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

Roman Svoboda
Department of Economic Theories, Faculty of Economics and Management, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague 6, Czech Republic
ORCID: https://orcid.org/0000-0003-1548-9403
Email: svobodar@pef.czu.cz

─Abstract─

The study investigates whether online price (inflation) indices during and shortly after the Covid 19 period (January 2020- December 2022) differ from prices in brick-and-mortar shops, respectively from the official inflation index. The research concerns Germany and food and beverage prices, with online prices web-scraped from Amazon.de. These prices are driven by the company's market share and competition on the site, serving as a representative of the whole German online customer shopping market. The study constructed several online indices and compared their development with the official German inflation index for the investigated category. Online inflation rates were expected to be higher than the official ones during the investigated period, due to restricted supply and a shift in demand to the online environment. However, we found that all measured online rates are significantly below the rate reported by the German statistical office. The results also show that competition on Amazon´s website is more dynamic than in brick-and-mortar shops and affects online prices. Our findings emphasize that both theoretical and practical inflation measurement should pay closer attention to online prices. Otherwise, the measurement is biased and does not give adequate information. Previous research indicates that online inflation rates are lower than official ones, mainly in "good times" when an economy is not hit by a negative supply shock. The article shows that lower online rates can occur even during these shocks.

Keywords: Germany, inflation, online price indices, consumer price index, e-commerce, Amazon, Covid-19, Russian-Ukrainian war, negative supply shocks.

INTRODUCTION

Economic theory (Mankiw, 2024) generally holds that inflation measured by the consumer price index (CPI) or a similar indicator (e.g., the purchase price index) is overstated due to substitution bias, which introduces new goods and unmeasured quality changes. The introduction and development of e-commerce mainly exacerbated substitution bias – the prices of goods bought online were lower than those in brick-and-mortar shops before the Covid-19 crisis, mainly due to lower costs (T. Mitchell, 2019). It is an example of outlet substitution: customers shift their purchases to cheaper shops. These shops, however, are underrepresented in the sample of shops used to measure inflation (Reinsdorf, 2022), which contributes to the bias.

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

The Covid-19 pandemic could reverse the overvaluation of official inflation rates. Some goods included in the CPI basket could not be bought or could be purchased only online. The demand also changed. As it is stated (Wolfer, 2020), people were buying more essentials, such as groceries, which drove up their prices. They were also buying fewer airline tickets, less gasoline, and less clothing, pushing those prices down (Baker et al., 2020; Chronopoulos et al., 2020). The quality of many goods and services worsened, and product variety decreased. Wolfers concluded that, due to these factors, inflation during Covid-19 has risen. There were several attempts (Cavallo et al., 2023; Diewert & Fox, 2022) to suggest changes in inflation measurement during the crisis. However, statistical offices or similar bodies usually continued to measure inflation in the standard way (Ball et al., 2022), which is also the case in Germany (Grigoli & Pugacheva, 2024)

Despite the attempts mentioned in the previous paragraph, there is, to our best knowledge, no comprehensive study has examined the entire COVID-19 period to investigate online and official inflation and how they differ. The article aims to fill this research gap, at least for Germany and food and beverage goods, where data were available to us. It compares online inflation in the selected category, measured by prices web-scraped from the website Amazon.de, with the development of the official German CPI index for the same category. The investigated period runs from 1st January 2020 to 31st December, covering the entire Covid-19 period. The pandemic was officially declared by the World Health Organization (WHO) on 11th March 2020 and ended on 5th March 2023. However, there is a consensus that the illness does not represent a serious threat, at least since the autumn of 2022. The aim of the article is to determine whether the expectation that online inflation exceeds the official rate is correct.

The article contributes to the research in the following ways: 1. The choice of country. Germany (all data are taken from OECD, 2025) was, in the last year of the investigated period (2022), the country with the fourth-highest nominal GDP in the world after the United States, China, and Japan, ranking 17th globally (53560.09 USD). It makes sense to investigate differences between online and standard indices in such an economically important country. 2. The choice of the category investigated. German households spend approximately 15% of their total spending on food, beverages, and tobacco products. The goods in this category were not affected by shop closures in Germany, even during the pandemic and the associated government-imposed lockdowns, as these items could still be bought in supermarkets and drugstores. Only the first lockdown in March 2020, an unexpected event, led to many shops restocking essential goods such as canned food, noodles, and crispbread. However, shops could quickly restore supply, and people still had the option to buy them in brick-and-mortar retail stores. The differences between the official and online inflation rates should, from that point of view, be short-term and small. The rates should develop in almost the same direction in the long run. The article explores whether these assumptions were met. The last third of the investigated period (since 24th February 2022) was affected, among other events, by the Russian-Ukrainian war, which caused additional shortages, mainly on the input side, as evidenced by rising utility prices

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

(e.g., electricity, gas, and oil). Although most Covid-19 restrictions were lifted when the war began and demand for products returned to normal, the supply problem persisted.

We also discussed the competition between Amazon and other sellers who used Amazon´s website as a marketplace and researched how this competition in the investigated period affected who sold a product at the lowest price. The article follows standard structure: Literature review, Materials and Methods, Results, Discussion, Conclusion.

LITERATURE REVIEW

Contemporary research investigating the overvaluation of official inflation values started with the famous report of the so-called Boskin Commission (Boskin et al., 1996) by 1.1 percent per year mainly due to the a) introduction of the products and quality change (0.6 percent) when new products were not part of the consumer basket or prices do not reflect improvement in the quality of purchased products, b) substitution effect (0.5 percent) when customers buy cheaper products. The report´s conclusions were generally accepted. It was estimated two years ago (Gordon, 2000) that the US upward bias was 0.65 percent, and six years later (Gordon, 2006), around 1 percent. It was further stated in 2018 (Moulton, 2018) that US inflation was overstated by 0,85 % per year.

The results of the studies comparing how outlet bias from brick-and-mortar to online shops contributes to the overstatement of the official CPI inflation and how online and official inflation differ, concentrating on the period before the Covid 19 crisis, are ambiguous. Goolsbee & Klenow (2018) found that, for the USA in 2014-2017, online inflation was 1.3 percentage points per year lower than inflation calculated from the CPI index. The study also emphasized that the change in the offered items when new products begin to be sold, and old ones are taken out of the market, further overstates official US inflation by an additional 1.5 to 2.5 percentage points per year. Another paper (Reinsdorf & Schreyer, 2020) concluded that, for OECD countries, inflation (based on 2015 prices) is reduced by around 0.4 percentage points due to improvements in the quality of digital products. Using digital products instead of non-digital ones decreased costs by about 0.1 percentage points, and greater product variety in digital products reduced inflation by 0.05 percentage points.

On the other hand, some studies did not reveal significant differences. One of them (Cavallo, 2017) gathered price data between December 2014 and March 2016 concerning more than 24000 products from the online and brick-and-mortar stores of 56 major retailers across 10 countries (Argentina, Australia, Brazil, Canada, China, Germany, Japan, South Africa, the United Kingdom, and the United States). The study found that online and offline price levels were identical about 72 % of the time, although there were differences both among countries (the lowest value was measured for Brazil – 42 %, the highest for Canada and the United Kingdom – 91 %) and the goods category – the least

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

identical prices were in the category of drugstores and office products (38 %, respective 25 %). These shares rose to 83% and 92% for electronics and clothing, respectively. Online and offline data followed similar frequency and size distributions, although only 19% of weekly price changes occurred simultaneously, and the price series of individual products were not well synchronized. Another paper (Cavallo & Rigobon, 2016) comparing annual and monthly online and CPI inflation rates from January 2008 to January 2016 in the USA shows that both inflation rates moved closely together. The differences were minor and temporary, even when the rates diverged. The same finding was made during the same period for other developed countries or groups of countries, such as Germany and the Eurozone. The study also investigated some sector prices in the USA and found that both inflation rates coincided. Faryna et al. (2018) revealed that Ukraine's online inflation rates, both for aggregate numbers and the food category, were slightly higher than official numbers. Cavallo (2013) even found that Argentina´s official inflation numbers were, between October 2007 and March 2011, significantly below online inflation rates, which were nearly three times higher. He concluded that official numbers were probably falsified.

When the Covid-19 crisis began, there were attempts to measure so-called Covid-19 inflation, as most items were bought online. It was found (Cavallo, 2024) that, compared with the official weights, consumers spent more on food when prices increased and less on transport and other categories when prices declined. US Covid inflation was 1.90% by September 2020, compared to the official inflation rate of 1.41%. The study further revealed that Covid-19 inflation was also higher in 2020 in other countries – the largest differences were observed in Brazil, Uruguay, and Chile (0.89, 0.65, and 0.58 percentage points, respectively). Another paper (Jiang et al., 2022) collected online prices from 107 websites in China for the period between 16th January and 30th April 2020, i.e., for the first Covid wave, when it counted online inflation based on these prices and revealed that the first wave of the pandemic caused a 0.4 % growth in comparison with the official prices. Cavallo & Kryvtsov (2023) revealed that, for the US food and beverage category, a 0.4% increase in stockouts is associated with a 0.32% increase in monthly inflation.

In addition to the last-mentioned text, there are several other studies investigating the development of food (and beverage) prices during the period of the Covid 19 pandemic (Agyei et al., 2021; Bai et al., 2022; Goeb et al., 2022; Hirvonen et al., 2021; Ruan et al., 2021), but they usually do not compare online prices with prices in brick-and-mortar shops or online and official inflation. Akter (2020) examined how Covid-19 restrictions, compared to standard times, affected food prices in 31 European countries. She used the so-called Stay-at-Home Restriction Index, which adjusts the European Union's Harmonized Index of Consumer Prices (HICP) using SHRI values. The results reveal that food prices increased by 1% in March 2020 compared to January and February 2020 due to the restrictions. Jaworski (2021) measured Poland's food inflation using online data from December 2019 to August 2020 (which included the first Covid-19 wave from

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

March to May 2020) and found that although online and official inflation moved similarly, online inflation was about 0.5 percentage points higher than the official one.

If we focus on papers similar to our research, they also do not provide a clear conclusion. Fedoseeva & Van Droogenbroeck (2023)analyzed the prices of the largest German online grocery shops in the Berlin area, focusing on how prices from 1st September 2019 to 30th June 2020 were affected by specific parts during this period. One of the main findings is that the stages of lockdown and opening are associated with the highest absolute price increases across the whole sample (about 0.28 euros). If the prices of food and beverages were investigated separately, food prices would have been affected more. The study by Hillen (2021) collected data from the Amazon Fresh website (an online and physical grocery store) for customers in Los Angeles from 2nd December 2019 to 18th June 2020. The study accessed the website daily and collected data across 12 product categories, finding that the median price in the pre-COVID-19 phase was 3.59 USD. However, it decreased in the preparation phase to 3.51 USD and then increased during the lockdown phase (3.64 USD). Prices decreased again (3.50 USD) in the last phase. There were, of course, some categories where the median price fell during lockdown compared to the first or preparation phase (specifically baby foods, beverages, and meat & seafood). Jaravel & O'Connell (2020) scanned data covering millions of transactions for fast-moving consumer goods in the United Kingdom in the first Covid wave between 23rd March and 17th May. Most of their indices were chained, with weights updated each period based on current purchases. The study found that aggregate month-to-month inflation was 2.4% in the first month of lockdown, a rate over 10 times higher than in preceding months. Peña & Prades (2021) web-scarped data from the leading retailers, including supermarkets, pharmacy retailers, and car dealerships in Chile, which covered, in the case of supermarkets, around 70 % of the market share and in the case of pharmacies, around 25 % of the market share in the period starting in June 2019 and ending in November 2020. They divide it into four parts: 1. pre-shocks from June to 18th October 2019; 2. social outbreak from 19th October till 17th March; 3. pandemic from 18th March till the end of June; 4. gradual uplift for the rest of the period. The study compared the development of online and brick-and-mortar prices for selected products (rice, beer, toothpaste, and television), but it did not reveal any unique pattern.

MATERIALS AND METHODS

To compare the development of online and official inflation, the values for the official one were taken from the German Federal Statistical Office, 1st Stellar level for the goods class food and non-alcoholic beverages (GERin). The online one was counted from the prices of goods sold on the Amazon.de website. Amazon was the largest German online retailer during the Covid 19 crisis. The net sales revenues of its competitors were significantly lower (see Table 1). Amazon's market share of total German online trade has consistently exceeded 50%, although the company did not dominate the online grocery market (Handelsverband Deutschland, 2022). Shopping on

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

Amazon´s website offers some specific features. On the one hand, Amazon is a classic online shop that buys goods from manufacturers and sells them to customers under its own name and account. On the other hand, Amazon is a large online marketplace where other retailers can also sell their goods, and Amazon takes a commission on purchases (Cavallo, 2018). In most cases, Amazon and the marketplace sell the same items.

Table 1: Germany's Top Ten E-Commerce Shops' Net Sales, 2020-2023 (in Million USD)

2020		2021		2022		2023 (1)	
www.amazon.de	13877,5	www.amazon.de	15680	www.amazon.de	16099	www.amazon.de	17068,4
www.otto.de	4500,0	www.otto.de	5124	www.otto.de	5056	www.otto.de	553,8
www.zalando.de	1943,5	www.mediamarkt.de	2544	www.zalando.de	2918	www.zalando.de	2714,8
www.mediamarkt.de	1842,0	www.zalando.de	2515	www.mediamarkt.de	2269	www.mediamarkt.de	2325,7
www.saturn.de	1104,1	www.ikea.com	1748	www.apple.com	1522	www.ikea.com	1616
www.lidl.de	1015,9	www.saturn.de	1340	www.ikea.com	1456		
www.apple.com	877,8	www.apple.com	1190	www.saturn.de	1103		
www.ikea.com	861,0	www.lidl.de	1022,1	www.lidl.de	1080		
www.notebooksbilliger.de	818,2	www.hm.com/de	900,2	www.hm.com/de	1029		
www.hm.com/de	712,7	www.docmorris.de	783,3	www.aboutyou.de	10001		

Only data for the top 5 companies are available for 2023.
Source: EHI Retail Institute (2023)

Thus, there are many different prices offers for a single item on Amazon. Amazon also scans the entire online market, always looking for the best offer. Amazon posts this price on its website as soon as it is found (Laskowski, 2024). With this market behavior, Amazon mirrors the current market price on its website (Stone, 2021). Some studies (Arjan, 2023) thus note that the so-called "Amazon effect" occurs in Germany: 35% of all in-store purchases are preceded by diligent research on Amazon.de, while online transactions mirror this at 52%. Based on these facts, the prices on this website can be considered representative German online prices.

The paper evaluates the daily prices of approximately 3500 articles recorded from 1st January 2019 to 31st December 2022 (it is the total number for the whole period; the numbers related to individual days are lower; see the following paragraphs) in the categories of food and beverages, including pet food, that are sold on Amazon's website in Germany. The items are mainly products from brand manufacturers and companies in the Fast-Moving Consumer Goods (FMCG) sector, particularly non-refrigerated products stored in Amazon's standard non-refrigerated warehouses.

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

The price data was collected automatically using specialized web scraping software called AMVisor. Web scraping provides numerous benefits over traditional data collection methods (R. Mitchell, 2015). It's entirely automated, cheaper, and can be implemented more frequently when data is immediately available (Juszczak, 2021). However, some studies (Cavallo & Rigobon, 2016) emphasize that it makes sense to focus on data from large online retailers that offer a wide range of products, and that an occasional change in the price of an individual product did not cause a discrepancy. The Amazon website satisfies these conditions. In our case, the software found the product detail pages of Amazon.de and extracts structured price information from the respective page layouts once a day at a random time between 6 a.m. and 10 p.m. The following prices were web scraped in the period from 1st January 2019 (to be able to count online inflation for 2020, we needed the relevant base period) to 31st December 2022:

- Buy Box price (BBP): The Amazon marketplace is structured at the item (article) level. This means that each item sold on Amazon has its own website. This website is linked directly to the article and the European Article Number (EAN), as well as to a unique Amazon article number. All sellers or vendors of the item are listed on these unique item detail pages. An article can be sold by one seller or by several sellers. If several sellers list the same item, the best (i.e., cheapest) offer wins the Buy Box. The item always has a BBP, which is the best price and shipping cost.
- Amazon price (AZNP): As the marketplace operator, Amazon itself also acts as a seller and offers its prices for the products under investigation. Amazon price is the price at which Amazon sells a product directly. Since Amazon both regulates the platform and competes, its prices are a key variable for pricing and competition in the marketplace. Amazon's pricing strategy influences third-party sellers' prices, as it sets the standards for the buy box based on the products and prices it offers.
- Amazon purchase price (PP): It is the price at which Amazon itself purchases a product from a supplier or manufacturer before selling it to the end customer. This price plays a central role in Amazon's pricing and profitability model. Amazon's purchase price can serve as an indicator of negotiating power, cost structures, and forecasts, as its pricing affects margins and price levels for end customers and shapes the company's pricing strategy.
- Best-seller price (SELP): It reflects the best price offered by a third-party seller (i.e., other than Amazon) on the Amazon marketplace. Since many sellers use this market, prices vary widely depending on competition and pricing strategies. SELP is, from that perspective, an essential metric for capturing the price level and the structure and intensity of the competitive environment among third-party sellers.

The Buy Box Price, the Amazon price, and the best-seller price reflect the effects of market competition on Amazon´s website. Their comparison shows whether Amazon's prices match those of the other sellers. Therefore, we use data on all these prices and count inflation for each of them. Data was used for the calculation if they satisfied the following condition (Hansen, 2020):

- There are at least 10 daily prices of an item per month in the relevant month of the current and base period (for instance, the item was sold ten times both from 1st January till 31st January 2020 and 1st January 2019 till 31st January). Items with a lower number of daily prices were not included. The lower frequency threatens data representativeness and could bias results.
- The price data are also not considered if they rise by 400% or fall by 80% from one day to the next.

The structure of the prices investigated is described in Table 2.

Table 2: The structure of online prices

	1/1/2019					31/12/2022				
	BBP	**SELP**	**AZNP**	**PP**	**BB**	**BBP**	**SELP**	**AZNP**	**PP**	**BB**
Product 0001	1.23 €	1.46 €	1.23 €	0.99 €	yes	1.67 €	1.67 €	1.73 €	1.12 €	no
Product 0002	2.55 €	2.99 €	2.55 €	1.99 €	yes	2.55 €	2.99 €	2.55 €	1.99 €	yes
Product 0003	5.99 €	5.99 €	6.19 €	3.76 €	no	6.45 €	7.12 €	6.45 €	4.03 €	yes
Product 3500	4.45 €	4.45 €	5.12 €	3.14 €	no	4.99 €	4.99 €	5.56 €	3.44 €	no

Source: own data
(BBP) = buy-box price, SELP =the best seller price, AZNP = Amazon price, PP = purchase price, BB = whether Amazon won BBP

Monthly average prices were calculated from the daily prices of the individual items. A price index was then calculated from the monthly average prices of an item for the current month and the same month of the previous year. The price index for the total sample per month was calculated from the price index for each item. The approach can be described in the following equations and symbols:

$$P_{AC,i} = \sum_{i=1}^{n} P_{i,j} / n \quad (1),$$

$$P_{ACM} = \sum_{i=1}^{m} P_{AC,i} \quad (2,)$$

$$OPIN = \frac{P_{ACCM} - P_{ACPM}}{P_{ACPM}} \quad (3),$$

$$I_{ACCM} = \frac{OPI_{ACCM} - OPI_{ACPM}}{OPI_{ACPM}} \quad (4),$$

whrere $P_{i,j}$ is the price if i-product in the day j, $P_{AC,i}$ is the average price of i-product, P_{ACM} is the sum of the average prices in ta specific month, OPI is online price index of a investigated price, P_{ACCM} is the average price of a current month, P_{ACPM} is is the average price of the previous month, I_{ACCM} is the inflation in a current month (expressed in the percent form), OPI_{ACCM} is online price index in a current month, OPI_{ACPM} is online price index in the previous month.

The approach resulted in a dynamic shopping basket with 375 items´ prices in January 2020. The number grew to 2385 item prices in December 2022. The reason is that not all the data was monitored by the scraping software in the initial months. A value can be compared only if it also has a comparative number in the same month from the

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

previous year. The monthly buy-box ratio on Amazon is further defined as the percentage of the buy-box occupied by Amazon in each month. Since the battle for the Buy Box between sellers and Amazon itself influences the sales price on the Amazon marketplace, determining the Buy Box quota is essential to better assess price trends. It can be expected that if the number of Amazon wins in the Buy Box battle decreases, the Buy Box price will be higher than the price with a higher Amazon share. Calculation Amazon buy-box quote per month (BBQ):

$$onthly\ BBQ = \sum_1^n BB(a_j)/n \qquad (5).$$

To prove whether online and official inflation followed the same trend, the Pearson's correlation coefficient

$$r_{x,y} = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2 \Sigma(y-y)^2}} \qquad (9),$$

(Witte & Witte, 2017) was used.

RESULTS

The calculated online inflation rates (BBPI, AZNPI, SELPI) show the same trend and direction as the inflation rate for food and beverages published by the German Federal Statistical Office (see Figure 1). Pearson correlation coefficients (always related to German inflation for food and beverage; all correlation values mentioned in the article are statistically significant at the 5 % significance level) achieved values of 0.9 for Buy Box price inflation, 0.89 for Amazon retail price inflation, and 0.84 for best-seller price inflation. However, all online inflation rates are below the official German inflation rate throughout the entire period. For instance, Amazon's Buy Box inflation began at -0.74% in January 2020 (see Table 3). It ends at 9.83 % in December 2022, while the inflation determined by the German Federal Statistical Office for food and beverages ranges from 2.40 % to 19.80 % at the same time. The average difference between German and Buy Box inflation is 4.43 for the entire period, and the median difference is 4.09. It should be emphasized that the average differences across the individual years are increasing: 2.50 in the first year, 6.15 in the second, and 6.21 in the third. July 2021 can be seen as the break point. Before this month, the difference was only higher than 4 percentage points (in April 2020, together with May 2020, the severe month of the first lockdown). Since July 2021, the differences have declined only once, by 4 percentage points (3.96 in March 2022), and were between 4 and 5 percentage points in the other three months. They consistently exceeded five percentage points from May 2022 and seven percentage points since August 2022. The difference from January 2020 to June 2021 is 2.72 percentage points; for the rest of the period, it is 6.14. As our sample has a growing tendency of the items, the values for later periods are more representative.

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

Table 3: The differences between German official and Buy Box Inflation rates

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
GERI	2.4	3.1	3.6	4.6	4.2	4.1	1	0.6	0.6	1.3	1.2	0.4
BBPI	-0.074	0.07	0.01	-0.29	1.69	1.44	0.77	-0.45	-1.59	-0.14	-1.08	-2.6
GERI - BBPI	3.14	3.03	3.59	4.89	2.51	2.66	0.23	1.05	2.19	1.44	2.28	3.00
	Jan-21	**Feb-21**	**Mar-21**	**Apr-21**	**May-21**	**Jun-21**	**Jul-21**	**Aug-21**	**Sep-21**	**Oct-21**	**Nov-21**	**Dec-21**
GERI	1.9	1.4	1.6	1.9	1.4	1.3	4.3	4.5	4.8	4.4	4.6	5.9
BBPI	-1.32	-2	-2.38	-1.11	-1.65	-1.02	-1.1	-1.38	-1.01	-1.95	-1.83	-0.3
GERI - BBPI	3.22	3.40	3.98	3.01	3.05	2.32	5.40	5.88	5.81	6.35	6.43	6.2
	Jan-22	**Feb-22**	**Mar-22**	**Apr-22**	**May-22**	**Jun-22**	**Jul-22**	**Aug-22**	**Sep-22**	**Oct-22**	**Nov-22**	**Dec-22**
GERI	4.9	5.1	5.9	8	10.7	11.9	14.0	15.7	17.7	19.2	19.9	19.8
BBPI	0.2	0.2	1.94	3.81	5.36	6.43	8.41	8.45	10.48	12.12	11.04	9.83
GERI - BBPI	4.70	4.90	3.96	4.19	5.34	5.47	5.59	7.25	7.22	7.08	8.86	9.97

Source: own data and data from the German statistical office concerning GERIn

A similar development concerns Amazon and best-seller inflation. Their values lie below official German inflation for most of the investigated period. The mean of the differences across the individual years increases, with the mean for the first 18 months significantly lower than that for the remaining 18 months (see Table 4). The only exception is when German inflation is slightly lower, as in the best-seller price inflation in April and May 2020. Both months were the most severe period of the first lockdown, when many items were in short supply, people were afraid of the future, and many accepted that most online sellers had raised prices. As shown in Figure 1, Amazon inflation is usually lower than best-seller inflation, i.e., other sellers sell their products for higher prices than Amazon. The difference between German inflation and AZNPI or SELPI is thus higher for the former.

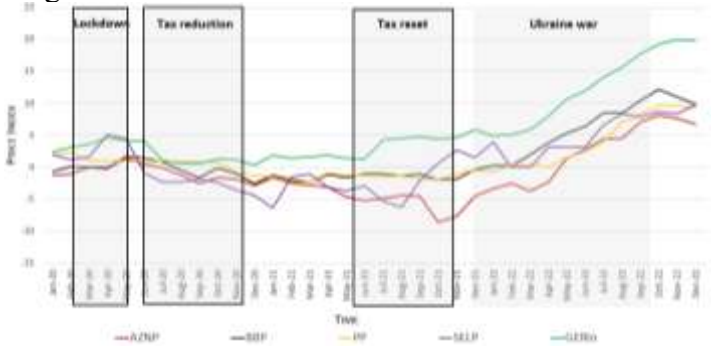

Figure 1: The development of German online and official inflation, January 2020 to December 2022

Source: own data and data from the German statistical office concerning GERI

AZNPI = Amazon retail price inflation rate, PPI = Amazon purchase price inflation rate, BBPI = Buy Box price inflation rate, SELPI = the best seller price inflation rate, GERI = German inflation rate for food and beverages

Amazon retail prices are highly correlated with their purchase prices (the correlation coefficient is 0.91 over the entire period). The company was able to use its advantages and increase (decrease) its retail prices less (more) than the change in its purchase prices. Lower AZNPI growth rates than the PPI rate occurred, for instance, in June 2020 and from September 2022 to December 2022, and the greater decrease in AZNPI inflation than in PPI inflation is recorded from November 2020 to January 2022. There were even months (such as July to October 2020 and February to April 2022) when Amazon retail price inflation was negative, while purchase price inflation was positive. Retail sale inflation exceeded purchase inflation only exceptionally, specifically in March and April 2020 due to the first lockdown and insufficient supply of final goods, and from June to August 2022, when the company responded to price increases in energy and other input prices due to the Russian-Ukrainian war.

Table 4: The differences between German inflation and Amazon inflation or the best seller price inflation

	Average difference for the entire period	Median of the differences for the entire period	Average difference for 2020	Average difference for 2021	Average difference for 2022	Average difference for the period from January 2020 to June 2021	Average difference for the period from July 2021 to December 2021
GERI - AZNPI	7.00	7.08	3.14	7.54	10.17	3.72	10.28
GERI - SELPI	5.17	4.85	2.55	5.47	7.48	3.27	7.07

Source: own data and data from the German statistical office concerning GERI

We revealed some specific events and periods:

- First lockdown, mainly its initial part in March and April 2020: Sellers generally raised prices sharply across all product categories during this period. Everything can be sold at good margins due to limited supply and consumer fear of a goods shortage. The best-seller price inflation reached 5.12 % and 4.35 % in April and May 2020 (and was higher, as we mentioned above, than German inflation, which was 4.60 % and 4.35 %). Its jump between March and April 2020 was by 3.5 percentage points. However, Amazon continued to sell goods at the same prices based on its algorithm until it recognized that both the supply shock from the decline in production and the demand shock from customers' shift to the online environment were external. Amazon inflation was only 0.04 % in April and 1.43 % in May. Although Amazon's prices were lower than its competitors', it was unable to meet the rising demand. This is evident in the decrease in the Buy Box ratio from 88.2% in February 2020 to 75.38% and 78.74% in April and May 2020, respectively. Amazon tries to make up for lost Buy Box shares by radically cutting prices over the next six months. June´s value of Amazon price inflation was 0.41. The values

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

from July 2021 were negative. Amazon´s Buy Box quote share increased to above 80% from June to November 2020.

- July 2020 (tax reduction): The German government lowered the (main) VAT rate from 19 % to 16 % and the reduced VAT rate from 7 % to 5 % from July to December 2021 to stimulate consumption and the economy. The decrease in German official inflation rates between June and July 2020 is almost exactly 3 percentage points – inflation was 4,10 % in June and 1 % in July. The differences in online prices on the Amazon page are significantly lower – only the difference in the best-seller price exceeds 1 percentage point (1.44). Other differences lie between 0 and 1 percentage points. Other sellers besides Amazon reduced their prices in June 2020 and continued to decrease in the following months. Amazon responded with some time lag – the highest price decline occurred between August and September, when the Amazon retail price inflation declined by 1.42 percentage points.
- July 2021 (tax reset): Inflation in July 2021 should incorporate the fact that the base period (July 2020) is affected by the VAT cut, so inflation in July 2021 should be higher than in the months just before July. It happened in the case of German inflation. The difference between its values in July 2021 (4.30) and June 2021 (1.30) is exactly 3 percentage points, i.e., the change in the main VAT rate. July inflation in online prices on the Amazon website did not reflect the VAT increase. The best seller price inflation even decreased by 2.52 percentage points. July 2021 Buy Box inflation was slightly lower than June 2021 inflation (-0.08 percentage point). Amazon inflation slightly increased by 0.41 percentage points. Amazon and other sellers on its page adjusted their prices earlier. They competed, and the one-time change in VAT taxes did not affect their price policy.
- The impact of the Russian-Ukrainian war: The growth of prices due to the war occurred with some time lag. German inflation increased by 2.1 percentage points between March and April 2022, 2.7 percentage points between April and May 2022, and 9.2 percentage points between May and November. Amazon retail price inflation rose by 3.76 percentage points between April and May 2022 and by 6.75 percentage points between May and October 2022, reaching its highest level (8.13 %). It was then slightly reduced to 7.62% and 6.72% in October and December 2022, respectively. The Buy Box inflation and best-seller price inflation also reached their highest levels in October 2022 (10.48% and 7.92%), up from values close to zero (0.2% and 0.03%) in February 2022. However, as we mentioned, the differences between all our inflation rates and German official inflation were the highest in this period. Although online inflation rates rose, they remained approximately 6 % points below the official rate.
- Deflation of online prices compared to German inflation: Amazon price inflation was negative from July 2020 to April 2022, while the official German inflation was positive. Other online price inflations developed similarly - they were negative for a long period, although German inflation was positive at that time. The best-seller price inflation was negative from June 2020 to September 2021, and the Buy Box

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

inflation was negative from August 2020 to December 2021. The fact that online inflation rates are positive for most months of the second half of the investigated period is reflected in the growing correlation coefficients between online price inflation and German inflation. For instance, the correlation between the Buy Box and German inflation was 0.643 in the first half and 0.978 in the second half. Similar values (0.654 and 0.966) are observed for the correlation between Amazon and German inflation, even though offline prices rose.

We also analyzed the behavior of Amazon and other sellers on the Amazon website. Total demand for food and beverages in online retail will increase by 47 % from 2019 to 2021 (Handelsverband Deutschland, 2022). In the same period, Amazon has increasingly left the Buy Box to sellers. The Amazon Buy Box quote fell in the investigated category from 89.71% in January 2020 to a low of 47.89% in March 2022 (see Figure 2). Although it grew from that time, it did not exceed 60% until December 2022.

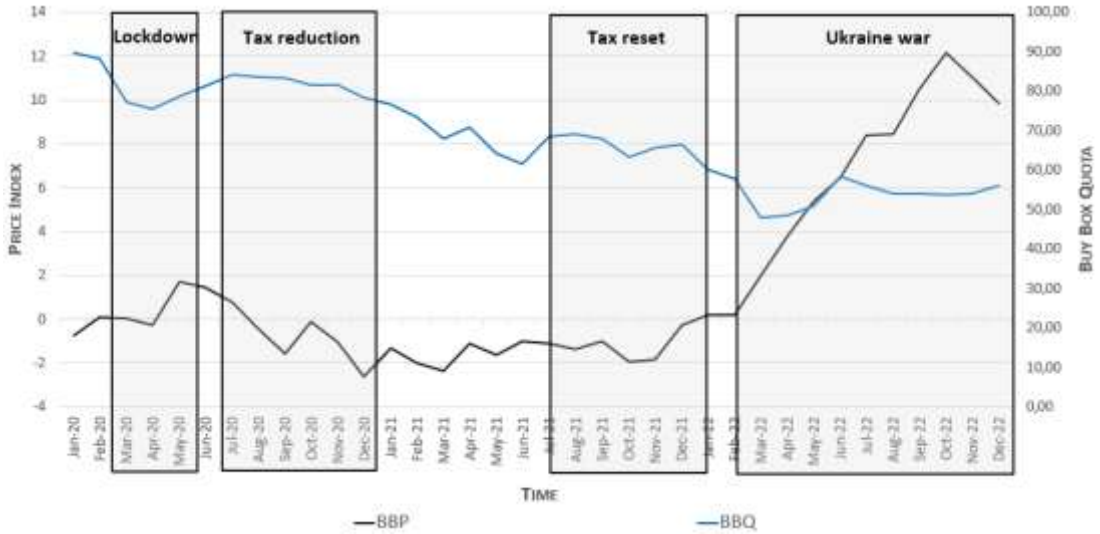

Figure 2: Buy Box price inflation (BBP) and Amazon´s Buy Box quote for food and beverages from January 2020 to December 2022
Source: own data

Concerning the question of whether there is any relationship between Buy Box price inflation and the Buy Box quote, it makes sense not to consider the period from January to May 2020, as it includes the first lockdown between March and May 2020, when the shortage of many goods biases the results. The rest of the time must be divided into two periods with different developments. The first one, from June 2020 to August 2021, shows a very strong positive correlation (0.87), i.e., the decline in Amazon wins in the Buy Box battle relates to the decline in Buy Box price. Producers and retailers were able to replenish their stores after the end of the first lockdown, and the Buy Box

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

competition resumed. The competition was not even affected by other lockdowns in autumn 2020, and in the first half of 2021, Amazon and other sellers were prepared for these restrictions. The battle for the Buy Box generated rather low prices, as only the best offer wins. This is mainly because sellers, especially when Amazon did not participate in the battle, were trying to outbid one another.

The situation changed for the rest of the period investigated. A strong negative correlation (-0.66) occurred from September 2021 to December 2022, indicating that although the number of Amazon wins declined, Buy Box prices increased. The period included the consequences of the Russian-Ukrainian war and a surge in demand after the end of the main Covid-19 restrictions, when people made purchases, they had put off during the lockdown. Consumers were generally willing to accept higher prices, as reflected in the positive Buy Box price inflation. Its value grew from January to October 2022. It achieved 10.48% in September and 12.12% in October. The values slightly declined in November and December 2022 but stayed close to 10 % (11.04 % in November and 9.83 % in December).

DISCUSSION

Our study found that all online inflation rates (Buy Box, Amazon, and best-seller) were, for almost the entire period from 1st January 2020 to 31st December 2022, lower than the official index compiled by the German statistical office, and the differences increased. The number of online purchases on the Amazon website was growing, as evidenced by Amazon´s net sales. From that point of view, many German customers bought (or could have bought) food and beverage items at lower prices than the official numbers suggest.

The main reason for lower prices was intense competition among sellers who used the page as a marketplace. Even during the first lockdown (March to May 2020), with the greatest restrictions on people's movement and the lack of some goods, which created a favorable environment for online price increases, online inflation did not exceed the official rate. However, not all online shops react in unison. Some online shops are managed by people who interpret events differently and apply them to prices that, as a result, differ from those based on a computer program (Tsagkias et al., 2020). A computer program does not account for all possible situations (such as a pandemic) and sometimes responds slowly to price changes (Berg & Knights, 2019), as was the case with Amazon. Especially during the first lockdown, which was an unexpected event, some sellers were quicker to adjust prices than Amazon, which had almost everything optimized by computerized systems (Chen et al., 2016; Laskowski, 2022). As a consequence, Amazon´s Buy Box quote decreased by 13 percentage points between January and April (from 88 to 75 percent). Other sellers increased in the first wave of pandemic prices. SELP inflation was higher in April and May 2020 than Amazon

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

inflation, and these sellers could realize higher profits, as customers were concerned about the future and willing to pay higher prices to secure sufficient stock.

Amazon later (from the summer of 2020) tried to raise the Buy Box quote. It partially succeeded when it exceeded 80% again between June and November 2020. However, it had to reduce its prices, as reflected in negative Amazon retail price inflation from July 2020 to April 2022. Other sellers responded to this Amazon pricing strategy. Best seller price inflation was also negative for most of this period. Consequently, Buy Box inflation was negative from August 2020 to December 2021. Some of these sellers, like Gorilla and Flink, were further able to offer better delivery and other services than Amazon. They mainly offer "short delivery" when items ordered online are delivered to the customer within a few minutes. These new online shops have many small warehouses of around 100 square meters in heavily populated inner-city neighborhoods, with a small assortment of high-demand food and beverage items. The warehouses are highly optimized for both personal and online shopping, with e-bikes mainly used for household deliveries (Handelsverband Deutschland, 2022). This is a service that Amazon has not been able to provide until now due to its logistics. Before the customers realized that Amazon was too expensive, Amazon allowed its new competitors to use its website as a marketplace. It enjoys the marketplace commission from them. and customers started to prefer them. Therefore, the Amazon Buy Box quote decreased by 20% between November 2020 and December 2022.

The strong competition among sellers is confirmed by the fact that Amazon retail price inflation was lower than company purchase price inflation for the whole investigated period, except June and July 2022 (see also Table 4) and, as we mentioned in the previous section, there were even periods (from July to October 2020 and from February to April 2022) when retail price inflation was negative but purchase price inflation positive. Although Amazon applied a low-selling-price policy to compete with other sellers, it was either unable or unwilling to extend it to its suppliers. Amazon, as an oligopoly, was financially strong enough to withstand this development, unlike other sellers. Amazon´s inflation grew more slowly than the best-seller inflation for 11 months and fell faster for 15 months in the investigated period.

An online marketplace where customers can easily see the offers and prices of individual sellers and make a purchase with one click is undoubtedly more competitive than brick-and-mortar shops. Sellers, including giants like Amazon, must adapt to this environment. Empirical research (Munday & Humbani, 2024) on the factors that affect the decision to continue using a particular online shop confirmed that expected company performance is among them. It is essential to the company that its customers return to its website, whether they buy a product from it or another seller. Amazon received revenues in each situation, regardless of who sells a good on its site. If customers start to buy elsewhere, there is no revenue. Longitudinal price reductions are a standard way to attract and retain customers.

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

Table 4: The mean of the differences between the monthly inflation rates of Amazon's retail prices and purchase prices

Period July – December 2020	Period January – June 2021	Period July – December 2021	Period January – June 2022	Period July – December 2022
-1.275	-2.07	-3.75	-1.11	-1.105

A negative value means that PP is higher than AZNP.
Source: own data

The return of online inflation indices to positive values occurred in the second half of the period investigated. It is linked to the start of the Russian-Ukrainian war, which severely impacted price developments. Official inflation in the monitored category reached double-digit values. Online retailers faced higher purchase price inflation (see Amazon's purchase price inflation) and had to raise their retail prices. The category investigated falls under necessities, so customers do not have to buy a specific good; they can choose from the products offered. If the prices of all goods rose, customers had to accept it, but they could still buy the goods cheaper than brick-and-mortar shops – online inflation rates were, after February 2022, more than 5 percentage points lower than official inflation.

Although many studies (Cavallo, 2024; Reinsdorf, 2022; Seiler, 2020) state that the official inflation values were underestimated during the Covid 19 period due to the change in consumer demand, shortage in some goods, their reduced quality and variability, our findings indicate that in the case of food and beverage category in Germany, these factors are at least partially counterweighted by the competition among online retailers. We confirmed that online prices follow their own dynamics, are more adaptive, and are subject to constant, strong competition. Prices in online retail respond directly to supply and demand, as well as to political and social influences.

Of course, several objections can be raised to the study. We already explained why Amazon´s website was used as a representative sample of online prices. It would be possible to create inflation indices based on the lowest prices found across many web pages by services such as Idealo.de, Guenstiger.de, and Preispiraten.de. However, the found prices may reflect goods available in only a few pieces, a defect, etc. (Gruntkowski & Martinez, 2022). Amazon guarantees that the offered goods are in stock and of appropriate quality (Berg & Knights, 2019). For instance, to win the Buy Box, a seller must meet several conditions, including having sufficient product stock. Amazon´s prices are more credible than the prices of an unknown shop. It was revealed (Roll-pastuch.de, 2023) that Amazon´s prices (the research included all goods sold on its German site) were, in the investigated period, around 12 % cheaper than those of its competitors, mainly due to the above-mentioned inability of the company to offer fast delivery. Amazon lagged its competitors during the period investigated, ranking among the 10 slowest providers, and was not even popular among customers who requested

the service. To be competitive, Amazon had to offer lower prices. The systematic literature review (Srivastava & Thaichon, 2023) confirmed that price value is one of the most important factors for consumers when choosing a seller. Their reduction can offset some of the company´s disadvantages. Based on the above, Amazon´s prices can be considered the cheapest German online prices due to sufficient stock availability and low purchase risk.

The second objection is that our data contains only prices, not volumes or revenue per product. We cannot, thus, create weight inflation indices. However, to our knowledge, the sold volumes remained quite stable during the investigated period. Laskowski (2024) who analyzed price and volume data obtained from German Amazon´s page including more goods categories in the period from January 2019 to December 2023, found that weighted and unweighted inflation indices, both online ones and official ones, developed similarly, the differences between weighted and unweighted indices are insignificant, and values of both weighted and unweighted online indices were for the most of him investigated period under the values of the weighted or unweighted official indices.

Our sample was small, initially with only 375 item prices. It grew steadily to almost 2500 prices. It does not detract from the results and findings. Indeed, with larger samples, the percentages may deviate by a few percentage points, but the trend will remain correct. The item selection is limited to non-refrigerated and non-perishable food and beverages. The products examined are likely to be products that are easy to store and hoard. This means there may have been an exceptionally high demand for the examined items. The products within the shopping basket under investigation changed dynamically. In contrast, the product selection in the Federal Statistical Office's shopping basket remained unchanged, so goods used for counting online inflation may differ from those used in the basket for official inflation. In addition, this research only compared online price development with the 1st stellar level of the German Federal Statistical Office's shopping basket, rather than with the lowest stellar level. We also emphasize that our evaluations and results concern only the situation in Germany during a specific period and concentrate solely on food and beverage. They cannot be without other investigations transferred to all product categories, as trade in this category is subject to regulations that vary from country to country.

CONCLUSIONS

Online shopping is still a relatively new phenomenon. But it has a significant impact on the market. Contemporary techniques, such as web scraping, allow for quicker and more frequent collection of information on online prices and examine how they differ from prices used for official inflation measurement. Our finding that online inflation rates derived from the prices of food and beverages realized on Amazon´s website in Germany in the years 2020 – 2022, i.e., during the Covid 19 period, when demand

shifted to the online environment, confirmed the importance of further inclusion of online prices in the set for inflation measurement. As we have shown, the main reason for this difference was strong competition between Amazon and other sellers using the site as a marketplace. If a firm wanted to keep its share and sell its products, it had to attract customers with low prices. Even after the start of the Russian-Ukrainian war, when competitors faced an increase in their input prices, they still could not, due to competition, increase prices at the same rate as German official inflation in the investigated category.

Our results agree with the finding that online and offline prices differ in their characteristics and development (Aparicio & Cavallo, 2021) as online sellers primarily focus on their market and do not closely track prices in brick-and-mortar shops or other events. If online and stationary prices vary and inflation calculations are based mainly on stationary prices, the inflation rate is undoubtedly biased, especially as the share of online shopping rises. However, the German Federal Statistical Office mainly collected prices from brick-and-mortar retailers. Only 10,000 out of 300,000 price data points are currently collected online (DeStatis, 2023). Our article indicates that the number needs to increase.

Future research should investigate the development of German online food and beverage inflation and its differences from the official one after the Covid-19 period and extend the set of goods to other categories. It is also necessary to discuss how often online prices should be measured per day or per month, and how to count from different values the correct number to be included in both the measurement of online inflation rates and the official one. The issue of how to account for the weights of online purchases, especially when their spending differs from that of stationary purchases, must also be given proper attention. Generally, as more purchases are made online, the investigation of the development of online prices and other aspects is a more relevant topic than in previous periods.

FUNDING

This work was supported by the Faculty of Economics and Management, Czech University of Life Sciences in Prague, under Grant 2024A2002.

REFERENCES

Agyei, S. K., Isshaq, Z., Frimpong, S., Adam, A. M., Bossman, A., & Asiamah, O. (2021). COVID-19 and food prices in sub-Saharan Africa. *African Development Review*, *33*(S1). https://doi.org/10.1111/1467-8268.12525

Akter, S. (2020). The impact of COVID-19 related 'stay-at-home' restrictions on food prices in Europe: Findings from a preliminary analysis. *Food Security*, *12*(4), 719–725. https://doi.org/10.1007/s12571-020-01082-3

Aparicio, D., & Cavallo, A. (2021). Targeted Price Controls on Supermarket Products. *The Review of Economics and Statistics*, *103*(1), 60–71. https://doi.org/10.1162/rest_a_00880

Arjan, B. (2023). Amazon influences offline retail in Germany. *E Commerce News*, (14th September). https://ecommercenews.eu/amazon-influences-offline-retail-in-germany/

Bai, Y., Costlow, L., Ebel, A., Laves, S., Ueda, Y., Volin, N., Zamek, M., & Masters, W. A. (2022). Retail prices of nutritious food rose more in countries with higher COVID-19 case counts. *Nature Food*, *3*(5), 325–330. https://doi.org/10.1038/s43016-022-00502-1

Baker, S. R., Farrokhnia, R. A., Meyer, S., Pagel, M., & Yannelis, C. (2020). How Does Household Spending Respond to an Epidemic? Consumption during the 2020 COVID-19 Pandemic. *The Review of Asset Pricing Studies*, *10*(4), 834–862. https://doi.org/10.1093/rapstu/raaa009

Ball, L., Leigh, D., & Mishra, P. (2022). Understanding US Inflation during the COVID-19 Era. *Brookings Papers on Economic Activity*, *2022*(2), 1–80. https://doi.org/10.1353/eca.2022.a901276

Berg, N., & Knights, M. (2019). *Amazon: How the world's most relentless retailer will continue to revolutionize commerce* (1 Edition). Kogan Page Ltd. https://www.amazon.com/Amazon-Relentless-Retailer-Continue-Revolutionize/dp/0749482796

Boskin, M., Dulberger, E. R., Gordon, R. J., Griliches, Z., & Jorgenson, D. (1996). *Final Report of the Advisory Commission to Study the Consumer Price Index*. Congress of the USA. https://www.finance.senate.gov/imo/media/doc/Prt104-72.pdf

Cavallo, A. (2013). Online and official price indexes: Measuring Argentina's inflation. *Journal of Monetary Economics*, *60*(2), 152–165. https://doi.org/10.1016/j.jmoneco.2012.10.002

Cavallo, A. (2017). Are Online and Offline Prices Similar? Evidence from Large Multi-Channel Retailers. *American Economic Review*, *107*(1), 283–303. https://doi.org/10.1257/aer.20160542

Cavallo, A. (2018). *More Amazon Effects: Online Competition and Pricing Behaviors* (No. W25138; p. w25138). National Bureau of Economic Research. https://doi.org/10.3386/w25138

Cavallo, A. (2024). Inflation with Covid Consumption Baskets. *IMF Economic Review*, *72*(2), 902–917. https://doi.org/10.1057/s41308-023-00213-y

Cavallo, A., Feenstra, R. C., & Inklaar, R. (2023). Product Variety, the Cost of Living, and Welfare across Countries. *American Economic Journal: Macroeconomics*, *15*(4), 40–66. https://doi.org/10.1257/mac.20210137

Cavallo, A., & Kryvtsov, O. (2023). What can stockouts tell us about inflation? Evidence from online micro data. *Journal of International Economics*, *146*, 103769. https://doi.org/10.1016/j.jinteco.2023.103769

Cavallo, A., & Rigobon, R. (2016). The Billion Prices Project: Using Online Prices for Measurement and Research. *Journal of Economic Perspectives*, *30*(2), 151–178. https://doi.org/10.1257/jep.30.2.151

Chen, L., Mislove, A., & Wilson, C. (2016). An Empirical Analysis of Algorithmic Pricing on Amazon Marketplace. *Proceedings of the 25th International Conference on World Wide Web*, 1339–1349. https://doi.org/10.1145/2872427.2883089

Chronopoulos, D. K., Lukas, M., & Wilson, J. O. S. (2020). Consumer Spending Responses to the COVID-19 Pandemic: An Assessment of Great Britain. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3586723

DeStatis. (2023). *Preise: Verbraucherpreisindex für Deutschland 12/2023.* DeStatis. https://www.destatis.de/DE/Methoden/Qualitaet/Qualitaetsberichte/Preise/verbraucherpreis.pdf

Diewert, W. E., & Fox, K. J. (2022). Measuring Inflation under Pandemic Conditions. *Journal of Official Statistics*, *38*(1), 255–285. https://doi.org/10.2478/jos-2022-0012

EHI Retail Institute. (2023). *Studie: E-Commerce-Markt Deutschland 2022*. EHI Retail Institute. https://www.ehi.org/produkt/studie-e-commerce-markt-deutschland-2022/

Faryna, O., Talavera, O., & Yukhymenko, T. (2018). What Drives the Difference between Online and Official Price Indexes? *Visnyk of the National Bank of Ukraine*, (243), 21. https://doi.org/10.26531/vnbu2018.243.021

Fedoseeva, S., & Van Droogenbroeck, E. (2023). Pandemic pricing: Evidence from German grocery e-commerce. *Agribusiness*, *39*(4), 1139–1156. https://doi.org/10.1002/agr.21807

Goeb, J., Maredia, M., Win, K. Z., Masias, I., Lambrecht, I., Boughton, D., & Minten, B. (2022). Urban food prices under lockdown: Evidence from Myanmar's traditional food retail sector during COVID-19. *Applied Economics*, *54*(47), 5412–5441. https://doi.org/10.1080/00036846.2022.2044999

Goolsbee, A. D., & Klenow, P. J. (2018). Internet Rising, Prices Falling: Measuring Inflation in a World of E-Commerce. *AEA Papers and Proceedings*, *108*, 488–492. https://doi.org/10.1257/pandp.20181038

Gordon, R. (2000). *The Boskin Commission Report and its Aftermath* (No. W7759; p. w7759). National Bureau of Economic Research. https://doi.org/10.3386/w7759

Gordon, R. (2006). *The Boskin Commission Report: A Retrospective One Decade Later*. NBER. https://www.nber.org/system/files/working_papers/w12311/w12311.pdf

Grigoli, F., & Pugacheva, E. (2024). COVID-19 inflation weights in the UK and Germany. *Journal of Macroeconomics*, *79*, 103543. https://doi.org/10.1016/j.jmacro.2023.103543

Gruntkowski, L. M., & Martinez, L. F. (2022). Online Grocery Shopping in Germany: Assessing the Impact of COVID-19. *Journal of Theoretical and Applied*

Electronic Commerce Research, *17*(3), 984–1002. https://doi.org/10.3390/jtaer17030050

Handelsverband Deutschland. (2022). *Online Monitor, 2022*. Handelsverband Deutschland. https://einzelhandel.de/index.php?option=com_attachments&task=download&id=10659,

Hansen, M. (2020). *Dynamische Preissetzung im Onlinehandel: Zu den Auswirkungen auf den Verbraucherpreisindex*. DeStatis. https://www.destatis.de/DE/Methoden/WISTA-Wirtschaft-und-Statistik/2020/05/dynamische-preissetzung-onlinehandel-052020.pdf

Hillen, J. (2021). Online food prices during the COVID-19 pandemic. *Agribusiness*, *37*(1), 91–107. https://doi.org/10.1002/agr.21673

Hirvonen, K., Minten, B., Mohammed, B., & Tamru, S. (2021). Food prices and marketing margins during the COVID-19 pandemic: Evidence from vegetable value chains in Ethiopia. *Agricultural Economics*, *52*(3), 407–421. https://doi.org/10.1111/agec.12626

Jaravel, X., & O'Connell, M. (2020). Real-time price indices: Inflation spike and falling product variety during the Great Lockdown. *Journal of Public Economics*, *191*, 104270. https://doi.org/10.1016/j.jpubeco.2020.104270

Jaworski, K. (2021). Measuring food inflation during the COVID-19 pandemic in real time using online data: A case study of Poland. *British Food Journal*, *123*(13), 260–280. https://doi.org/10.1108/BFJ-06-2020-0532

Jiang, T., Liu, T., Tang, K., & Zeng, J. (2022). Online prices and inflation during the nationwide COVID-19 quarantine period: Evidence from 107 Chinese websites. *Finance Research Letters*, *49*, 103166. https://doi.org/10.1016/j.frl.2022.103166

Juszczak, A. (2021). Zastosowanie danych scrapowanych w pomiarze dynamiki cen. *Acta Universitatis Lodziensis. Folia Oeconomica*, *1*(352), 25–37. https://doi.org/10.18778/0208-6018.352.02

Laskowski, R. (2022). Differences between Online Prices and the Consumer Prices Index During Covid-19 in Germany. *ACTA VŠFS*, *16*(1), 76–87. https://doi.org/10.37355/acta-2022/1-05

Laskowski, R. (2024). *An online price index – an early warning indicator for inflation and the removal of uncertainties.* [Ph.D. Thesis]. University of Finance and Administration. https://is.vsfs.cz/th/qt8oq/

Mankiw, N. G. (2024). *Principles of economics* (Tenth edition). Cengage. https://www.cengage.com/c/principles-of-economics-10e-mankiw/9780357722718/

Mitchell, R. (2015). *Web scraping with Python: Collecting data from the modern web* (First Edition). O'Reilly Media. https://www.oreilly.com/library/view/web-scraping-with/9781491985564/

Mitchell, T. (2019). *E-commerce and the Consumer Price Index: Measuring Inflation in a Digital Economy*. Government of Canada. https://www150.statcan.gc.ca/n1/pub/62f0014m/62f0014m2019008-eng.htm

Moulton, B. R. (2018). *The Measurement of Output, Prices, and Productivity: What's Changed Since the Boskin Commission?* Hutchins Center on Fiscal & Monetary Policy at Brookings. https://www.brookings.edu/wp-content/uploads/2018/07/Moulton-report-v2.pdf

Munday, M., & Humbani, M. (2024). Determining the drivers of continued mobile food delivery app (MFDA) usage during a pandemic period. *Cogent Business & Management*, *11*(1), 2308086. https://doi.org/10.1080/23311975.2024.2308086

OECD. (2025). *OECD Economic Surveys: Germany 2025* (Vol. 2025). OECD Publishing. https://doi.org/10.1787/39d62aed-en

Peña, J., & Prades, E. (2021). Price Setting in Chile: Micro Evidence from Consumer On-Line Prices During the Social Outbreak and Covid-19. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3806309

Reinsdorf, M. (2022). *Is Inflation Still Low in the Digital Economy?* Innovation Frontier Project. https://innovationfrontier.org/wp-content/uploads/2022/06/Digital-Inflation.pdf

Reinsdorf, M., & Schreyer, P. (2020). Measuring consumer inflation in a digital economy. In *Measuring Economic Growth and Productivity* (pp. 339–362). Elsevier. https://doi.org/10.1016/B978-0-12-817596-5.00015-9

Roll-pastuch.de. (2023). *Schnell geliefert, aber zu welchem Preis? Das Preismodell von Gorillas, Flink und Co.* Roll-pastuch.de. https://www.roll-pastuch.de/preismodell-von-gorillas-flink-und-co/

Ruan, J., Cai, Q., & Jin, S. (2021). Impact of COVID-19 and Nationwide Lockdowns on Vegetable Prices: Evidence from Wholesale Markets in China. *American Journal of Agricultural Economics*, *103*(5), 1574–1594. https://doi.org/10.1111/ajae.12211

Seiler, P. (2020). Weighting bias and inflation in the time of COVID-19: Evidence from Swiss transaction data. *Swiss Journal of Economics and Statistics*, *156*(1), 13. https://doi.org/10.1186/s41937-020-00057-7

Srivastava, A., & Thaichon, P. (2023). What motivates consumers to be in line with online shopping?: A systematic literature review and discussion of future research perspectives. *Asia Pacific Journal of Marketing and Logistics*, *35*(3), 687–725. https://doi.org/10.1108/APJML-10-2021-0777

Stone, B. (2021). *Amazon Unbound: Jeff Bezos and the Invention of a Global Empire*. Simon & Schuster. https://www.amazon.com/Amazon-Unbound-Invention-Global-Empire/dp/1982132612

Tsagkias, M., King, T. H., Kallumadi, S., Murdock, V., & De Rijke, M. (2020). Challenges and research opportunities in eCommerce search and recommendations. *ACM SIGIR Forum*, *54*(1), 1–23. https://doi.org/10.1145/3451964.3451966

Vol: 18 **No:** 01 **Year:** 2026 **ISSN:** 1309-8055 (Online) (**pp.** 219-242) **Doi:** 10.34109/ijefs.202618111

Witte, R. S., & Witte, J. S. (2017). *Statistics* (Eleventh edition). Wiley. https://www.wiley.com/en-us/Statistics%2C+11th+Edition-p-9781119254515

Wolfer, J. (2020). Inflation Is Higher Than the Numbers Say. *New York Times*, (2nd September). https://www.nytimes.com/2020/09/02/business/inflation-worse-pandemic-coronavirus.html