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Call for applications: Klaus Liebscher Economic Research Scholarship

Please e-mail applications to *scholarship@oenb.at* by the end of October 2021. Applicants will be notified of the jury's decision by end-November.

The Oesterreichische Nationalbank (OeNB) invites applications for the "Klaus Liebscher Economic Research Scholarship." This scholarship program gives outstanding researchers the opportunity to contribute their expertise to the research activities of the OeNB's Economic Analysis and Research Department. This contribution will take the form of remunerated consultancy services.

The scholarship program targets Austrian and international experts with a proven research record in economics and finance, and postdoctoral research experience. Applicants need to be in active employment and should be interested in broadening their research experience and expanding their personal research networks. Given the OeNB's strategic research focus on Central, Eastern and Southeastern Europe, the analysis of economic developments in this region will be a key field of research in this context.

The OeNB offers a stimulating and professional research environment in close proximity to the policymaking process. The selected scholarship recipients will be expected to collaborate with the OeNB's research staff on a prespecified topic and are invited to participate actively in the department's internal seminars and other research activities. Their research output may be published in one of the department's publication outlets or as an OeNB Working Paper. As a rule, the consultancy services under the scholarship will be provided over a period of two to three months. As far as possible, an adequate accommodation for the stay in Vienna will be provided.[1]

Applicants must provide the following documents and information:

- a letter of motivation, including an indication of the time period envisaged for the consultancy
- a detailed consultancy proposal
- a description of current research topics and activities
- an academic curriculum vitae
- an up-to-date list of publications (or an extract therefrom)
- the names of two references that the OeNB may contact to obtain further information about the applicant
- evidence of basic income during the term of the scholarship (employment contract with the applicant's home institution)
- written confirmation by the home institution that the provision of consultancy services by the applicant is not in violation of the applicant's employment contract with the home institution.

[1] *We assume that the coronavirus crisis will abate in the course of 2021. We are also exploring alternative formats to continue research cooperation under the KLERS program for as long as we cannot resume visits due to the pandemic situation.*

Nontechnical summaries in English and German

Nontechnical summaries in English

Financial literacy in Austria – Focus on millennials

Pirmin Fessler, Marilies Jelovsek, Maria Antoinette Silgoner

This article summarizes the main findings from the second wave of the Austrian Survey of Financial Literacy (ASFL) which was conducted in spring 2019. As compared to the previous survey round in 2014, the financial knowledge of Austrian residents seems to have increased significantly. While men outperform women in terms of financial knowledge, they score slightly worse in terms of financial behavior and attitudes. Austrian residents are rather prudent, risk averse and forward looking and have a good overview of their finances. In general, financial literacy is rather equally distributed across age groups. However, 15- to 38-year-olds (hereinafter called millennials) differ from other age cohorts in several respects: They have relatively low levels of financial literacy, are less financially organized, and they show more risky and less forward looking behavior. At the same time, they are more open to digital means of payments and financial innovations in general. Even though the observed differences are not very large and may vanish as millennials mature and gain experience with business and finance, we deem it important to monitor the financial literacy development for this group, given the rising complexity of financial decisions many among this group will face and the tremendous financial resources they will ultimately inherit.

A spatial analysis of access to ATMs in Austria

Helmut Stix

This study analyzes the access to cash via automated teller machines (ATMs) for consumers in Austria, providing information on how far people have to walk or travel, and how much time it takes, to reach the nearest ATM in both urban and rural areas. The fine-grained analysis is based on a 100x100 m geographical grid of Austria. For each grid cell, we calculated the corresponding travel distance and travel time to the next ATM. The results show that, in Austria, the average distance people must travel to access an ATM is 1.2 km. The median distance comes to 630 m, which means that 50% of the population travel less far to withdraw cash from an ATM. In terms of travel time, we find that, in Austria, it takes 2.9 minutes on average to reach the nearest ATM, with the median time being 2.1 minutes. A total of 85% of the population reside within a 2 km travel distance and an approximate five-minute travel time of an ATM. When looking at a travel distance of 5 km, this percentage rises to 97%. We also found that the larger a municipality is, the smaller the distance and the shorter the travel time is to get to the next ATM. In Vienna, residents live, on average, less than 400 m from the nearest ATM; in small municipalities with less than 2,000 inhabitants the average travel distance is 2.1 km. Yet, even in these municipalities, the share of the population that has access to an ATM within 5 km of where they live comes to more than 90%. Overall, our results indicate that the domestic ATM network seems to be relatively dense, on average. This is supported by the finding that even in rural areas most people can reach the next ATM within less than 5 km. Based on the geographical grid of Austria used in this study, we can also identify regions with longer distances to the nearest ATM. When breaking down the results by municipalities, we find that the share of municipalities where a large part of the population faces longer distances is relatively small. For example, in 108 of Austria's 2,096 municipalities, more than 40% of inhabitants face a distance of more than 5 km to get to the next ATM. These municipalities have an average population of some 840 people.

A new long-run consumer price index for Austria (1800–2018)

Gerald Hubmann, Clemens Jobst, Michaela Maier

Indices measuring the development of consumer prices in Vienna or Austria date back to the year 1800. This article presents the first systematically documented consumer price index for Austria spanning the period from 1800 to today without time gaps. We calculated the new index from existing shorter index series, discussing the selection of the available time series at length. To be able to merge existing shorter time series and to adequately integrate war periods and currency reforms, we had to make a number of adjustments to deal with methodological issues, which at the same time enabled us to fix unresolved problems affecting the existing indices. In contrast to the existing time series, our new long-run index thus yields significantly higher inflation rates during the Napoleonic Wars and a more pronounced decline in the level of prices after their end as well as a steeper price increase in 1948 and 1949. Finally, this article examines the suitability of consumer price indices for the conversion of historical prices. The article includes a table with annual index figures; monthly series are available online.

Nontechnical summaries in German

Finanzbildung in Österreich – Millennials im Fokus

Pirmin Fessler, Marilies Jelovsek, Maria Antoinette Silgoner

Dieser Artikel fasst die ersten Ergebnisse der im Frühjahr 2019 zum zweiten Mal durchgeführten Erhebung zur Finanzbildung in Österreich. Gegenüber der ersten Welle (2014) ist eine signifikante Verbesserung beim Finanzwissen festzustellen. Allgemein schneiden Männer bei Finanzwissensfragen besser ab als Frauen, erzielen punkto Finanzverhalten und Einstellungen zum Thema Geld und Finanzen aber etwas schlechtere Ergebnisse. Insgesamt agiert die österreichische Bevölkerung in Finanzfragen eher vorsichtig, risikoavers und vorausschauend und hat die Finanzen generell gut im Blick. Nach Altersgruppen sind die Finanzbildungsergebnisse recht gleichmäßig verteilt, doch sticht die Gruppe der 15- bis 38-Jährigen („Millennials") mehrfach hervor: Ihr Finanzbildungsniveau ist vergleichsweise niedrig; sie sind nicht so gut organisiert, wenn es um ihre Finanzen geht; und sie agieren risikofreudiger und weniger vorausschauend als die anderen Generationen. Zugleich stehen sie digitalen Zahlungsmitteln und Finanzinnovationen insgesamt offener gegenüber. Selbst wenn die dargestellten Unterschiede insgesamt nicht sehr groß sind und mit zunehmendem Alter bzw. mehr Finanz- und Geschäftserfahrung immer geringer werden dürften, erscheint es angebracht zu verfolgen, wie sich das Finanzbildungsniveau dieser Gruppe weiterentwickelt. Immerhin werden viele Millennials früher oder später komplexere finanzielle Entscheidungen als jetzt zu treffen haben und eines Tages durch Erbschaften über ein in Summe sehr großes Vermögen verfügen.

Die Erreichbarkeit von Geldautomaten in Österreich

Helmut Stix

Im vorliegenden Beitrag wird die Erreichbarkeit von Bankomaten in Österreich in hoher geografischer Auflösung untersucht. Damit liegen Ergebnisse darüber vor, innerhalb welcher Wegstrecken bzw. welcher Wegzeiten Bankomaten im städtischen und ländlichen Raum Österreichs erreichbar sind. Konkret wurde Österreich in 100 x 100 m Rasterzellen eingeteilt und von jeder dieser Rasterzellen die Wegstrecke und die Wegzeit zum nächstgelegenen Bankomaten berechnet. Die Ergebnisse zeigen, dass der nächste Bankomat in Österreich im Durchschnitt 1,2 km entfernt ist. Die mittlere Entfernung (der Median) liegt bei 630 m; das heißt, dass für 50 % der heimischen Bevölkerung die nächste Geldquelle weniger weit entfernt liegt. Zeitlich ausgedrückt sind in Österreich durchschnittlich 2,9 Minuten einzuplanen, um zum nächsten Bankomaten zu gelangen; der Median liegt bei 2,1 Minuten. Für 85 % (97 %) der Bevölkerung liegt die nächstgelegene Geldquelle innerhalb von 2 km (5 km) ihres Wohnsitzes; etwa 85 %, brauchen weniger als 5 Minuten um diese zu erreichen. Je größer die Gemeinde, desto kürzer ist der Weg für die Bargeldbehebung bzw. desto weniger Zeit muss dafür eingeplant werden. In Wien ist der nächste Bankomat im Durchschnitt binnen 400 m erreichbar. In kleinen Gemeinden mit weniger als 2.000 Einwohnerinnen und Einwohnern liegt die durchschnittliche Entfernung bei 2,1 km. Auch in kleineren Gemeinden mit weniger als 2,000 Einwohner haben mehr als 90 % der Einwohner einen Bankomaten innerhalb von 5 km. Die Ergebnisse zeigen, dass die österreichische Bevölkerung im Durchschnitt gut mit Bankomaten versorgt ist. Auch im ländlichen Raum steht für den überwiegenden Teil der Bevölkerung innerhalb von 5 km ein Bankomat zur Verfügung. Mittels des Rasternetzes ist es möglich, Regionen und Gemeinden zu identifizieren, in denen ein höherer Anteil der Bevölkerung weitere Wegstrecken hat. Dies ist hauptsächlich in kleineren Gemeinden mit weniger als 2.000 Einwohnerinnen und Einwohnern der Fall – solche Gemeinden haben im Durchschnitt 840 Einwohner und sind in allen österreichischen Bundesländern außer Wien zu finden.

Ein neuer langer Verbraucherpreisindex für Österreich (1800–2018)

Gerald Hubmann, Clemens Jobst, Michaela Maier

Indizes zur Entwicklung der Verbraucherpreise in Wien bzw. Österreich gehen bis zum Jahr 1800 zurück. Der vorliegende Beitrag präsentiert den ersten systematisch dokumentierten, durchgehenden Verbraucherpreisindex für Österreich von 1800 bis heute. Dieser neue Index wird auf Basis bereits bestehender Indexreihen, die für kürzere Zeitabschnitte verfügbar sind, erstellt. Die Auswahl der zugrunde liegenden Reihen wird ausführlich besprochen. Für ihre Zusammenführung zum neuen, langen Verbraucherpreisindex über Kriege und Währungsreformen hinweg sind Anpassungen vorzunehmen, die einerseits methodische Gründe haben und durch die andererseits Probleme der bestehenden Indizes behoben werden. Im Unterschied zu den bisher verwendeten Indexreihen ergeben sich damit eine signifikant höhere Inflation während der Napoleonischen Kriege und ein stärkerer Rückgang des Preisniveaus nach deren Ende sowie ein stärkerer Preisanstieg in den Jahren 1948 und 1949. Abschließend widmet sich der Beitrag der Frage, wieweit Verbraucherpreisindizes zur Umrechnung historischer Preise verwendet werden können. Der Artikel enthält eine Tabelle mit den jährlichen Indexwerten. Monatliche Reihen sind online verfügbar.

Analyses

Rising infection rates threaten to derail economic recovery

Gerhard Fenz, Friedrich Fritzer, Ernst Glatzer, Martin Schneider, Helmut Stix, Klaus Vondra[1]

Economic activity in Austria has been sharply curbed by the ongoing COVID-19 pandemic. During the first-wave lockdown, the OeNB's weekly GDP indicator registered a decline of economic output by one quarter. After the exit from lockdown, the GDP gap narrowed very rapidly, amounting to –3½% compared to previous year levels in the first half of October. Among the hardest-hit sections of the economy, tourism benefited from markedly stronger domestic demand during the summer, which limited the year-on-year decline in overnight stays to 15% in July and August. Meanwhile, the travel alerts newly issued by a number of countries for Austria since mid-September have been taking their toll, though. For October, real-time data on card payments already point to a 40% decrease in overnight stays. In contrast, export performance has been improving, mirroring the slight upward trend in the production sector. By September, the decline in goods exports had dropped to a small percentage according to the OeNB's export indicator. Looking ahead, the ongoing rapid rise in infection rates constitutes downside risks to growth, however. While the GDP forecasts for 2020 (about –7%) are fairly solid given strong third-quarter performance, the recovery projected for 2021 may turn out to be below the range currently expected (+4½ to +5%). The recovery in the labor market has already been slowing down. Registered unemployment exceeded the year-earlier mark by 71,000 unemployed individuals by mid-October and thus a mere 30% of the peak measured in April, but unemployment has been shrinking at a decreasing pace. The early warning system for impending layoffs implemented by Public Employment Service Austria points to more layoffs coming in the weeks ahead. Inflation has been highly volatile in 2020 so far, reflecting energy price fluctuations as well as one-off effects (fashion clearance sales started later usual) and price measurement problems. In September, HICP inflation came to 1.3%. In line with the OeNB's inflation forecast of September 2020, HICP inflation is expected to run to 1.4% in 2020 and to climb to 1.7% in 2021.

1 The OeNB's weekly GDP indicator

Third-quarter economic output down 4½% from 2019

Economic activity in Austria has been sharply curbed by the ongoing COVID-19 pandemic. Coming up with timely estimates of how badly the economy has been hit and how soon it will recover has created new challenges for economic research. The economic indicators that have been used in the past tend to be lagging indicators and tend to be limited to providing monthly and quarterly snapshots. This is why the OeNB developed a new indicator that measures economic activity in Austria in real time using daily and weekly data. The new indicator has been published at weekly intervals since mid-May 2020 (https://www.oenb.at/Publikationen/corona.html).

According to the OeNB's weekly GDP indicator, the domestic economy contracted by up to one-quarter during lockdown in late March/early April. This setback was driven by all major demand components other than public consumption; even private consumption, which tends to have a stabilizing impact on economic activity, weighed in. When the lockdown measures were lifted, the economy

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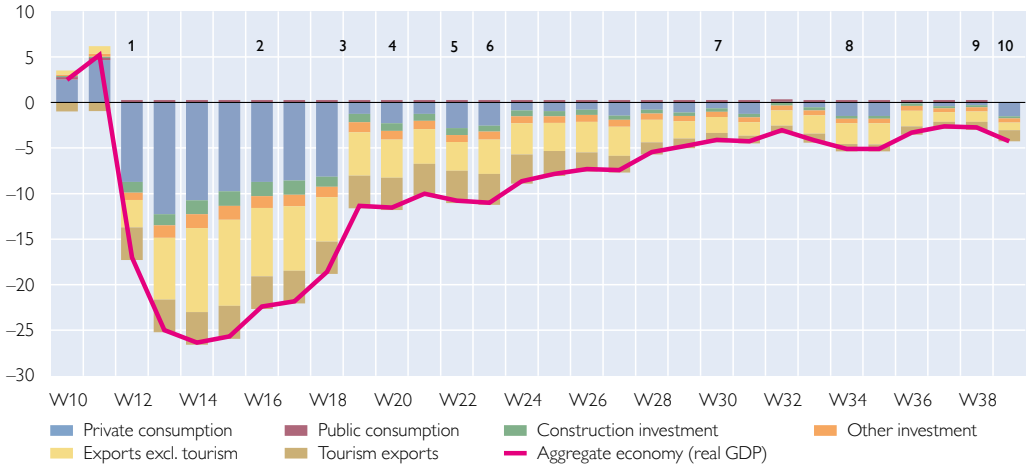
started a brisk recovery. The easing of health policy measures, rising consumer spending supported by pent-up demand and public relief measures caused economic conditions to improve significantly in the run-up to the summer months. Even so, the annual change in output still amounted to a 7% decline at the end of June. All in all, second-quarter output was 14.5% lower than a year earlier – as indeed projected most accurately by the OeNB's weekly economic indicator for early July.

The summer did not bring any significant improvement in economic conditions, with economic measures moving steadfastly sideways. The GDP gap hovered around close to –5% for weeks, improving only slightly over time. The gradual recovery in individual sections of the economy, such as tourism or construction, was offset by dwindling pent-up demand for consumer spending in particular and ongoing challenges faced by a range of service providers. At the end of September, the GDP gap measured –4%. Preliminary estimates based on the weekly GDP indicator imply that third-quarter GDP was down 4½% in 2020 compared with 2019. In other words, we see an improvement by 10 percentage points compared with second-quarter growth, yet a downturn echoing the maximum contraction during the 2008/2009 economic and financial crisis (second quarter of 2009: –5¼%). While the GDP growth pattern clearly followed a V-shape in the initial months of the COVID-19 pandemic, the right-hand recovery curve has been flattening in recent months.

Chart 1

Weekly GDP indicator for Austria

Year-on-year change of real GDP in %; import-adjusted growth contributions in percentage points



Source: OeNB.

[1] *Lockdown (March 16).*
[2] *Opening of small shops (April 14).*
[3] *Opening of all shops (May 2).*
[4] *Opening of restaurants (May 15).*
[5] *Opening of hotels (May 29).*
[6] *Gradual reopnening of borders (June 4).*
[7] *Reintroduction of mandatory face masks (July 24).*
[8] *Travel warning (Croatia, Balearics – gradually from August 8).*
[9] *Travel warnings for Austria (September 16).*
[10] *Tightening of protection measures (September 21).*

Note: W = week.

Growth risks until end-2020 and for 2021 increasingly on the downside

Late in the third quarter and early in the fourth quarter of 2020, economic growth was moderate and characterized by divergent developments. Rising infection rates, travel alerts issued by numerous countries for Austria or for individual regions in Austria, and the re-tightening of coronavirus containment measures negatively impacted the service industry, while manufacturing and exports remained largely unaffected for the time being. The tourist industry is faced with a second drop-off of overnight stays, as implied by real-time data on card payments (see section 2). The export-oriented manufacturing industry, meanwhile, experiences a continuation of the positive trend seen in recent weeks. Judging from estimates of export volumes (excluding tourism) derived from truck mileage data, week 41 was the first week during the pandemic period to finally see a slight increase on the corresponding week of 2019 (see section 3).

Overall, the weekly GDP indicator result for week 40 was 3.5% below the level of economic output measured for the same week of 2019, and 3.7% below the result for week 41 in 2019. Given the high infection rates and the containment measures required in Austria and worldwide, and given increasing concerns about job losses, the risks to growth will remain on the downside during the weeks ahead.

As the recovery was stronger than expected until early summer, there was no actual need to revise the OeNB's June 2020 economic outlook for 2020 (–7.2%). The downside risks to the projections for 2021 (+4.9%) have increased, though, as of late. Thus, the OeNB's projections are very close to the forecasts published by WIFO in the first half of October (2020: –6.8%, 2021: +4.4%), IHS (2020: –6.7%, 2021: +4.7%) and IMF (2020: –6.7%, 2021: +4.6%).

2 The pandemic's impact on tourism-related services continues to be high

Tourism is among the economic sectors that have been hit hardest by the COVID-19 pandemic. In Austria, the tourist industry contributes as much as 7.3% to economic value added, which is more than in many other countries. With the restrictions on travel, overnight stays dropped by close to 100% during the April lockdown. This was followed by a gradual recovery in the following months and a summer respite for the tourist industry. In July and August, the tourist industry made up all but 15% of the year-on-year gap in overnight stays, as Austrian destinations attracted 20% more domestic guests than in 2019 and the same numbers of German tourists as in 2019.

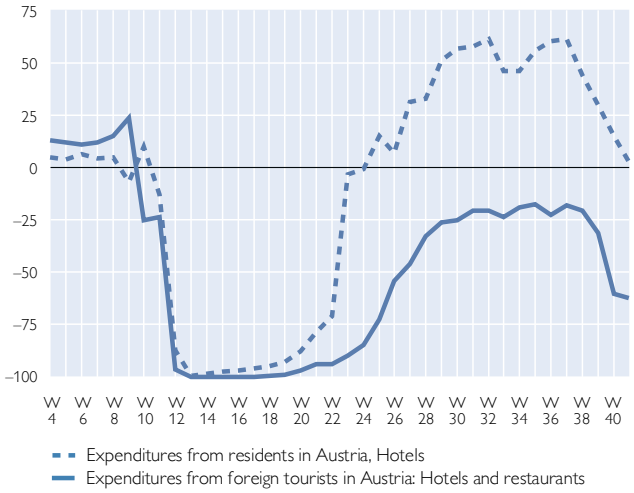
So far, overnight statistics have only become available up to August. However, real-time data on card payments made by tourists visiting Austria allow us to produce estimates for September and October as well as a first review for the summer season of 2020 (May to October). September is expected to have seen the smallest decline in overnight stays (–10%) compared with pre-pandemic levels. The travel alerts for Austria issued by a number of countries since mid-September have, however, started to take their toll already in the first two weeks of October. The value of card payments made by foreign tourists dropped by as much as 60% – which is twice as much as the decline registered in September. The amounts spent by domestic tourists exceeded the 2019 levels just by a small margin. If we extrapolate this trend for the second half of October, we arrive at a decline in overnight stays by close to 40%. Regarding the projections for domestic tourists, the newly harmonized fall school break (for the first time, all schools in Austria closed from

Chart 2

Weekly travel-related card payments

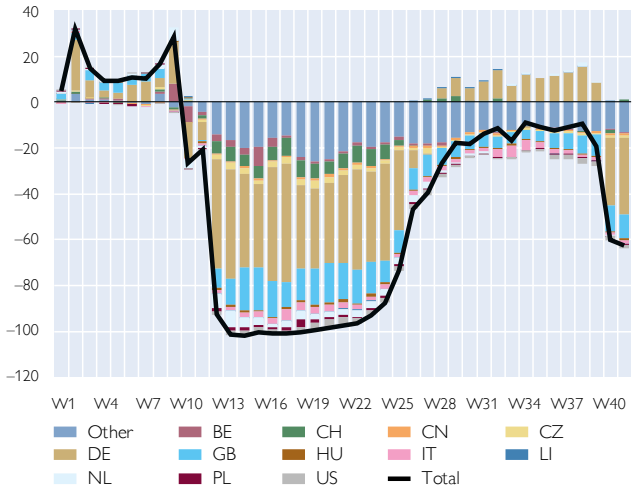
Travel-related payment card transactions

Difference to previous year in %



Expenditures from foreign tourists in hotels via payment cards in 2020, countries of orgin

Growth contributions of contries in percentage points; difference to previous year in %



Source: Payment service providers, authors' calculations.

October 26 to October 30) constitute some upward risks. In a risk scenario, which assumes higher levels of vulnerability even for provinces not directly affected by the travel alerts, the dropoff is projected to be as high as 60%.

Based on these assumptions, the baseline scenario yields a drop in overnight stays of 30.2% for the summer season of 2020 (May to October) against the summer season of 2019. The current travel alerts for October account for 2.3 percentage points of the decline. The risk scenario yields a decrease by 32.3%. At any rate, the setback in October does not bode well for the upcoming winter season.

Table 1

Summer season overnight stays in Austria

	Total	Domestic tourists	Foreign tourists	German tourists
	Annual change in %			
May – August 2020	–33.1	–7.4	–43.5	–24.4
July – August 2020	–14.0	19.4	–25.9	–0.4
September 2020 forecast	–10.5	12.9	–20.7	5.1
October 2020 forecast				
Baseline scenario	–37.2	6.4	–58.7	–53.2
Risk scenario	–56.1	6.4	–86.9	–89.7
2020 summer season forecast (May to October)				
Baseline senario	–30.2	–2.7	–41.8	–21.6
Risk scenario	–32.3	–2.7	–44.7	–25.4

Source: Statistics Austria, payment card providers, OeNB.

Note: Data for May to August provided by Statistics Austria; September and October forecasts derived from data collected by payment card providers.

3 Exports reflect slight upward trend in manufacturing

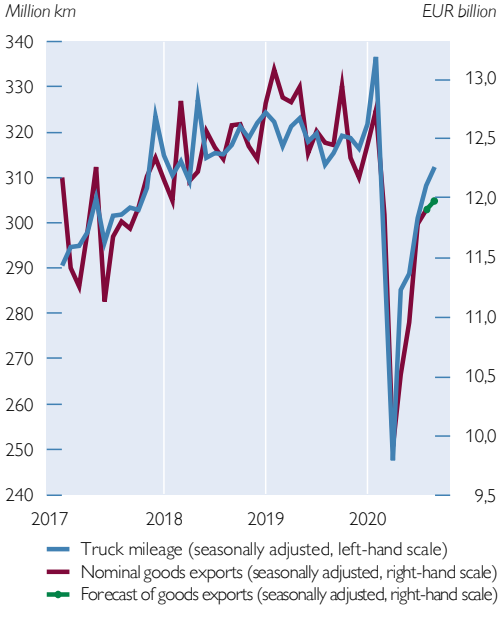
According to Statistics Austria, nominal goods exports shrank by 10.4% in the first seven months of 2020, with April and May witnessing declines by about one-quarter and exports to regions beyond Europe taking visibly larger hits (Asia: –13%, the Americas: –16.7%). Exports to other European countries shrank by 9.4%. Within Europe, exports to countries hardest hit by the pandemic (Spain: –28.6%, United Kingdom: –19.5%) topped the list of export contractions, while exports to Germany, Austria's number-one trading partner, saw a below-average dent in exports (–7.9%). In terms of product groups, the loss leaders (–17%) were machinery, transport equipment and manufactured goods, which together account for more than 60% of goods exports. The only product groups to show export gains were food (+2.7%) and chemical products (+6.5%, including pharmaceutical products (+23.8%)).

As implied by the OeNB's truck mileage-based export indicator, manufacturing trade continued to recover in late summer/early fall, with the year-on-year decline narrowing to 4.7% in August and 1.7% in September. The September result is, however, upward-biased because the number of working days was one day higher in 2020 than in 2019. When adjusted for this bias, the projections yield a decline by 3.9% for September. In other words, exports have continued to rebound, but at a lessening pace.

Chart 3

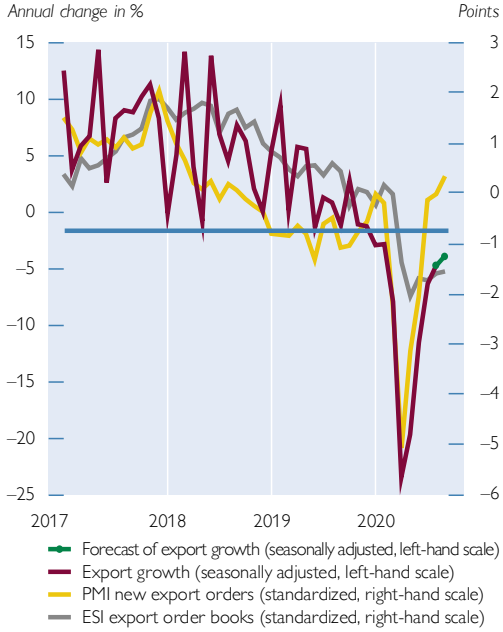
OeNB export indicator and leading indicators for external trade

Truck mileage and goods exports



Source: Austrian highway authority (ASFINAG), OeNB.

Leading indicators for external trade

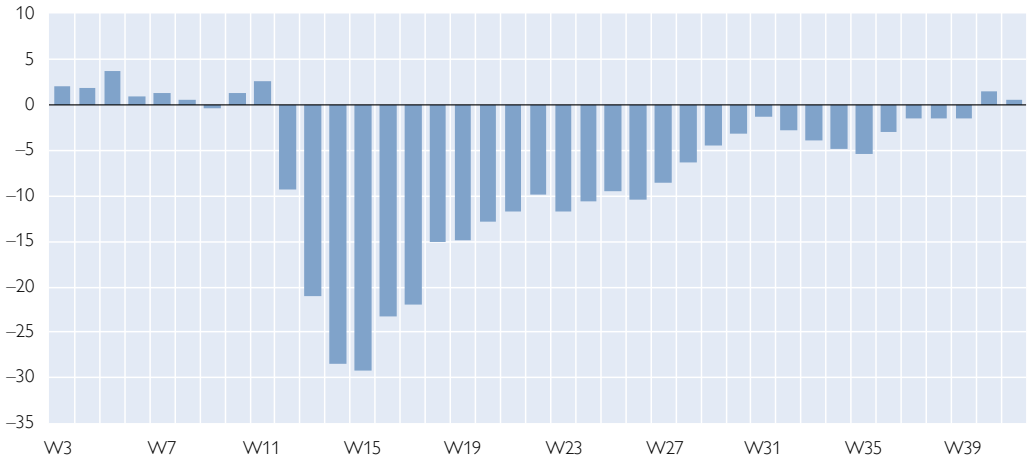


Source: Eurostat, Statistics Austria, Bank Austria, OeNB.

Chart 4

Weekly truck mileage growth during the COVID-19 pandemic

Year on year changes in %, seasonally adjusted



Source: ASFINAG, OeNB.

Looking ahead, most of the available economic indicators suggest that the recovery process will continue. In the Bank Austria's Purchasing Managers Index, the subindex measuring expectations of export orders registered 52.7 in September. This is clearly above the expansion threshold of 50 and more closely aligned with the overall new order index than in previous months. This contrasts with a significantly more pessimistic view of export order books evident from the European Commission's latest survey. While the September reading did improve slightly, to –46.4, it remains well below the long-term average (–25). The positive view is bolstered by weekly truck mileage data as collected by Austria's highway operator, ASFINAG. In early October (weeks 40 and 41), ASFINAG truck mileage figures for Austria's highways slightly exceeded 2019 levels for the first time since the COVID-19 pandemic reached Austria. Regarding truck traffic in the sections near Austria's borders, which is a particularly good gauge for export growth, the figures reverted to positive territory for the first time in week 41. Thus, while large parts of the service industry continue to suffer rather heavily from the COVID-19 fallout, the slight recovery of Austria's export-oriented industry is evidently ongoing.

4 Mixed impact on different sectors of the economy

While the lockdown had affected business activity across the board, the current crisis is characterized by the heterogeneity of vulnerability across the economy.

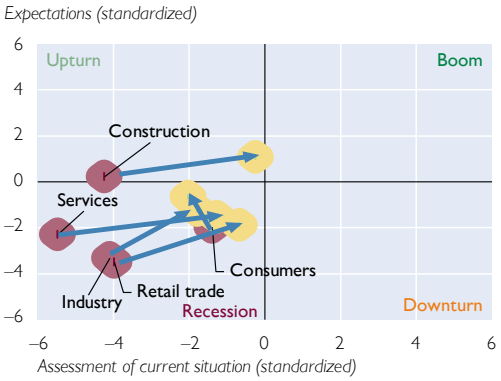
Travel agencies and tour operators recorded the heaviest lockdown toll by far as they saw 89% of the sales generated in the second quarter of 2019 evaporate in the second quarter of 2020. Hotels and other tourist accommodation and the restaurant/catering industry also suffered a drastic blow, seeing their sales contract by 73% and 54%, respectively. Likewise, the lockdown severely affected sports and entertainment activities as well as other personal service activities. In the transport sector, air transport was the loss leader (–84%).

Meanwhile, conditions have been improving in many sections of the economy. Chart 5 shows business sentiment as measured in May and September by European

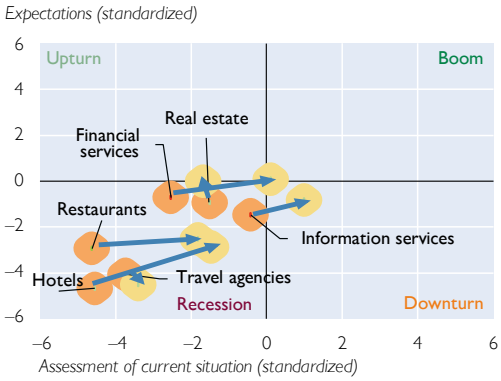
Chart 5

Mixed impact on different economic sectors

All sectors: May and September 2020



Services: May and September 2020



Source: Eurostat.

Commission surveys, looking three months back and looking three months ahead. In this comparison, we see the current-conditions component of business sentiment to have improved significantly in manufacturing, construction, retail and services. Consumer sentiment was the only outlier with a more negative assessment in September than back in May. At the same time, the future-expectations component remains below long-term averages outside the construction industry.

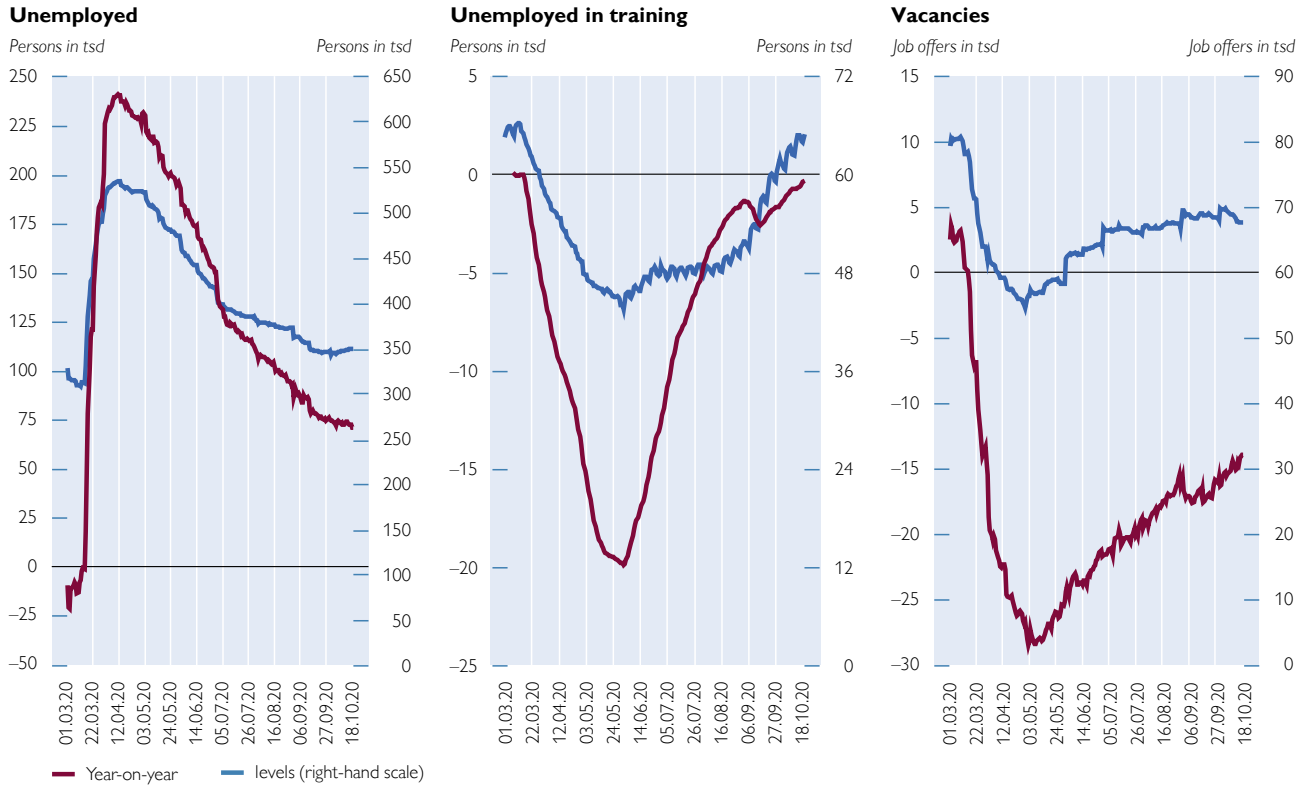
5 Labor market: decline in unemployment leveling off

Following steep increases until mid-April, unemployment levels dropped somewhat in the following months. On October 19, 2020, the number of individuals registered as either unemployed or receiving training stood at 348,000. This corresponds to an increase by 71,000 people compared with the same month of 2019 (see left panel and middle panel). Thus, the unemployment figures have continued to go down, but the improvement has been weakening since July. In parallel, the number of registered vacancies has been going up since mid-April, but the increase has been stagnating in recent weeks.

With regard to the outlook for unemployment in the months ahead, two factors are playing a role: First, seasonal unemployment is bound to increase. We know from past experience that the unemployment figures for late January typically exceed the unemployment figures for late August by 80,000. Second, there are signs that the ebb and flow of unemployment with the business cycle may be about to stagnate. Apart from media reports about layoffs in manufacturing – a sector which has so far added very little to unemployment given support through the coronavirus short-time work scheme – incoming data from the early warning system for impending layoffs installed by Austria's Public Employment Service imply that more people may be losing their jobs in the weeks ahead. In September 2020, the number of employees who had been given early warning of layoffs was close to 16,500 higher than in September 2019, having risen substantially from the corresponding figures for July (+6,000) and August (+8,200). The stagnation of registered vacancies referred to above would also point in this direction.

Chart 6

Labor market developments since March 2020



Source: AMS (Public Employment Service Austria). Number of unemployed in training (7-day averages, year-on-year, smoothed).

6 Inflation projected to reach 1.4% in 2020 and 1.7% in 2021 despite recession[2]

Having stood at 2.2% at the start of 2020, HICP inflation in Austria dropped to 0.6% in May. Thereafter, July marked the high point for inflation (1.8%), and by September inflation had declined to 1.3%. To some extent, the temporary peak in July reflects one-off effects (with fashion clearance sales starting later than usual) as well as price measurement problems concerning the service industry. Moreover, the inflation spurt until July was also driven by the moderate rise in oil prices since June (starting from very low levels). Core inflation (excluding energy and food) surged to 2.7% from May to July before dropping back to 2.0% by September amid the normalization of fashion sales. The large gap between core inflation and headline inflation can be explained by the fact that headline inflation was diminished by the energy inflation component, while core inflation was not.

In line with the OeNB's inflation forecast of September 2020, HICP inflation is expected to run to 1.4% in 2020 and to climb to 1.7% in 2021 (chart 7). Monthly inflation rates will be going down visibly until the end of 2020 before starting to rebound in January 2021. The energy component of inflation is expected to retain

[2] *These figures were obtained by mechanically updating the September 2020 inflation forecast, i.e. by incorporating the HICP data published for September.*

its dampening impact until early 2021. Moreover, the COVID-19 pandemic and the ensuing fall in aggregate demand are expected to have a moderating impact on the components of core inflation (industrial goods excluding energy and services). The energy price effects of this year's slump in crude oil prices will peter out in the second quarter of 2021. As the diminishing impact of the COVID-19 pandemic on inflation weakens gradually in 2021, HICP inflation is projected to rise to 1.7% in 2021. With the oil price effect dropping out, core inflation excluding energy and food prices is set to mirror headline inflation thereafter and drop from 2.0% in 2020 to 1.6% in 2021.

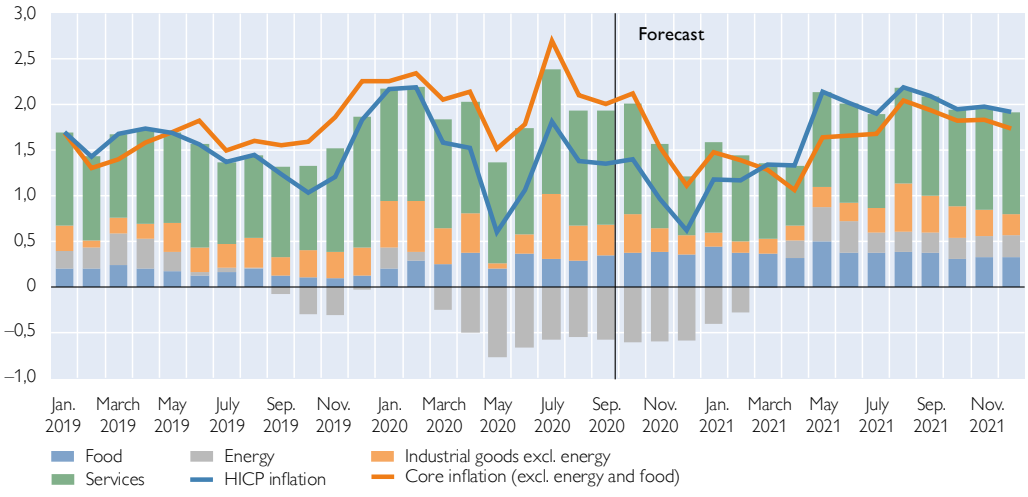
To provide financial support to the hospitality industry, the VAT rate for food and accommodation services was temporarily cut to 5% in July 2020. This rate will probably apply until December 2021. In line with government intentions, the lower VAT rate is unlikely to be passed on to consumers, as the hospitality industry faces higher costs and lower incomes resulting from capacity constraints imposed with a view to containing the COVID-19 pandemic (hygiene rules, social distancing) and as numerous business are struggling with liquidity problems.

The current inflation projections well exceed the forecast published in June 2020 (+0.6 percentage points for 2020, +0.9 percentage points for 2021). Underlying reasons include the sharp increase in HICP inflation in recent months (above all in July 2020), which had not been anticipated, and the upward revision of commodity price assumptions for both crude oil and nonenergy commodities (table 2). In addition, price measurement problems in the area of food and accommodation services are likely to prevail for the time being, which means that the inflation rate for services is going to respond more slowly than expected in the latest projections. Last but not least, services prices tend to be downward rigid, which makes a rapid adjustment to changing demand patterns unlikely.

Chart 7

The OeNB's inflation forecast of September 2020

Inflation in %; inflation contribution in percentage points



Source: OeNB, Statistics Austria.

Table 2

Assumptions underlying the OeNB's September 2020 inflation forecast

		September 2020 assumptions			Revisions to June 2020 assumptions		
	2019	2020	2021	2022	2020	2021	2022
Energy and exchange rates					%		
Oil price (EUR/barrel Brent)	57.2	37.6	40.2	41.6	13.4	17.0	10.6
USD/EUR exchange rate	1.1	1.1	1.2	1.2	4.8	9.2	9.2
Nonenergy commodity prices		*Index 2005=100*			%		
Total	129.1	131.0	138.6	142.4	4.1	6.4	6.0
of which world market prices for food	138.8	143.9	154.1	158.8	0.1	3.7	4.9
of which world market prices for metal commodities	116.8	116.4	128.8	131.9	12.1	22.0	20.7
EU food production prices	110.7	109.1	104.4	104.8	–6.2	–11.8	–11.8
Interest rates		%			*Percentage points*		
Three-month interest rates	–0.4	–0.4	–0.5	–0.5	–0.1	–0.1	–0.1
10-year government bond yields	0.1	–0.2	–0.2	–0.1	–0.1	–0.2	–0.2

Source: Eurosystem.

Financial literacy in Austria – focus on millennials

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Refereed by: Brent Kigner, Fachhochschule Kufstein Tirol, University of Applied Sciences, emeritus; Eveline Wuttke, Goethe University Frankfurt, Department of Business Education

This article summarizes the main findings from the second wave of the Austrian Survey of Financial Literacy (ASFL), the Austrian contribution to the OECD/INFE survey on adult financial literacy, which was conducted in spring 2019. As compared to the previous survey round in 2014, the financial knowledge of Austrian residents seems to have increased significantly. While men outperform women in terms of financial knowledge, they score slightly worse in terms of financial behavior and attitudes. Austrian residents are rather prudent, risk averse and forward looking and have a good overview of their finances.

In general, financial literacy is rather equally distributed across age groups. However, 15- to 38-year-olds (hereinafter called millennials) differ from other age cohorts in several respects: They have relatively low levels of financial literacy, are less financially organized, and they show more risky and less forward looking behavior. At the same time, they are more open to digital means of payments and financial innovations in general. Even though the observed differences are not very large and may vanish as millennials mature and gain experience with business and finance, we deem it important to monitor the financial literacy development for this group, given the rising complexity of financial decisions many among this group will face and the tremendous financial resources they will ultimately inherit.

JEL classification: A20, D12
Keywords: financial literacy, financial education, financial stability, survey data

In the aftermath of the global financial crisis, the issue of financial education has come to the fore, and financial literacy has gained international recognition as a critical life skill for individuals (Hilgert et al., 2003). Innovations and advanced technologies have increased the number of financial products and services offered, creating a complex and fast-paced financial landscape. In light of the complexity of the financial market, financial education efforts have been stepped up, and relevant strategies and programs have been developed in recent years (Alsemgeest, 2015).

At the same time, scientific interest in the topic has increased almost exponentially, as suggested by chart 1, which shows the number of citations of the term "financial literacy" in scientific journals (SSCI index).

The OeNB works in close contact with the education community in Austria to improve financial literacy. The OeNB's main goal in this area is to help consumers make sound financial decisions. Topics such as monetary policy, inflation and price stability are regular features of interactive programs (workshops, presentations and teacher seminars) that are created in line with the OeNB's mission statement ("We support financial literacy by offering a broad range of information and education services").

An important precondition for any financial education program is sound information about the state of financial literacy. A mere decade ago, research on what

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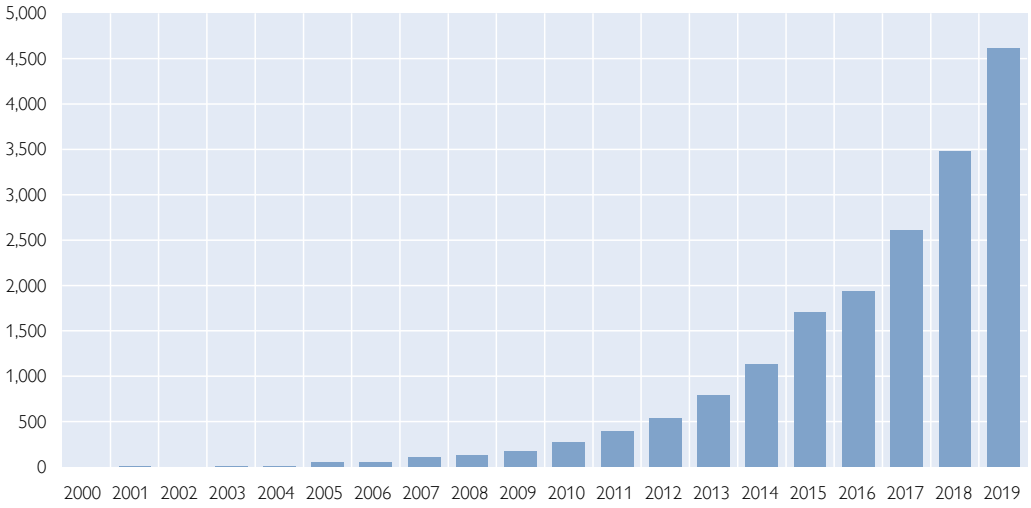
Chart 1

Citation index for the term "financial literacy"

Number of citations per year in SSCI-listed journals



Source: Social Sciences Citation Index (SSCI), January 2020.

people know about economics and finance was scarce, primarily due to a lack of a universally accepted approach of how to measure financial literacy. Annamaria Lusardi and her coauthors (e.g. Lusardi and Mitchell, 2008) were pioneers in designing a small set of financial knowledge questions that later became known as the Big Three[2] and were adopted in surveys in dozens of countries around the world. The set of questions was extended subsequently in the following years, but overall the coverage of the survey – both in terms of financial literacy questions and in terms of demographic and control variables – remained limited. Numerous other financial literacy surveys were adopted at the national level. Most of these surveys share the common weakness that they lack theoretical foundations and cover only limited dimensions (see e.g. Aprea and Wuttke, 2016).

About a decade ago, the OECD's International Network on Financial Education (INFE) started an ambitious project to design an extensive blueprint survey on adult financial literacy, the so-called Toolkit for measuring financial literacy and financial inclusion (OECD, 2015), with the aim of rolling it out in a decentralized way to its member countries and other countries participating in the INFE. After a pilot study in 2010/2011, the first regular survey wave in 2014/2015 covered about 35 countries on different continents and at different levels of development, including Austria. The design of the OECD/INFE survey follows the OECD's approach of defining financial literacy as "a combination of financial awareness, knowledge, skills, attitude and behavior necessary to make sound financial decisions

[2] *The three questions are: (1) Suppose you had USD 100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow: [more than USD 102; exactly USD 102; less than USD 102; do not know; refuse to answer]; (2) Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy: [more than, exactly the same as, or less than today with the money in this account; do not know; refuse to answer]; (3) Do you think that the following statement is true or false? "Buying a single company stock usually provides a safer return than a stock mutual fund." [true; false; do not know; refuse to answer].*

and ultimately achieve individual financial wellbeing" (Atkinson and Messy, 2012). The questionnaire therefore covers not only financial knowledge but also several aspects of financial behavior and attitudes. One of the strengths of the OECD's approach – in addition to providing data – is that it constructs a set of financial literacy scores from the individual survey questions to allow international rankings. The descriptive results were published in OECD (2016) and OECD (2017), while analysis and research papers based on the Austrian contribution (the ASFL 2014) were summarized in Silgoner et al. (2015) and Cupak et al. (2018).

In spring 2019, the OECD repeated the exercise. Countries were expected to deliver national data by spring 2020. The OeNB again participated in the exercise. This article describes the first results from the second wave of the Austrian Survey of Financial Literacy (ASFL 2019). We investigate the current state of financial knowledge, behavior and attitudes in Austria, highlighting also – wherever possible – changes as compared to the previous survey round. We explore differences among sample subgroups by gender, education and age, with a special focus on the subgroup of millennials.

Throughout this article, we split the sample into age bands, for convenience giving each of them customary labels. Such sample splits and labels are by nature arbitrary, as there is no universally accepted definition of generations. We refer to millennials as the demographic cohort born after 1980, also known as Generation Y. Most of the time, we divide this group further into young millennials (age 15–28) and old millennials (age 29–38). Generation X (age 39–58) are those born in the 1960s and 1970s. The rest of the sample either belong to the baby boomers (age 59–74) or the silent generation (age 75+), i.e. those born before the end of World War II.

This article is structured as follows: In section 1, we describe the dataset and the OECD's financial literacy scores. Section 2 presents the key results from the ASFL 2019. Section 3 focuses on the results for millennials and investigates special characteristics of this group, and section 4 concludes.

1 Dataset and calculation of scores

This article is based on the ASFL 2019, the Austrian contribution to the second wave of the regular OECD/INFE financial literacy survey. It was conducted by the OeNB among about 1,500 Austrian residents in spring 2019.

Box 1

The survey setting – some technical details

The sample used in the ASFL was based on stratified multistage clustered random sampling. NUTS 3 regions, municipality size as well as districts in Vienna were used for regional stratification. Replacement of unit nonresponse by drawing new addresses was allowed. Ultimately, the gross sample consisted of 3,356 households (3,201 after neutral dropouts). Respondents within households were drawn randomly. The final net sample comprised 1,418 computer-assisted personal interviews (CAPIs) conducted in April and May 2019. The nonresponse rate was about 55.7%. We used survey weights to produce descriptive population statistics throughout the article. The weights consist of a combination of (sample) design weights and poststratification weights based on external population statistics on age and gender at the province level.

The survey questionnaire is based on the OECD toolkit (OECD, 2018), but as in 2014, the OeNB included several additional survey questions that are of special

interest for the Austrian case. The complete set of financial knowledge questions is reported in box 2; the remainder of the questionnaire, including financial behavior and attitude questions, is available from the authors upon request.

According to OECD methodology (OECD, 2018), the survey data are used to calculate a set of financial literacy scores:

- The *financial knowledge score* is given by the total number of financial knowledge questions answered correctly (as opposed to a wrong answer, "don't know" or "refused to answer") out of the seven questions marked with an asterisk (*) in box 2. The score ranges from 0 to 7.
- The *financial attitude score* is based on a set of three statements ("I find it more satisfying to spend money than to save it for the long term," "Money is there to be spent," "I tend to live for today and let tomorrow take care of itself"). Respondents are asked how much they agree with a statement on a scale from 1 to 5, where 1 indicates "completely agree" and 5 "completely disagree." The financial attitude score is the arithmetic average agreement with the three statements and ranges from 1 to 5.
- The calculation of the *financial behavior score* is far more complex. It is based on a total set of ten questions that cover several aspects: active participation in financial decisions, savings behavior, product comparison and information sources before taking financial decisions, money management and financial planning. The financial behavior score ranges from 0 to 9. For details of the calculation, see annex A in OECD (2018).
- The total *financial literacy score* simply adds up these three scores, so it can take a maximum value of 21. This corresponds to the OECD/INFE approach that all three aspects of financial literacy in the end contribute to financial wellbeing.

Box 2

Financial knowledge questions in the survey

The ASFL 2019 covers 10 questions on financial knowledge. Questions used to calculate the OECD's financial knowledge score are denoted with an asterisk. The correct answers are indicated in brackets after each question. In addition to the various answer choices, participants could refuse to respond or state that they don't know the answer. Overall, the mix of questions – multiple choice questions, true/false questions and questions requiring respondents to do some math – is in line with common recommendations to design surveys in a way that they work equally well for respondents, regardless of their socioeconomic background, gender or culture.

Time value of money[3] (*): *Five brothers receive a gift of EUR 1,000 in total and are asked to share the money equally. Imagine that the brothers have to wait for one year to get their share of the EUR 1,000 and inflation stays at around 2%. In one year's time, will they be able to buy (a) more with their share of the money than they could today, (b) the same amount or (c) less than they could buy today?* ***(c)***

Interest paid on a loan (*): *You lend EUR 25 to a friend one evening and he gives you EUR 25 back the next day. How much interest has he paid on this loan?* ***(0)***

Interest plus principal (*): *Imagine that someone puts EUR 100 into a no fee savings account with a guaranteed interest rate of 2% per year. They don't make any further payments into this account and they don't withdraw any money. How much would be in the account at the end of the first year, once the interest payment is made?* ***(EUR 102)***

[3] *As presented here, this question contains information taken from an introductory knowledge question which is not among the set of questions used to calculate the OECD's financial knowledge score. See annex 2 for the two questions actually put to respondents.*

Compound interest (*): *And how much would be in the account at the end of five years? Would it be (a) more than EUR 110, (b) exactly EUR 110, (c) less than EUR 110 or (d) impossible to tell from the information given?* ***(a)***

Risk and return (*): *Is the following statement (a) true or (b) false? An investment with a high return is likely to be high risk.* ***(a)***

Definition of inflation (*): *Is the following statement (a) true or (b) false? High inflation means that the cost of living is increasing rapidly.* ***(a)***

Diversification (*): *Is the following statement (a) true or (b) false? It is usually possible to reduce the risk of investing in the stock market by buying a wide range of stocks and shares.* ***(a)***

Real interest: *Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year: After 1 year, how much would you be able to buy with the money in this account (disregarding any bank fees)? Would it be (a) more than today, (b) the same amount or (c) less than today?* ***(c)***

Overdrawing an account: *Is the following statement (a) true or (b) false? It usually does not matter whether I overdraw my checking account or take out a loan because in both cases the interest rates do not differ significantly.* ***(b)***

Exchange rate: *Suppose you have taken out a loan in Swiss francs. Then the euro depreciates against the Swiss franc. How does this change the amount of euro you need to make your loan installments? Does it (a) increase, (b) stay exactly the same or (c) decrease?* ***(a)***

Simplifications tend to come with some drawbacks. For example, asking people about interest rates or inflation may not really give an accurate picture of their real-life ability to take sound economic and financial decisions. Furthermore, the distinction between financial behavior and attitude is sometimes not clear cut. Also, calculating the total financial literacy score as the sum of the other three scores leads to some sort of double-counting: If we expect knowledge to impact on behavior, we would expect people with a high financial knowledge score to also show high financial behavior scores (see e.g. Fessler et al., 2019). This way, people with sound financial knowledge are credited twice for this advantage.

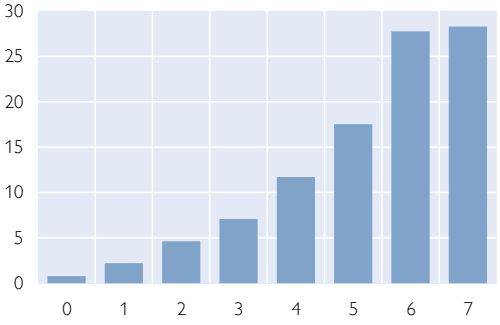
These caveats need to be kept in mind, especially when interpreting cross-country differences in the OECD's financial literacy scores. They share a common feature of most internationally comparable data sets: The methodology is always a compromise to account for the different traditions, conditions and circumstances in place in a wide range of countries. The attempt to make data suit all purposes may lead to data not fully matching national needs in the end.

The World Bank, for example, follows a different, outcome-driven approach to designing national financial literacy programs (e.g. Holzmann et al., 2013). In line with its behavior-oriented definition of financial capability, the World Bank identifies country-specific key vulnerabilities and challenges of the financial system to develop a well-targeted set of measures. The Austrian approach is somewhere in between in that it relies on the OECD's methodology but extends the scope of the survey in directions that are of special importance for Austria.

Chart 2

OECD financial knowledge score

Percentage share of respondents who answered x financial knowledge questions correctly



Source: ASFL 2019, OeNB.

Chart 3

Self-assessment of financial knowledge by knowledge score achieved

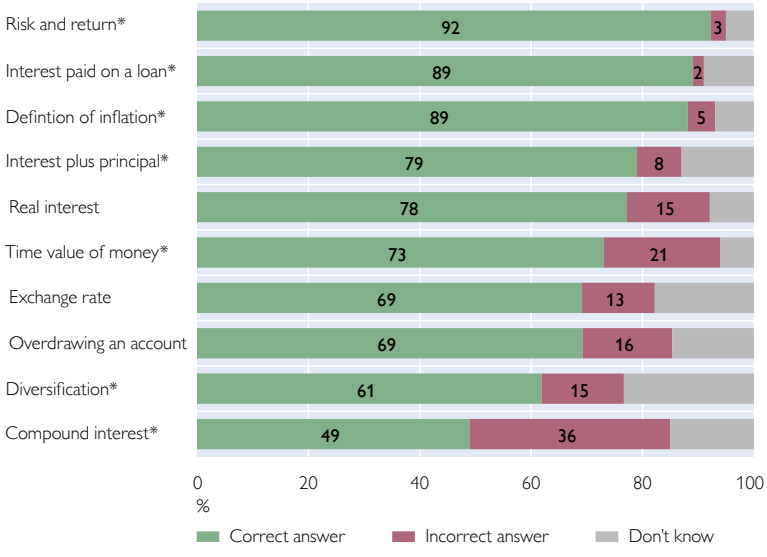
Question asked: How would you rate your overall knowledge about financial matters compared with other adults in Austria?

Percentage share of each answer

Source: ASFL 2019, OeNB.

Chart 4

Answers to the 7 OECD and 3 additional knowledge questions



Source: ASFL 2019, OeNB.

Note: Questions used to calculate the OECD's financial knowledge score are denoted with an asterisk.

2 Key results from the ASFL 2019

2.1 Knowledge gaps are largest for the youngest, the oldest and women

Chart 2 shows the distribution of the financial knowledge score for Austria. The bars indicate the share of respondents who get a specific financial knowledge score, defined as the number of financial knowledge questions answered correctly from the list of items denoted with an asterisk in box 2, i.e. those questions that the OECD uses to calculate the financial knowledge score.[4]

More than one-half of respondents perform rather well – they answered all (or almost all) knowledge questions correctly. 28% of respondents get the highest possible financial knowledge score of 7. On the other hand, a non-negligible share of respondents (15%) show a rather poor performance, answering less than four questions correctly. This is a source of concern, especially since none of the questions require expert knowledge, but all of them are essential when dealing with standard financial products. We therefore see scope for improvement.

At the same time, people are not fully aware of their knowledge gaps. We asked people to rate their own knowledge about financial matters as compared with other adults in Austria on a scale from 1 to 5 (1 stands for "very high," 5 for "very low"). Respondents were asked to answer this question before starting the knowledge quiz so we would get an idea of their self-assessment, unaffected by their actual performance. Chart 3 shows that people have a tendency towards overconfidence in their own financial knowledge. What is of special concern is the high share of those who answered less than three

[4] *The question on compound interest is only counted as answered correctly if the answer to the question on interest plus principle is also accurate.*

Table 1

Means of financial literacy scores across personal socioeconomic characteristics

	Unweigthed sample size	Knowledge	Behavior	Attitude	Literacy (sum)
Age					
Young millennials (15–28)	158	5.0	5.5	2.7	**13.2**
Old millennials (29–38)	198	5.3	5.9	3.1	**14.3**
Generation X (39–58)	515	5.4	6.1	3.2	**14.8**
Baby boomers (59–74)	354	5.4	5.8	3.2	**14.4**
Silent generation (75+)	193	5.2	5.5	3.1	**13.9**
Gender					
Male	668	5.6	5.8	3.1	**14.5**
Female	750	5.1	5.9	3.2	**14.1**
Education					
Primary	744	5.0	5.5	3.0	**13.6**
Secondary	512	5.5	6.2	3.2	**14.9**
Tertiary	162	6.1	6.3	3.1	**15.6**
Job					
Self-employed, business owner	101	6.1	6.4	3.1	**15.6**
White collar worker	737	5.5	6.0	3.2	**14.6**
Public servant	115	5.5	6.1	3.3	**14.9**
Farmer	31	5.0	5.8	3.3	**14.1**
Blue collar worker	391	4.9	5.5	3.0	**13.4**
Homemaker	8	5.1	4.0	2.9	**12.0**
Overall mean		5.3	5.8	3.0	**14.2**
Possible maximum		**7**	**9**	**5**	**21**

Source: ASFL 2019, OeNB.

questions correctly (bars 0 to 2 in chart 3) and nevertheless believe that their financial knowledge is "quite" or "very" high compared with that of other adults in Austria (light and dark green areas, respectively). Overconfidence can breed risky financial behavior.

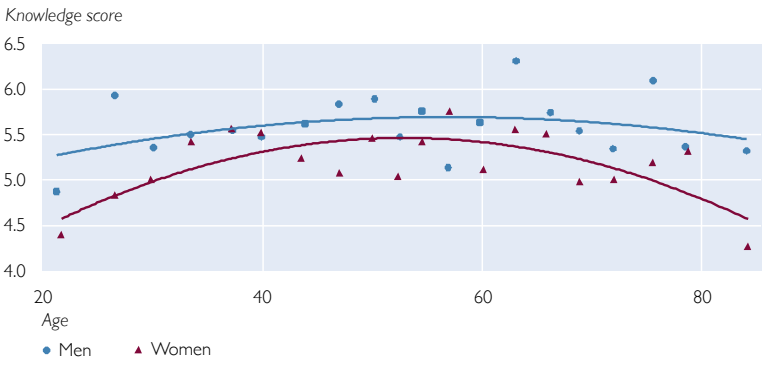
Chart 4 shows in more detail how respondents perform on the knowledge questions. The questions without an asterisk are Austria-specific and were added to the existing OECD toolkit. Note that the OECD financial knowledge score, which we also use in this study, focuses entirely on the number of questions answered correctly and thereby largely ignores the difference between "don't know" – indicating awareness of one's own knowledge – and a wrong answer.

Most respondents manage to give the correct answer to rather simple questions, like the one on the link between risk and return. However, while most (89%) know that high inflation means that the cost of living is increasing rapidly, one-quarter of respondents do not understand that you can buy less with the same amount of money after one year of inflation (time value of money). About 30% do not understand the implications of exchange rate movements for foreign currency debt, and the same fraction is not aware that overdrawing an account is far more costly than taking out a loan. Only about 60% of respondents grasp the key principle of risk diversification, and the concept of compound interest is understood by less than one-half of respondents.

Table 1 provides a breakdown of the average financial knowledge score by age, gender, education or job status. The first column shows unweighted numbers of

Chart 5

Relationship between age and level of knowledge



Source: ASFL 2019, OeNB.

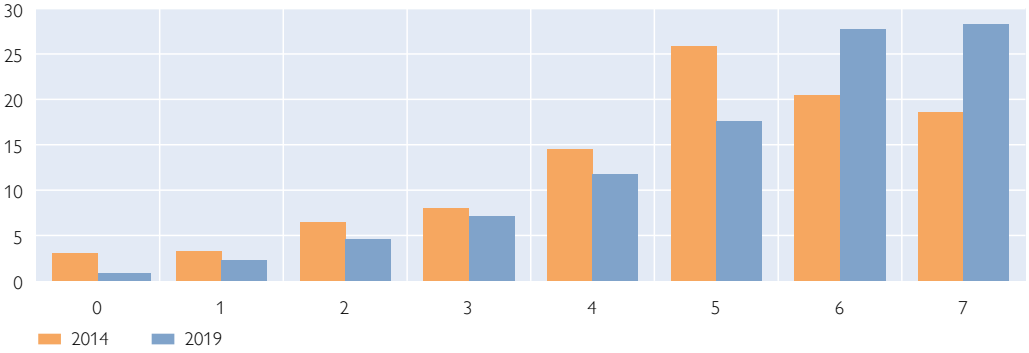
observations.[5] Splitting the sample by gender, we observe that men significantly outperform women in terms of financial knowledge – a common finding in the international literature. The average financial knowledge score of men is 5.6, while that of women is only 5.1. Greimel-Fuhrmann and Silgoner (2017) used ASFL 2014 data to investigate the potential reasons behind the comparatively weak performance of women. They identified a mix of determinants, including differences in personal endowments (such as education or income), the level of interest and involvement in financial matters as well as gender differences in the answer behavior in survey settings.[6] Especially the level of personal involvement in financial decisions seems to be crucial: Greimel-Fuhrmann and Silgoner (2017) do not find a gender gap when focusing on respondents who are widowed or divorced or live in single-person households and presumably are alone responsible for their financial decisions.

Table 1 also shows that knowledge is lowest in the youngest age cohort (referred to as young millennials in the following). Chart 5 gives more insight into the link between age and the knowledge score: In this binned scatter plot, the blue dots (men) and red triangles (women) each represent 5% of the respective sample and show the average knowledge score for each age bin. The chart confirms, for both women and men, the typical inverse U-shaped relationship described in the literature, indicating that people in the middle of their professional careers score highest in terms of financial knowledge. Young people, who have not yet acquired that much

Chart 6

OECD financial knowledge score: ASFL 2014 vs. ASFL 2019

Percentage share of respondents who answered x financial knowledge questions correctly



Source: ASFL 2014 and ASFL 2019, OeNB.

[5] *Note that for job status, the overall number is lower than the full sample, as 35 respondents who report that they have never held a job (to date) are excluded. In addition, the data on very small subgroups such as homemakers or farmers do not allow any interpretation, as the precision of the resulting estimates is very low.*

[6] *Women admit more often than men that they don't know the answer instead of just taking a guess.*

experience with financial products and business life in general, perform comparatively poorly. The same is true for the oldest age cohorts, who are used to very standard and safe financial products, such as savings books, and who never invested in financial knowledge. The red line in chart 5 also shows that these age effects are more pronounced for women than men. This evidence calls for financial education initiatives that focus on young people as well as targeted training programs for women.

Finally, table 1 shows – not surprisingly – that financial knowledge increases with the level of education. Self-employed people tend to score highest in terms of financial knowledge.

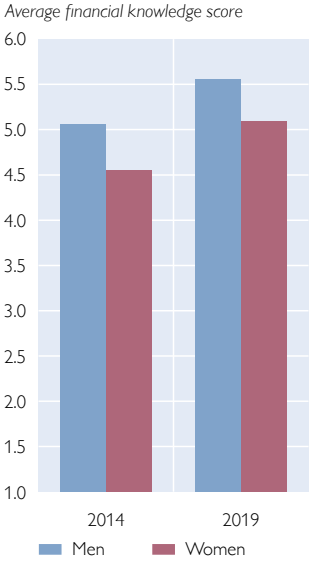
2.2 Financial literacy has improved from 2014

Chart 6 compares the financial knowledge score results from the two survey rounds, the ASFL 2014 (orange) and the ASFL 2019 (blue).[7] Again, the bars show the share of respondents exhibiting a specific financial knowledge score, defined as the number of financial knowledge questions answered correctly.

A comparison of the orange and blue bars in chart 6 shows that financial knowledge has increased significantly over the last five years. In 2019, 28% of respondents were able to answer all seven questions correctly, as compared to only 19% in 2014. About three-quarters of respondents gave the right answer to at least five questions, which the OECD considers a minimum target, as compared to only 65% in 2014. On average, people today give the correct answer to about half a question more than in the ASFL 2014. This improvement is not due to composition effects, such as a higher share of men or university graduates within the samples. Today, respondents score significantly better than in 2014 for all questions except the one about risk diversification. See chart A1 in annex 1 for regression results, which confirm that the differences between 2014 and 2019 are statistically significant at the 5% level for almost all individual questions and remain so even if we control for a set of socioeconomic covariates.

Chart 7

OECD financial knowledge score by gender



Source: ASFL 2014 and ASFL 2019, OeNB.

A comparison of the two survey waves shows that both men and women accumulated knowledge (chart 7), but women improved more than men (12% and 10%, respectively), which helps reduce the gender gap somewhat. Improvements were also observed for all levels of education and all age groups.

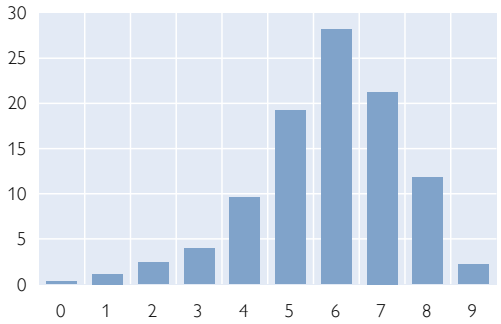
From the survey alone, it is impossible to derive definitive explanations for the improvement in financial knowledge

[7] *As outlined in annex 2, the questionnaire used for the 2019 wave differed slightly from the questionnaire used for the 2014 wave with regard to two questions. However, we do not see these slight adjustments to constrain the comparability of the results from the two waves.*

Chart 8

OECD financial behavior score

Percentage share of respondents with a score of x



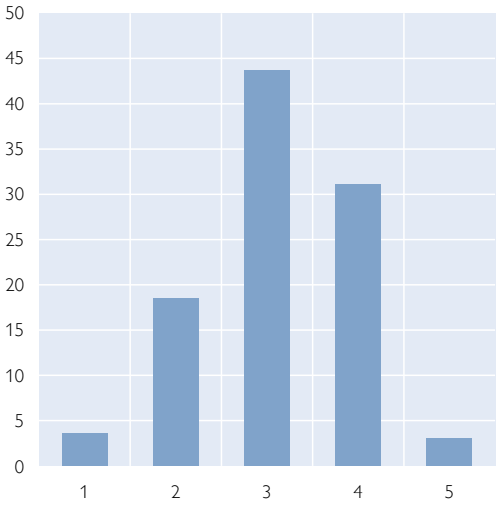
Source: ASFL 2019, OeNB.

over time. One hypothesis (that would need to be confirmed with further research, however) could be that the extensive media coverage of challenges related to the financial and economic crisis that started in 2008 has sparked people's interest in core economic concepts, so they have become more knowledgeable about them. After all, Norvilitis et al. (2006) found that financial knowledge, unlike financial behavior and attitudes, is very susceptible to changing external conditions. All types of news media focused on the major economic challenges associated with the crisis, such as deep recession, high unemployment, private and public debt and persistently low inflation. Economic and monetary policy reactions as well as their limitations (overindebtedness, zero lower bound of monetary policy, effectiveness of unconventional monetary policy measures) were also widely discussed. The intensive financial education initiatives launched in Austria by the OeNB and other key stakeholders of financial education may have contributed to this improvement. But these effects are hard to isolate, given the long-term orientation of most education initiatives.

Chart 9

OECD financial attitude score

Percentage share of respondents with a rounded score of x



Source: ASFL 2019, OeNB.

2.3 Population rather prudent, forward oriented and risk averse

The distribution of the financial behavior score, as measured by OECD methodology,[8] is tilted to the right, indicating that Austrian residents self-report rather positive financial behavior (chart 8). The distribution of the financial attitude score is shown in chart 9.

Again, we find interesting differences across sociodemographic subgroups (table 1). While men outperformed women in terms of financial knowledge, women scored better in terms of behavior and attitudes (although the difference is significant only for attitudes). One of the questions investigated in Greimel-Fuhrmann and Silgoner (2017) was how this difference affects financial

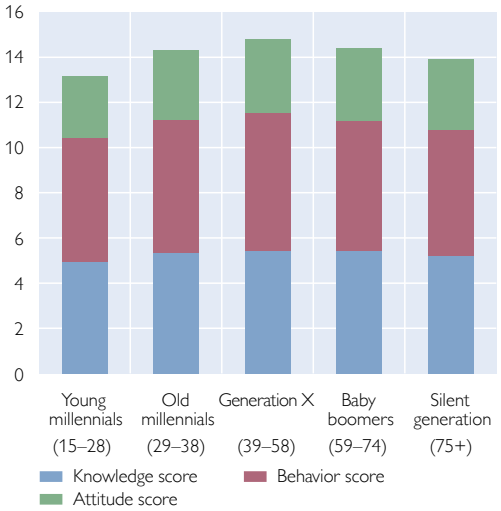
[8] *The methodology for calculating the financial behavior score has changed from 2015. Comparing the scores of the two survey rounds is therefore not feasible.*

wellbeing. The authors use the period of time that people would get by after losing their main source of income as a proxy for financial wellbeing and find no gender gap there. Apparently, there are different ways of achieving the same level of financial wellbeing: Women may partly compensate a lack of knowledge with extra prudent and forward-looking behavior, while men – equipped with a higher level of financial knowledge – can potentially afford more risky behavior. But causality may also run in the other direction: The more willing individuals are to take risk, the higher might be their incentive to invest in knowledge so they can assess risks properly.

Chart 10

Financial literacy across generations

Average financial literacy scores



Source: ASFL 2019, OeNB.

Chart 10 summarizes the information provided in table 1 on the three scores for the different age cohorts. Generally, financial literacy seems to be rather equally distributed across generations. However, all three scores peak for Generation X, i.e. people in the middle of their professional career (age 39–58). The lowest scores in all three dimensions of financial literacy are achieved by the youngest age group (young millennials), followed by the silent generation. Overall, this mirrors the slight inverse U-shape we see for financial knowledge in chart 5 for the other two financial literacy scores. Given the increasing complexity of financial decisions and the enormous financial resources millennials will eventually inherit, monitoring the development of their financial literacy seems reasonable.

Finally, table 1 shows that respondents with only primary education show especially poor results in all three dimensions of financial literacy. Since it is often difficult to reach people once they have left school, financial education initiatives should be targeted at young people, e.g. students in primary and lower secondary school. Table 1 shows that business owners and the self-employed score highest in terms of both financial knowledge and behavior.

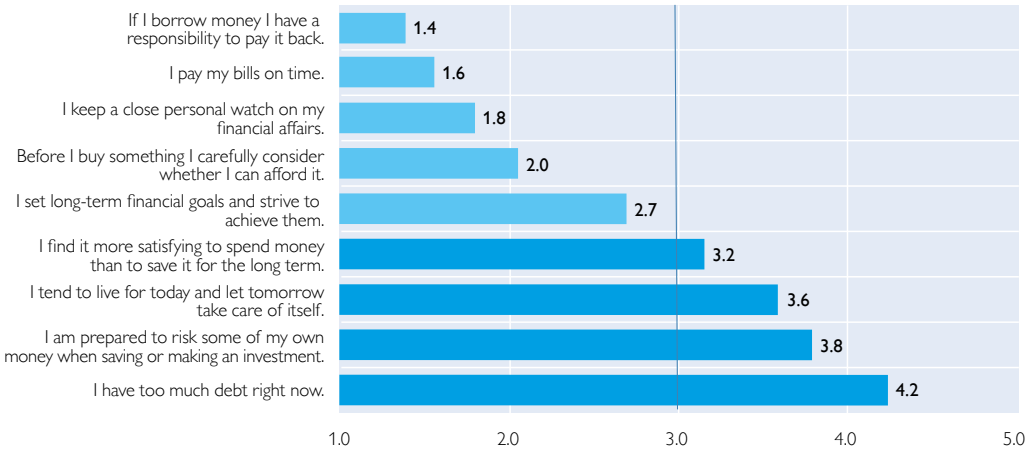
As described in section 1, the OECD calculates the total financial literacy score as the sum of the financial knowledge, behavior and attitude scores. Austria's total score in the ASFL 2019 was 14.2 (out of 21; bottom of table 1) – the very score Austria achieved five years earlier in the ASFL 2014. Back then, Austria scored slightly above the average of participating OECD countries (OECD, 2016). The unchanged total financial literacy score masks improved results for financial knowledge (5.3 as compared to 4.9) but poorer results for financial behavior (5.8 as compared to 6.0) and attitudes (3.1 as compared to 3.3). However, as mentioned earlier, the methodology behind the calculation of the financial behavior score has changed somewhat from 2014.

Chart 11 highlights selected aspects of financial behavior and attitudes. The bars show the average level of agreement to a number of statements on a scale of 1 to 5, where 1 indicates "I fully agree" (or for some questions: "It always applies" or "It

Chart 11

Selected aspects of financial behavior and attitudes (1)

Average agreement with statements on a scale from 1 to 5 (1 = completely agree/always applies, 5 = completely disagree/never applies)



Source: ASFL 2019, OeNB.

completely describes my situation") and 5 "I complete disagree" (or "It never applies" or "It does not describe my situation at all").

Chart 11 shows that Austrian residents are rather prudent and forward oriented. Respondents understand that they have to pay back borrowed money (score of 1.4), they pay their bills on time (1.6), and they state that they keep a close watch on their financial affairs (1.8). Most of them also consider purchases carefully (2.0). In all these cases, women report more favorable behavior, i.e. indicate even stronger agreement with the statement. Most people state that they set long-term financial goals (2.7) and strive to achieve them. Likewise, the majority of respondents claim that they do not find it more satisfying to spend money than to save for the long term (3.2) and that they do not live for today and let tomorrow take care of itself (3.6). Survey participants are generally hesitant to risk money when saving or investing (3.8), with women being even more risk averse. Only a minority seems to feel overindebted (4.2).

From other questions (not shown in the chart), we can conclude that people have confidence in the financial system. A score of 2.3 shows that respondents mostly trust financial service providers to treat them fairly. However, Austrian residents are generally rather skeptical when it comes to financial innovations. When asked whether they use their mobile phone to make or receive payments, the average score is 3.8, which means that the majority of respondents answered in the negative. The level of disagreement is more pronounced among women (3.9) than among men (3.6). People are even more skeptical of crypto assets: The average score for the statement that now is a good time for people to invest in crypto assets or initial coin offerings (ICOs) is only 4.1; i.e. people strongly disagree, especially women.

As part of the survey, we also ask whether people believe that ethical standards are important for the financial system. People mostly agree that banks should check the ethics of companies before providing them with banking services (average score of 2.0). They also declare that they prefer to use financial companies that

have a strong ethical stance (average score of 2.2). However, they also think that it should be more important for investors to choose companies that are making a profit than to choose companies that are minimizing their impact on the environment (average score of 2.3). In all three dimensions, the ethical stance of a bank or a company seems to be more of an issue for females than for males.

When interpreting these rather positive results on the ethical conscience of Austrian residents, we should keep in mind that respondents are often affected by social desirability bias in survey settings, which means they tend to give answers that they believe will be viewed favorably by others. Also, respondents tend to agree with offered statements (acquiescence bias). The fact that survey participants would like to see banks follow strong ethical standards, while at the same time agreeing that financial aspects should take precedence over environmental considerations for investors, seems to confirm that some acquiescence bias is involved. To gain deeper insights into people's ethical conscience, it would be necessary to thoroughly investigate how much they actually know about ethical goals and standards and what they are willing to do about them (actual personal purchase and investment patterns). There may be substantial gaps between stated preferences and actual behavior.

3 Millennials are different…

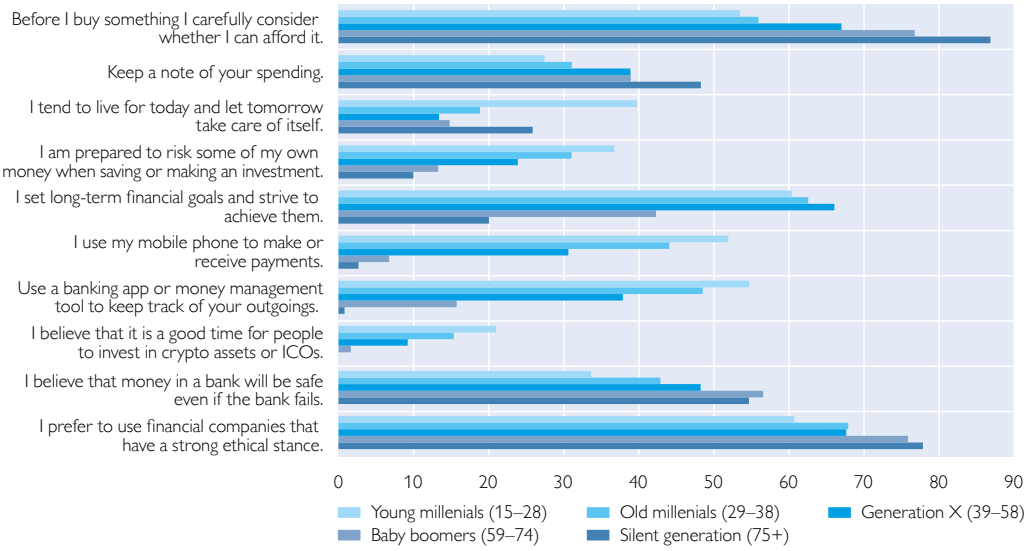
Millennials are commonly perceived as being different from older age cohorts in many respects, including their savings and investment behavior, their perception of risks and their openness to technical and financial innovations.

In this respect, table 1 and chart 10 already revealed that the youngest participants in the 2019 survey scored relatively low in terms of both financial knowledge and financial behavior and attitudes. Let us now shed more light on how precisely millennials are different from other generations in terms of financial behavior and

Chart 12

Selected aspects of financial behavior and attitudes (2)

Percentage share of respondents who completely or somewhat agree with the statement



Source: ASFL 2019, OeNB.

attitudes and what implications this may have for financial stability. We deliberately abstract here from questions that are directly linked to the financial situation (such as whether respondents have a large financial buffer), given that millennials are still at an early stage of their professional career and at the beginning of their earnings cycle. Chart 12 shows the share of respondents who (completely or at least somewhat) agree with a given statement.[9]

We observe the following fundamental differences between millennials (i.e. those younger than 39) and older age cohorts:

- Overall, millennials tend to be less financially organized. From chart 12 we see that the share of respondents who carefully consider whether they can afford a purchase is much lower among young and old millennials than among other age cohorts. Similarly, and in spite of their probably smaller income, they have a lower tendency to keep track of spending or follow alternative budgeting habits (e.g. keeping money for bills separate from day-to-day spending money or keeping track of bills; not shown in the chart). Similar results were reported e.g. by Wuttke and Aprea (2018).
- Millennials also seem to be less risk averse and forward looking, as shown by the relatively high share of agreement with "I tend to live for today and let tomorrow take care of itself" and "I am prepared to risk some of my own money when saving or making an investment," as compared with Generation X and baby boomer respondents. In both cases, young millennials stand out clearly, which is also confirmed by the answers to a question designed to establish respondents' risk aversion:[10] Among (young and old) millennials, the share of those not willing to take any financial risk when making savings or investment decisions is only about 45%, as compared to 56% for Generation X and 78% of baby boomers (not shown in the chart).
- Interestingly, however, millennials are not markedly different from Generation X when it comes to long-term financial goals. All three age cohorts state that setting long-term financial goals and striving to achieve them is important to them. Apparently, there is a mismatch between people's awareness of the importance of long-term goals and their focus on the short-term steps necessary to achieve them.
- Millennials are more likely to use new – specifically financial – technologies than the other age groups: While more than one-half of young millennials and 44% of old millennials declare that they use their mobile phone to make or receive payments, this share declines markedly with age: Only about 30% of Generation X and less than 10% of baby boomer respondents use this payment option. We observe a similar pattern when asking whether respondents use a banking app or money management tool to keep track of their outgoings. Interestingly, this is another discrepancy to what we reported in the first bullet point: Even though they use new financial technologies such as banking apps, millennials are less financially organized. Apparently, users are unable to fully absorb the wealth of information provided by new financial technologies. When it comes to

[9] *For some questions, it is the share of respondents who declare that the statement always or often applies to them.*

[10] *Question: If your household has to make saving or investment decisions: Which of the following statements best describes your household's attitude toward risks? (a) I am prepared to take substantial financial risks expecting to earn substantial returns, (b) I am prepared to take above-average financial risks expecting to earn above-average returns, (c) I am prepared to take average financial risks expecting to earn average returns, (d) I am not willing to take any financial risk.*

crypto assets, the share of respondents who believe that right now would be a good time to invest in crypto assets or ICOs is low in general, but again markedly higher among millennials.

Summarizing this evidence, we conclude that millennials show more risky and less forward looking behavior than other age groups. The use of new financial technologies may not necessarily help them keep track of their finances. Interestingly, millennials have less trust in the banking system than the other age groups, as indicated by the responses to the second to last question in chart 12 ("I believe that money in a bank will be safe even if the bank fails.").

Finally, let us come back to the questions on the ethical conscience of respondents. Given that the recent climate change protests were kickstarted by the very young generation of school and university students, we would also expect above-average support for aspects related to green finance among millennials. However, as indicated by the last item in chart 12, the level of agreement with the statement "I prefer to use financial companies that have a strong ethical stance" appears to increase with age. A similar picture emerges for whether banks should check the ethics of companies before providing them with banking services (not shown in the chart). Apparently, people become aware of the financial aspects of environmental concerns only once they start making investment decisions themselves, i.e. at a later stage in the earnings cycle.

4 Conclusions from the perspective of a major financial education provider

In spring 2019, for the second time after 2014, the OeNB conducted a survey on financial knowledge, behavior and attitudes in Austria (ASFL 2019), the Austrian contribution to the OECD/INFE survey on adult financial literacy. We find that more than one-half of respondents perform relatively well in a financial knowledge quiz – they were able to correctly answer all (or almost all) seven knowledge questions. As compared to the previous survey round in 2014, financial knowledge has increased. While men significantly outperform women in terms of financial knowledge, they score slightly worse in terms of financial behavior and attitudes. Austrian residents are rather prudent, risk averse and forward looking and have a good overview of their finances. Survey participants have confidence in the financial system and believe that ethical standards are important, but are rather skeptical when it comes to financial innovations.

Millennials (those younger than 39 years) differ from other age cohorts in several respects: They have relatively low levels of financial literacy, are less financially organized, show more risky and less forward looking behavior, but are more open to digital means of payments and financial innovations in general. Even though the observed differences are not very large and may vanish as millennials mature and gain experience with business and finance, we deem it important to monitor the development of financial literacy for this group, given the rising complexity of financial decisions many of them will face. We are confident that further research and future surveys will reveal whether millennials are intrinsically different from other cohorts, or merely younger.

These first results highlight promising routes for future research. First, it would be interesting to explore why people performed better in the 2019 financial knowledge test than in the 2014 test. We hypothesize that most people in Austria

were affected by the financial crisis that started in 2008, which underscored e.g. the value of having financial buffers, even in a zero interest environment. The extensive coverage of crisis-related topics in all types of media may have contributed to people's interest in, and knowledge of, core economic concepts. However, such a hypothesis would need to be verified with a separate survey.

Second, the benefits of sound financial knowledge increase when it actually leads to healthier financial behavior. Fessler at al. (2019) identified a significantly positive and causal link between financial knowledge and behavior based on the ASFL 2014. The 2019 survey now offers new information to re-investigate this link.

Finally, with regard to the affinity of millennials to new financial technologies, our survey data allow us to replicate research by Lusardi et al. (2017). They find that millennials in the U.S.A. who regularly use their mobile phone for financial services tend to be less financially literate and (probably therefore) tend to more often display expensive financial behavior (such as overdrawing their checking account or getting costly cash advances from their credit cards) than nonusers of the same age group. A first analysis shows that the evidence from Austria does not follow this pattern, but further analysis would be needed to dig deeper into the issue.

At any rate, millennials will constitute the core of active financial market participants at some point, so a profound understanding of their preferences and financial literacy deficiencies is essential to evaluate future financial stability risks and tailor financial education initiatives to vulnerable groups who need them most.

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Annex 1

Chart A1 shows differences between the 2014 and 2019 waves of the ASFL survey in the probabilities of answering knowledge questions correctly. Error bars denote 95% confidence intervals. To produce this graph, we ran 14 regressions, 2 for each question, and estimated the probability of answering the question correctly using a linear probability model. Both waves are pooled. In the first set of regressions, we regress on a wave dummy only, while in the second set we control for age and age squared as well as dummies for gender, education, household size, region and municipality size. Household weights are reweighted in order to ensure the same sum of weights for both waves, while keeping the within-wave relative size of weights.

Annex 2

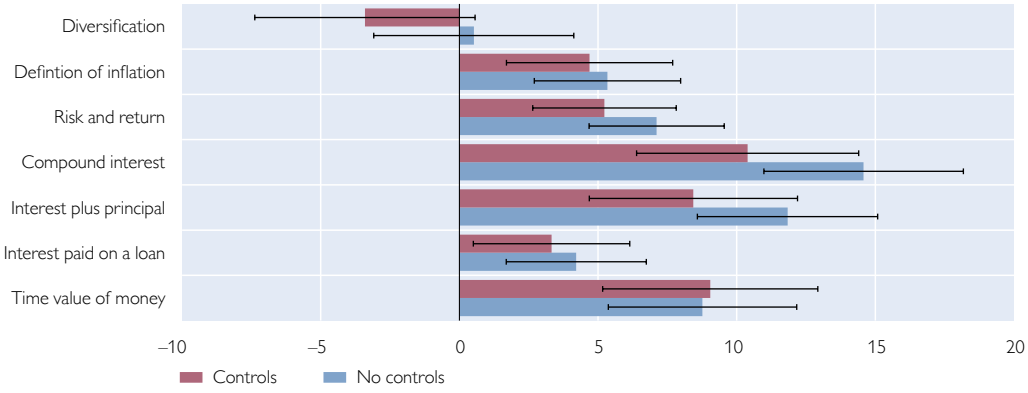
Summary question presented in box 2

The first financial knowledge question shown in box 2 ("time value of money") contains information taken from an introductory knowledge question which is not among the set of questions used to calculate the OECD's financial knowledge score. In the 2019 questionnaire, this question is worded as follows:

Chart A1

Probability of answering a question correctly

Change in percentage points between 2019 and 2014



Source: ASFL 2014 and 2019, OeNB.

Note: Controls include age and age squared as well as dummies for gender, education, household size, region and municipality size.

1. "Imagine that five brothers are given a gift of EUR 1,000 in total. If the brothers have to share the money equally how much does each one get?"

The questionnaire then moves on to the question on the time value of money:

2. "Now imagine that the brothers have to wait for one year to get their share of the EUR 1,000 and inflation stays at around 2%. In one year's time will they be able to buy: (a) more with their share of the money than they could today, (b) the same amount, (c) less than they could buy today?"

Changes made between 2014 and 2019

For the 2019 wave, the wording of the seven OECD knowledge questions was changed with respect to two questions:

Question on the "time value of money":

2014: "Now imagine that the brothers have to wait for one year to get their share of the EUR 1,000 and inflation stays (constant) at 2%. In one year's time will they be able to buy: (a) more with their share of the money than they could today, (b) the same amount, (c) less than they could buy today?"

2019: "Now imagine that the brothers have to wait for one year to get their share of the EUR 1,000 and inflation stays at around 2%. In one year's time will they be able to buy: (a) more with their share of the money than they could today, (b) the same amount, (c) less than they could buy today?"

Question on "risk and return":

"I would like to know whether you think the following statements are true or false: An investment with a high return is likely to be high risk." This question remained unchanged in English and essentially unchanged in German between the two waves, but we made the wording somewhat more accessible in the German questionnaire for the 2019 wave.

Of course, questions that have been reworded complicate comparisons over time as a rule. However, as is evident from the observations made in annex 1, the broad-based improvement of the OECD's financial knowledge score is not attributable to these minor wording changes.

A spatial analysis of access to ATMs in Austria

Helmut Stix[1]
Referee: Matthias Uhl, Deutsche Bundesbank

This paper sheds light on the geographical distribution of automated teller machines (ATMs) in Austria. Our results indicate that Austrians live within a travel distance of 1.2 km on average of an ATM, with travel times (by car) to the closest ATM averaging 2.9 minutes. A total of 82% of the population reside within a travel distance of 2 km of an ATM and 85% of the population travel less than 5 minutes to reach the next ATM. When comparing ATM access in urban and rural areas, we find that the average distance to the closest ATM ranges from 2.1 km in municipalities with less than 2,000 inhabitants to 0.6 km in larger cities.

Although our findings generally point to reasonable travel distances, on average, across Austria, a more disaggregated view allows us to identify areas where ATM access is more limited. 2.9% of the population (or some 260,000 residents) have to travel more than 5 km to reach the closest ATM. About 60% of these residents live in municipalities with less than 3,000 inhabitants and 80% in municipalities with less than 5,000 inhabitants. Municipalities with a high share of residents who have a travel distance of more than 5 km can be found in all of Austria's nine provinces (except Vienna). These municipalities have on average 840 inhabitants.

JEL classification: R12, E51, E41
Keywords: ATM network, cash access points, spatial analysis

This paper examines the spatial distribution of automated teller machines (ATMs) in Austria, providing information on how far Austrians have to travel, and how much time it takes, to reach the closest ATM.

There are two main reasons to conduct such an analysis. First, despite the broad availability of cashless payment options, cash still plays a significant role in Austria – both for everyday purchases and as a store of value (see Bagnall et al., 2016; Schautzer and Stix, 2019). Moreover, in Austria, the primary place to withdraw cash is the ATM.[2] For consumers, the cost of using cash is strongly associated with the time needed to reach the closest source of cash withdrawals.

Second, one of the key tasks of the Oesterreichische Nationalbank (OeNB) and its subsidiaries is to provide Austrian businesses and consumers with cash. Therefore, the OeNB has a keen interest in an efficient supply chain – from the production of cash to its distribution among the public. Furthermore, a broad availability of cash access points is key to ensuring that consumers are free to choose among payment methods (Deutsche Bundesbank, 2020). However, the increased closure of bank branches and ATMs in some countries has sparked a debate about how to safeguard

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[2] *88% of the population aged 14 and over use an ATM at least once a month, which compares with 43% for bank desks (Ritzberger-Grünwald and Stix, 2018). Results for withdrawal amounts are unavailable; yet, the results obtained by Brown et al. (2020) for Switzerland might be indicative for Austria. Hence, it can be expected that Austrians withdraw more than 90% of the total amount they withdraw at ATMs.*

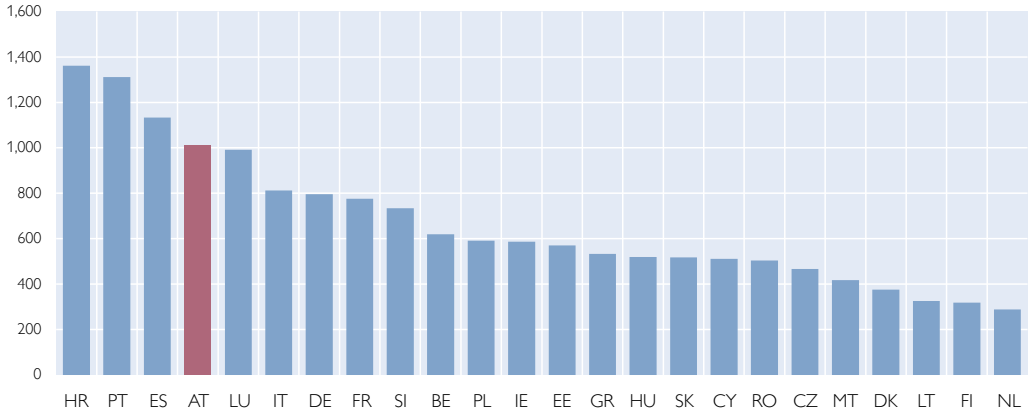
broad access to cash. In its Retail Payments Strategy, the European Commission "[e]xpects Member States to ensure the acceptance and accessibility of cash as a public good […]. One means whereby Member States might preserve access to cash could be to provide for minimum coverage of automated teller machines (ATM), or equivalent means of access, on their territory" (European Commission, 2020, p. 14). In its opinion on a Swedish initiative to set thresholds for the maximum distance to the nearest ATM, the European Central Bank states that "it [is] important that all Member States […] take appropriate measures to ensure that credit institutions and branches […] provide adequate access to cash services, in order to facilitate the continued use of cash".[3]

While several countries have seen a considerable fall in the number of cash access points, available figures suggest that the opposite seems to be true for Austria. In fact, the number of ATMs has increased over the past years – from about 7,400 in 2005 to about 9,000 in 2019[4]; moreover, in a European comparison, Austria is among the countries with the highest number of ATMs per capita (chart 1). However, such numbers only reflect averages across a country and may therefore hide regional differences in access to cash, in particular in rural areas. This seems to be particularly relevant for Austria where a large share of the population lives either in relatively small villages or in larger cities. More precisely, about 25% of Austrians live in municipalities with less than 3,000 inhabitants, while some 21% of the population reside in Vienna. Calculating an average across the entire country may therefore be uninformative about access to cash in rural areas.

Chart 1

Number of ATMs by country

Number of ATMs per million inhabitants



Source: ECB Statistical Data Warehouse.

Note: Values refer to 2019.

[3] *Opinion of the European Central Bank of 26 November 2019 on the requirement for certain credit institutions and branches to provide cash services (CON/2019/41) available at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019AB0041&from=EN.*

[4] *Source: https://www.oenb.at/isaweb/report.do?report=5.4.1. The number of retail bank branches, in contrast, declined by about 1,000 over this period (see Stix, 2020 for a related paper on the geographical distribution of bank branches in Austria).*

The relatively high number of ATMs per capita is reflected in how Austrians rate their access to ATMs. The results of a survey conducted by the OeNB in 2016 among 1,700 Austrian residents show that 49% of respondents considered it "very easy" to find an ATM, another 47% "fairly easy." A mere 4% stated that it is "fairly difficult" or "very difficult" to access cash from an ATM.[5] A favorable rating was also observed for smaller municipalities with up to 2,000 inhabitants, where 95% of respondents said that it is "very easy" or "fairly easy" to get to an ATM.[6]

While the survey results and the data on the number of ATMs presented above provide first insights into the availability of ATMs in Austria, these data sources might be less suited to identify areas with poor ATM access due to the limited number of respondents in surveys. This is particularly the case for small areas and/or relatively small numbers of residents who have to travel larger distances to reach an ATM.

This is why this paper carries out a fine-grained analysis of the spatial distribution of ATMs in Austria, providing estimates about actual travel distances and times to the closest ATMs for small geographical areas and at the municipality level. These estimates can be used to assess the availability of ATMs in urban and rural areas and to identify areas with limited access. Moreover, they provide a benchmark for monitoring any future changes to Austria's ATM network.

When interpreting the findings of this paper, some remarks are in place. The paper provides a descriptive account of travel distances and times and tries to avoid, as much as possible, normative judgments, which would require a more elaborate analysis. This is well justified as we only focus on one aspect of accessibility, i.e. the physical distance to the next ATM. The same distance can have very different implications for different people, depending e.g. on their mobility, the availability of means of transport or whether or not they use digital payment instruments. Also, physical distances might be inconsequential if people stop at an ATM on their way to the city center, for example. These factors are not considered in the following analysis. Moreover, we do not take into account differences in ATM operating hours and other cash access points, such as grocery stores that offer cash-back. Finally, we would like to emphasize that the process of georeferencing ATM locations is prone to errors. Although thorough data checks were conducted, inaccuracies in the exact location of each ATM and their assignment to municipalities cannot be ruled out. Therefore, our results should be treated as indicative only.

We are unaware of recent studies that calculate travel distances and times to the closest ATMs based on actual road network distances. However, several recent studies adopt an approach based on straight-line ("as the crow flies") distances. As a case in point, the National Forum on the Payment System (NFPS, 2017) reports on the accessibility of ATMs and cash deposit machines in the Netherlands over the period from 2013 to 2017. Delaney et al. (2019) present a comprehensive analysis of how far Australians have to travel to deposit or withdraw cash. Sonea et al. (2019) conduct a spatial analysis of cash access points in the United Kingdom and develop indicators to identify the vulnerability of an area to the closures of cash

[5] *The results reported refer to the assessment of those respondents who typically use a specific ATM to withdraw cash.*

[6] *For a detailed description of the survey, see Rusu and Stix (2017). Esselink and Hernández (2017) report detailed results for the use of cash by consumers in the euro area. Their findings show, amongst other things, that Austrian consumers are among those most satisfied with the availability of ATMs. Deutsche Bundesbank (2020) draws an interesting comparison between the cash withdrawal behavior in urban and rural areas. Overall, respondents considered the effort involved in accessing cash to be low in both urban and rural areas, a finding similar to that for Austria.*

access points. Other interesting studies for France (Banque de France, 2019) and Spain (Gonzalo and Tejero Sala, 2018) adopt a somewhat more aggregated geographical perspective than in this paper, i.e. by mainly focusing on the availability of bank branches or ATMs at the municipality level.

The remainder of the paper is organized as follows: Section 1 presents the methodology used to assess ATM access in Austria and explains how the routes to ATMs were calculated. Section 2 discusses the key results broken down by municipality (population) size categories and provinces. In section 3, we adopt a more disaggregated geographical perspective by analyzing ATM access across Austria's municipalities. Section 4 presents some results based on straight-line distance measurements and section 5 concludes the paper.

1 Methodological remarks

In this section, we describe the dataset of ATM locations and explain how the routes to the nearest ATMs were computed.

1.1 A brief description of Austria's ATM network

In general, Austrian consumers have free-of-charge access to the vast majority of ATMs in the country, also when cash is withdrawn from ATMs run by banks other than their own. At end-2019, there were four ATM operators in Austria which provided a total of 9,058 ATMs. The majority of ATMs is operated by banks, with a significant share being located inside, or adjacent to, bank branches (especially in rural areas). As mentioned earlier, withdrawal fees are charged at a rather small share of ATMs. Since it is difficult to identify fee-charging ATMs, we did not exclude them from our analysis. However, we expect their exclusion to not have a significant impact on the aggregate results, as fee-charging ATMs are typically located at popular locations, such as train stations or touristic places, which have a rather high density of ATMs. Yet, since the number of fee-charging ATMs may be higher in touristic municipalities (e.g. in ski resorts), we expect their inclusion or exclusion to affect the results at the municipality level.

1.2 Collecting ATM location data

Data on the exact postal addresses of all ATMs in operation were provided by Austria's ATM operators.[7] For most ATM locations, we obtained georeferenced data; the remaining ATM locations were geocoded. Checks of all geocoded locations were conducted to ensure the correctness of the data. This was done by e.g. comparing the geolocations of ATMs with those of bank branches, as a large part of Austria's ATMs is located inside, or adjacent to, bank branches. Due to the high number of ATMs, however, errors in geocoded ATM locations cannot be ruled out completely. While any remaining errors are unlikely to significantly bias the results for Austria as a whole, they may affect the results at the municipality level. This should be considered when interpreting the results for individual municipalities.

Moreover, it should be noted that the number of ATMs varies throughout the year, with additional ATMs being put up e.g. at Christmas markets or in ski resorts during the winter season. These ATMs were not excluded from the analysis presented here, given the difficulties involved in identifying whether a specific

[7] *The author would like to thank all ATM operators for providing the respective data.*

location is seasonal or not. In addition to seasonal ATMs, we took into account ATMs with limited operating hours which are otherwise broadly accessible, i.e. ATMs located in local shops, grocery stores, gas stations, and other locations. ATMs located in discos or nightclubs, in contrast, were omitted from the analysis, as they are only accessible for a limited share of the population. Since we searched for these ATMs by manually checking the location name and the geolocations, we cannot guarantee that all ATMs of this kind were identified. In total, 62 ATMs were excluded, which brings the number of ATMs included in the analysis to 8,996.

1.3 Calculating the routes to the nearest ATM

Routes to the next ATM were calculated based on a road network analysis using a geographical information system. The road network analysis was conducted by an external company and was based on "TomTom" © maps. To account for the differences in how people travel in urban as opposed to rural areas, travel distances and times were calculated based on both traveling by car and on foot. The road network analysis was conducted on the basis of the fastest route in either transport mode. It should be noted that the fastest route is not always the shortest route, in particular when driving by car.

The analysis is based on a 100x100 m geographical grid of Austria. The center of each populated grid cell was used as the starting point to calculate the routes to the three nearest ATMs. More details on how routes were calculated are provided in box 1.

Box 1

How were routes to the nearest ATM calculated?

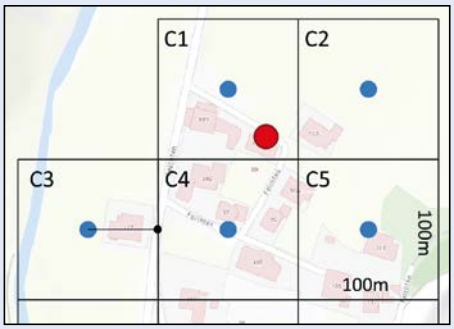
Route calculations are based on a 100x100 m geographical grid of Austria. Of the resulting number of grid cells, 580,995 grid cells were populated as of January 1, 2019. The center of each of these grid cells (blue dots) is used as the starting point for route calculations (see chart 1 – B1). More specifically, we measure the straight-line distance from the center of each grid cell to the nearest street, from where the routes to the three nearest ATMs (red dots) are calculated.

In grid cell C3, for example, the closest street is the one to the right. The straight-line distance from the center of the grid cell to the closest street is indicated by the black line. On average, straight-line distances to the closest street are rather small, except for a few outliers. Across all populated grid cells, the average (median) straight-line distance is 30 m (24 m). For 1.3% of grid cells, the straight-line distance is above 100 m, for 0.2% it is larger than 500 m. The maximum straight-line distance comes to 3.5 km. While the straight-line distances are included in the results for the shortest route, they are not included in the results for the fastest route (due to missing information on appropriate average speeds).

The route calculations are based on a number of assumptions regarding the two modes of transport:

Chart 1 B1

Minimum distance from starting point to nearest street



Source: Statistik Austria – data.statistik.gv.at. Map tiles© basemap.at.

- ***By car:*** *The reported travel times by car reflect pure driving times without accounting for the time needed to get to the car or find a parking spot. We take into account speed limits, one-way streets and turning restrictions; however, driving bans, e.g. in pedestrian zones, are ignored. Thus, average distances and driving times are somewhat downward biased, in particular in urban areas. Moreover, different average speeds are assumed depending on the type of street and whether the route is in or out of town. For example, an average speed of 65 km/h is assumed for main federal roads outside of towns, while an average speed of 40 km/h is used for roads in towns. Table A2 in the annex provides the full set of travel speed assumptions.*
- ***On foot:*** *For the calculation of travel times on foot, we only consider actual walking routes (it is e.g. not possible to walk on motorways). We assume an average walking speed of 4 km/h.*

Shortest and fastest routes: *For each grid cell, we compute the shortest (distance) and fastest (travel time) routes for each of the two transport modes.*

- *Shortest route = minimum distance (by car, on foot)*
- *Fastest route = minimum travel time (by car, on foot)*

Chart 2 – B1 shows the minimum travel times per grid cell. Grid cell C3, for example, is located rather close to an ATM, i.e. within a travel time of 5 minutes. The more remote grid cell in the lower right corner (colored in dark red) is more than 15 minutes away.

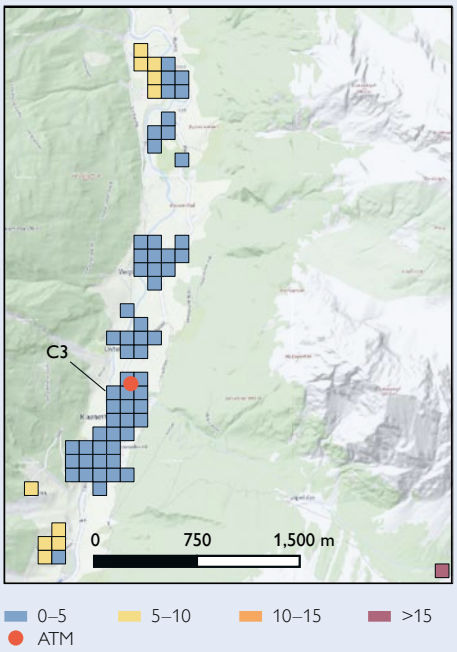
Imputation of empty grid cells: *For some grid cells, car routes cannot be calculated, as vehicle traffic is restricted for certain streets in these grid cells, mainly due to one-way street restrictions or turning restrictions in cities. For these cells, we impute the missing values by using the average of the values obtained for the nearest neighboring grid cells. This is done for 1,488 grid cells (0.26% of all grid cells).*

For some streets, e.g. in pedestrian zones, vehicle access is prohibited. If the starting point or end point of a route is located in a pedestrian zone, the corresponding car route cannot be determined. It is for this reason that pedestrian zones and driving bans are disregarded for the calculation of car routes.

Chart 2 B1

Minimum travel times to the nearest ATM by grid cells

Time to nearest ATM (walk or car) in min



Source: OeNB, Statistik Austria – data.statistik.gv.at. Map tiles© basemap.at.

Whether people choose to walk or to take the car to reach the next ATM depends on a number of factors, including personal preferences, impaired mobility, environmental conditions or whether or not they have small children. Moreover, people may stop at an ATM while out shopping. As these factors vary over time and as the corresponding information is unavailable to us, we cannot assign a preferred travel mode to specific geographical areas in Austria. Rather, we take an agnostic approach and compute the shortest route (in kilometers) to the nearest ATM irrespective of whether people choose to walk or go by car. In the same vein, we compute the fastest route (in minutes, see box 1).

For each grid cell, we furthermore collected data on the number of people who had their main residence in this cell as of January 1, 2019 (Source: Statistik Austria). This allows us to compute population-weighted summary statistics for different levels of agglomerations (such as municipalities or provinces). For example, the average distance to the nearest ATM for agglomeration j is computed as the weighted average of the shortest routes from all starting points i within this agglomeration, with the weights being proportional to the population residing at each starting point:

$$\text{Mean distance}_j = \sum_{i \in j} Shortest\ route_{i,j} * w_{i,j} \quad (1)$$

where i refers to the starting points in agglomeration j and w_{ij} denotes the population weights of grid cell i (population in grid cell i over the total population in agglomeration j). Similar computations were conducted for average (mean) travel times.

2 Average travel distances

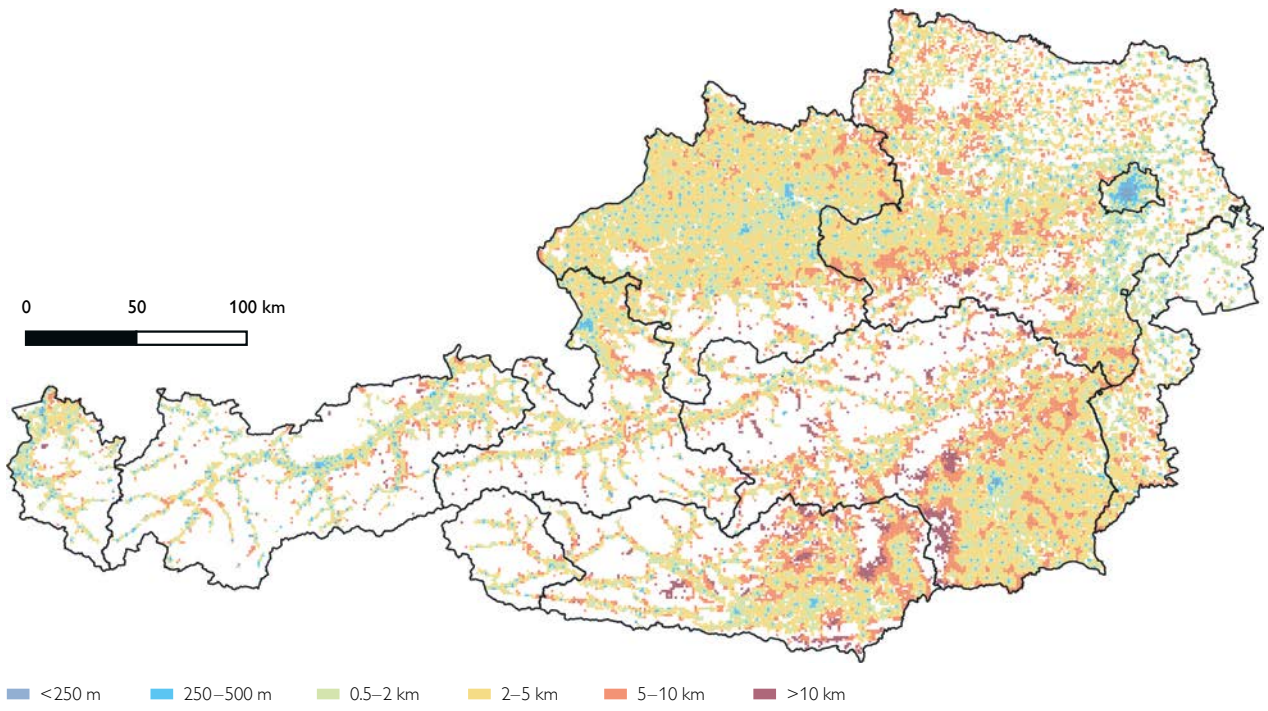
2.1 Average travel distances by grid cells

Chart 2 illustrates the average distances to the nearest ATM for all populated 1x1 km grid cells. The darker the color of a grid cell, the longer the average distance is to access the closest ATM. Most grid cells are colored in blue, light blue, green and orange, which means that the population living in these areas can reach the nearest ATM within distances of less than 5 km. Darker grid cells can be found in all of

Chart 2

Average distance to the nearest ATM by grid cells

Average distance to nearest ATM (1x1 km grid)



Source: Statistik Austria – data.statistik.gv.at, OeNB.

Note: The underlying data refer to a 1x1 km grid-cell level and were computed by averaging the results for the 100x100 m grid cells using population weights.

Austria's nine provinces, albeit at a higher frequency in Styria, Carinthia and Lower Austria.

These findings provide a first overview of how average distances vary across the country; yet, they provide relatively little information about which share of the population faces which distances. Many of the red grid cells, for example, are very sparsely populated. By calculating population-weighted average distances, these grid cells would contribute very little to the averages at the country or provincial level.

2.2 Travel distances and times to the nearest ATM

Table 1 summarizes average travel distances and times weighted by the total population of each grid cell. For Austrian residents, the average distance (fastest route) to the nearest ATM is 1.2 km. The median distance is 630 m, i.e. 50% of the Austrian population have to travel less far. In terms of travel time, we find that Austrians take 2.9 minutes on average to reach the nearest ATM, with the median value being 2.1 minutes. While the travel time calculations are based on realistic average travel

Table 1

Distance and travel time to the nearest ATM

	Mean	Minimum	P25	Median	P75	P90	P99
Distance (in km)	1.2	0.0	0.3	0.6	1.4	3.1	6.5
Travel time (in min)	2.9	0.0	1.1	2.1	3.7	6.0	12.2

Source: OeNB.

Note: Results are population-weighted. Total population: 8,858,775. "P25" denotes the 25th percentile, which means that 25% of the population have to travel less far or less long than the value specified.

Table 2

Distance to the nearest ATM by municipality size and province

	Mean	P25	Median	P75	P90	P99
	km					
by municipality size (number of inhabitants)						
up to 2000	2.1	0.6	1.4	3.1	4.7	8.6
2,001–3,000	1.7	0.6	1.1	2.5	4.1	7.0
3,001–5,000	1.6	0.5	1.0	2.2	3.7	6.8
5,001–10,000	1.3	0.5	0.9	1.7	3.1	6.2
10,001–50,000	1.0	0.4	0.6	1.1	2.0	6.0
50,001–1 million	0.6	0.3	0.4	0.7	1.1	2.8
>1 million (Vienna)	0.4	0.2	0.3	0.5	0.8	1.8
by province						
Burgenland	1.4	0.5	0.8	1.6	3.7	6.6
Carinthia	1.8	0.5	1.0	2.5	4.3	9.5
Lower Austria	1.5	0.5	0.9	2.0	3.8	7.1
Upper Austria	1.3	0.4	0.8	1.8	3.2	5.5
Salzburg	1.2	0.4	0.7	1.5	2.8	5.9
Styria	1.6	0.4	0.9	2.3	4.1	8.0
Tyrol	1.0	0.3	0.6	1.2	2.3	5.7
Vorarlberg	0.9	0.4	0.7	1.0	1.7	4.5
Vienna	0.4	0.2	0.3	0.5	0.8	1.8

Source: OeNB.

Note: Results are population-weighted. Total population: 8,858,775. "P25" denotes the 25th percentile, which means that 25% of the population have to travel less far or less long than the value specified.

speeds, the time it takes to get to the car or find a parking spot is not taken into account. This is likely to particularly affect the results for cities, where going by car turns out to be almost always faster than going on foot, which does not always reflect reality.

The results indicate that the domestic ATM network seems to be relatively dense, on average, across Austria. This is supported by the finding that 99% of the Austrian population live within a distance of 6.5 km or a travel time of 12.2 minutes from the nearest ATM.

Table 2 shows average distances to the nearest ATM broken down by municipality size categories and provinces. Corresponding travel times are summarized in table A2 in the annex. Travel distances and times decrease with the size of the municipalities, but even for smaller municipalities with less than 2,000 inhabitants the mean distance seems to be relatively modest (2.1 km). Substantial differences can be observed between small municipalities and Vienna, where 50% of residents live within less than 300 m of the nearest ATM.

When using the classification system for urban and rural areas provided by Statistics Austria, the mean distances range from 0.5 km in large urban centers to 1 km in regional centers, 1.4 km in rural areas surrounding centers and 1.8 km in rural areas.

When examining the population's access to cash, it is legitimate to ask whether one should also consider bank branches as a source of cash withdrawals. To account for this, we calculated travel distances and times to the closest ATMs or the closest bank branches. Our findings suggest that the corresponding averages are very similar. Specifically, the difference between the average travel distance to an ATM and the average travel distance to an ATM or bank branch is negligible.[8] This finding is in line with our expectations, as many bank branches have an ATM and as most bank-operated ATMs are located inside, or adjacent to, bank branches.

As an alternative to measuring average distances, one can also ask about which share of the population lives within a specific travel distance or time from the nearest ATM. The corresponding results are summarized in table 3. About 18% of Austrians have to travel less than 250 m to withdraw cash from an ATM; 66% less than 1 km. As many as 97.1% of Austrians (or 8,598,305 residents) live within 5 km of an ATM; in terms of travel time, 85% take less than 5 minutes to reach the closest ATM.

Table 3

Distance and travel time to nearest ATM

	Distance							Time			
	<100 m	<250 m	<500 m	<1 km	<2 km	<5 km	<10 km	<2 min	<5 min	<10 min	<15 min
Cumulative share of population	3.9	17.9	41.2	66.3	82.4	97.1	99.9	47.6	85.0	97.8	99.5
Number of inhabitants	341,127	1,587,914	3,653,691	5,870,139	7,296,667	8,598,305	8,846,475	4,218,739	7,533,353	8,667,441	8,817,924

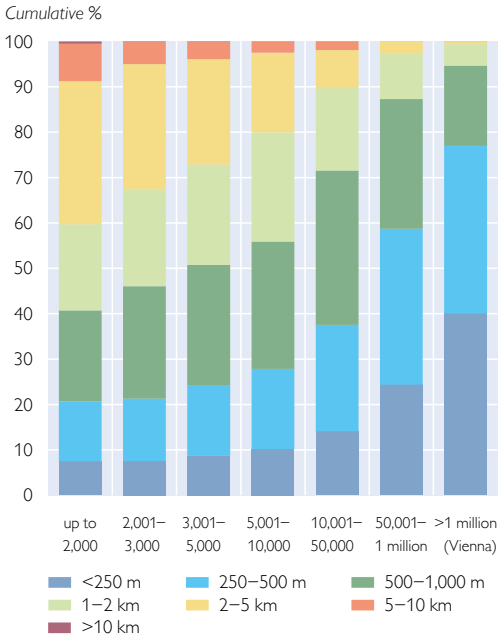
Source: OeNB.

Note: Results are population-weighted. Total population: 8,858,775.

[8] *Mean distances differ by about 30 m and median distances by some 14 m, while P90 values differ by 90 m and P99 values by about 160 m. The fact that average differences are rather small does not rule out that in some areas larger differences may be observed. For more details on the Austrian bank branch network from a spatial perspective, see Stix (2020).*

Chart 3

Distance to the nearest ATM by municipality size

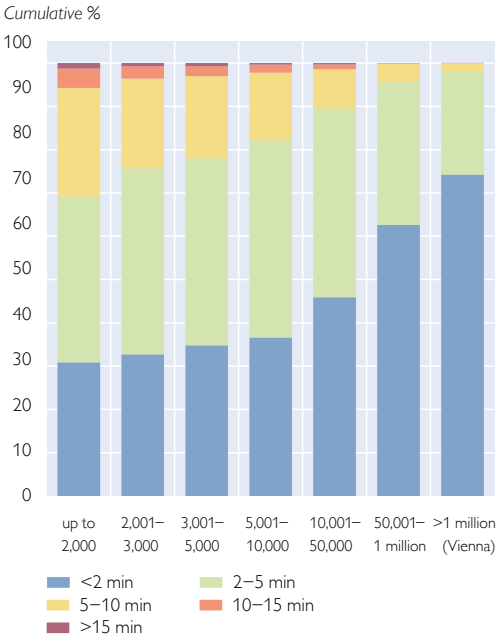


Source: OeNB.

Note: The chart shows how far which share of the population has to travel to reach the nearest ATM, broken down by municipality size categories, i.e. number of inhabitants.

Chart 4

Travel time to the nearest ATM by municipality size



Source: OeNB.

Note: The chart shows how long which share of the population has to travel to reach the nearest ATM, broken down by municipality size categories, i.e. number of inhabitants.

Chart 3 shows how the share of the population that lives within a certain distance of an ATM varies according to the municipality size categories. The blue bars represent the share of residents located within less than 250 m of an ATM, which stands at about 9%, or slightly below, in municipalities with up to 10,000 inhabitants. This share increases to about 25% in larger cities with more than 50,000 inhabitants and to 40% in Vienna. 95% of residents in Vienna and 41% of residents in small municipalities with less than 2,000 inhabitants live within a 1 km distance to the closest ATM (sum of the dark blue, blue and green bars).

Chart 4 displays the share of the population that lives within a certain travel time to the next ATM, again broken down by municipality size categories. As mentioned earlier, travel times by car only include actual driving times and may therefore be perceived as overly optimistic in cities in particular. As a case in point, we find that for 74% of residents in Vienna the nearest ATM is less than 2 minutes away. The more interesting finding, however, that we observe from chart 4 is that the majority of the population lives within 5 minutes of the closest ATM.[9] It is only in smaller municipalities with less than 10,000 inhabitants that a considerable share of people has to travel more than 5 minutes.

In general, it is difficult and highly subjective to define a threshold value that separates satisfactory from unsatisfactory ATM access, given differences in e.g. people's preferences, health, mobility and access to means of transport. In the

[9] *In the vast majority of cases, the shortest travel time refers to the one by car.*

Table 4

Number of inhabitants traveling more than 5 km or 10 minutes by municipality size

	Inhabitants	Inhabitants traveling more than 5 km		Inhabitants traveling more than 10 min	
	Number	*Number*	*%*	*Number*	*%*
Austria	8,858,775	260,470	2.9	191,334	2.2
by municipality size (number of inhabitants)					
up to 2000	1,333,610	114,857	8.6	76,584	5.7
2,001–3,000	927,388	45,163	4.9	33,109	3.6
3,001–5,000	1,209,729	47,141	3.9	36,522	3.0
5,001–10,000	1,146,491	28,362	2.5	25,265	2.2
10,001–50,000	1,283,163	24,583	1.9	17,869	1.4
50,001–1 million	1,060,888	356	0.0	1,083	0.1
>1 million (Vienna)	1,897,506	8	0.0	902	0.0

Source: OeNB.

Note: Results are population-weighted. Total population: 8,858,775.

following, we nevertheless focus on such a threshold value, namely on a 5 km distance, or alternatively, a 10 minute travel time.[10]

Overall, about 2.9% of the Austrian population (or 260,470 residents) are more than 5 km away from the nearest ATM, and 2.2% (or 191,334 residents) have to travel more than 10 minutes (table 4). These figures vary considerably across municipality size categories. In villages with less than 2,000 inhabitants, 8.6% of residents do not have access to an ATM within a 5 km distance. In larger cities with more than 50,000 inhabitants, the corresponding share is close to zero. Since long travel distances mainly concern residents of smaller municipalities, we have furthermore taken a closer look at municipalities with less than 1,000 inhabitants (not shown in table 4). There, about 14.9% of residents have to travel more than 5 km to reach the next ATM. When analyzing these results based on Statistics Austria's classification system, we find that 6.1% of residents in rural areas have a travel distance of more than 5 km. This share comes to 4.1% in rural areas surrounding centers.[11]

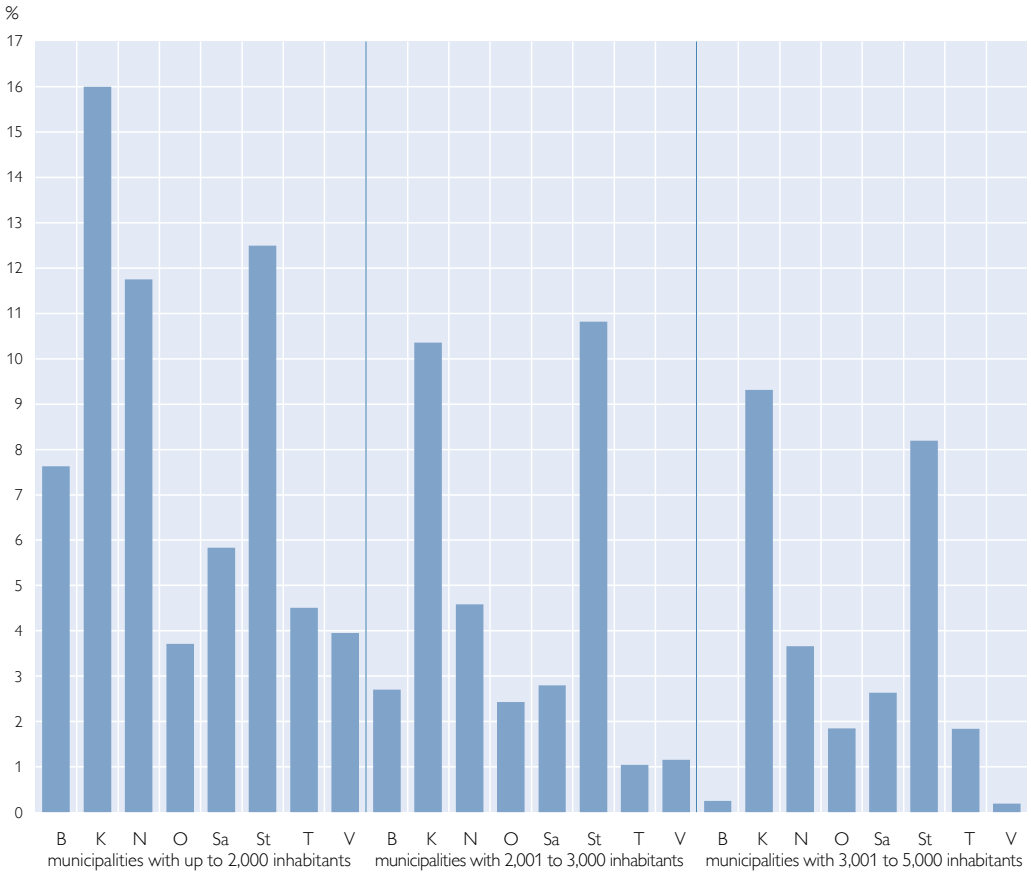
Marked differences can also be seen across Austria's nine provinces. However, a direct comparison between provinces might not be very informative due to e.g. differences in the size distribution of municipalities, their settlement structure or topology. To achieve a more meaningful comparison, we therefore look at specific municipality size categories and can thus control for one (but not for all) of the salient differences. Chart 5 depicts the share of the population that lives at an average distance of more than 5 km from the next ATM. In municipalities with less than 2,000 inhabitants located in Carinthia (K), Styria (St) and Lower Austria (N), more than 10% of residents have to travel more than 5 km. In Burgenland (B) and Salzburg (Sa), this share ranges between 5% and 10%. For municipalities with more than 2,000 and less than 3,000 inhabitants located in Carinthia and Styria,

[10] *NFPS (2017), for example, also applies a 5 km threshold value.*

[11] *Again, one might wonder how these numbers will change if we consider distances to the closest ATMs or the closest bank branches. The corresponding results show that the absolute number of people who live at a distance of more than 5 km decreases slightly to 240,525 or 2.7% of the population. In municipalities with less than 2,000 inhabitants, this share increases to 7.6%. Thus, the inclusion of bank branches does not affect the overall pattern of results qualitatively.*

Chart 5

Share of population traveling more than 5 km to the nearest ATM by province and municipality size



Source: OeNB.

Note: B = Burgenland; K = Carinthia; N = Lower Austria; O = Upper Austria; Sa = Salzburg; St = Styria; T = Tyrol; V = Vorarlberg.

the share of residents who do not have access to an ATM within a 5 km radius again comes to above 10%. By and large, these results mirror those shown in chart 2.

2.3 Density of Austria's ATM network

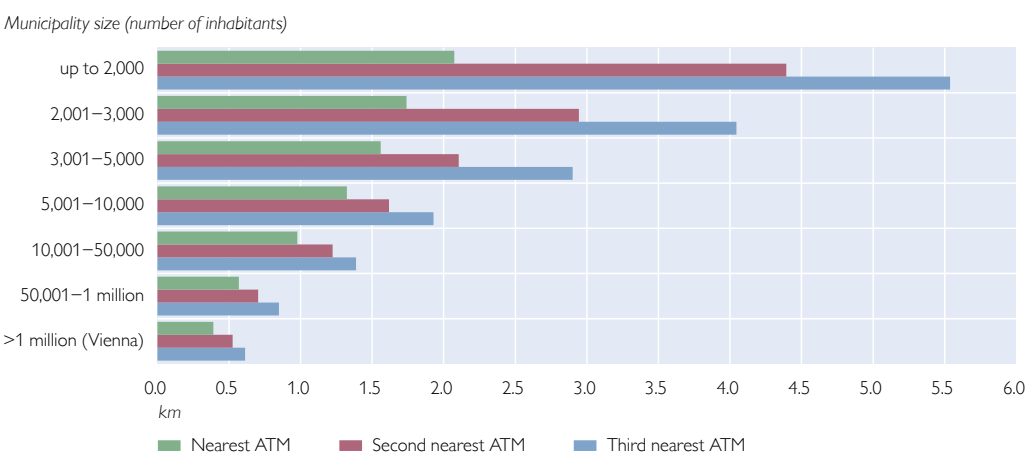
The density of the domestic ATM network is not only determined by the distance to the nearest ATM but also by the proximity of other ATMs. The latter is relevant if consumers have to find another ATM in case the nearest ATM is out of order or closed.

Chart 6 depicts the average distance to the three nearest ATMs broken down by municipality size categories.[12] Since average travel distances and times to the next ATM were found to be rather modest, we would also expect the distances to other ATMs located in the area to be short. This is true for towns with more than 10,000 inhabitants. In Vienna, for example, the average distance to the nearest ATM is 390 m. The second nearest ATM is located within 525 m on average, the

[12] *Note that the second nearest ATM can be at the same location than the nearest ATM. For example, this could be the case if several ATMs are located in one bank branch.*

Chart 6

Average distance to the three nearest ATMs by municipality size



Source: OeNB.

Note: The chart shows the average distance to the three nearest ATMs. Municipality size refers to the number of inhabitants.

third nearest within 612 m. Thus, the first and the second ATM are located just 136 m on average from one another, the first and the third ATM 222 m.

Moreover, chart 6 shows that the average distance between the first and the second ATM increases with the distance to the nearest ATM. In municipalities with less than 2,000 inhabitants, the average distance between the first and the second ATM comes to 2.3 km, meaning that the second closest ATM can often be found in the neighboring municipality. In municipalities with more than 3,000 inhabitants, the average distance between the nearest and the second nearest ATM is less than 550 m, which implies that the next ATM is usually located in the same municipality.

3 ATM access by municipalities

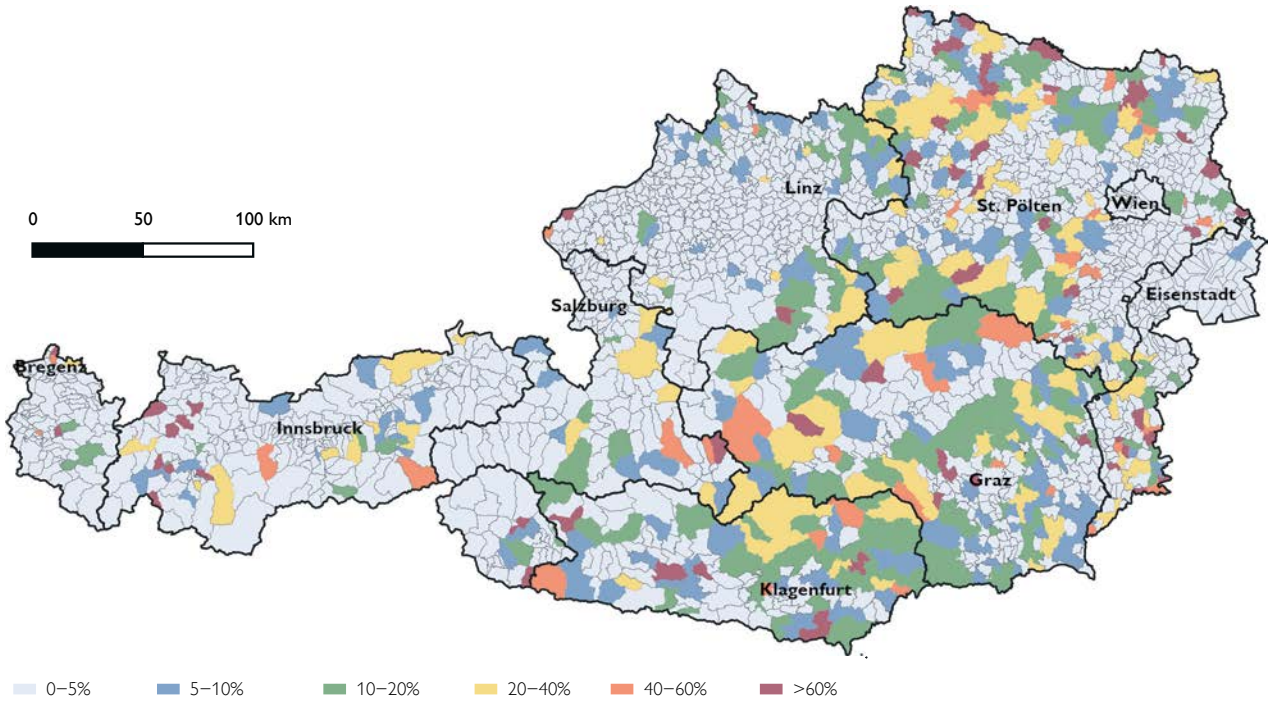
Up until now, we focused on municipality size categories and provinces to describe access to ATMs in Austria. In the following, we provide additional evidence at the municipality level by calculating key access indicators for each of the 2,096 municipalities in Austria.

For each municipality, chart 7 indicates the share of the population that has to travel more than 5 km to reach the nearest ATM. A corresponding map for travel times can be found in chart A1 in the annex. In line with chart 2, chart 7 shows that the ATM network seems to be relatively dense in many parts of the country, which is exemplified by a small share of residents who live more than 5 km away from the next ATM. However, there are also municipalities where ATM access seems to be more restricted. In 69 municipalities, for example, more than 60% of inhabitants have to travel more than 5 km. For an additional 39 municipalities, this share ranges between 40% and 60% of inhabitants. In other words, in 108 municipalities the share of residents who have a travel distance of more than 5 km stands at 40% or more. All of these 108 municipalities are classified as "predominantly rural" according to the classification of municipalities provided by Statistics Austria. They are rather small in terms of population size, with an average number of inhabitants of 836. Consequently, the absolute number of inhabitants who live at a distance of

Chart 7

Share of population traveling more than 5 km to the nearest ATM by municipality

Share of population in %



Source: Statistik Austria – data.statistik.gv.at, OeNB.

Note: Municipality borders as of 2019.

more than 5 km from the next ATM is low (e.g. 50% of 836). This is relevant if we consider the questions of whether access to cash can be improved by putting up an additional ATM and whether the additional ATM can be operated economically. These issues may be debatable for municipalities that consist of several clusters of smaller agglomerations which are spread out geographically. While answering these questions is beyond the scope of this paper, it would certainly be interesting to analyze in more detail the economic, social and topological characteristics of the municipalities with a more limited ATM access. The detailed results for Austria's municipalities provided in this paper may be used as a basis for such analyses.

3.1 Travel distances in municipalities with or without ATM access

In the following, we explore whether the availability of an ATM in a given municipality affects average travel distances. Our data reveal that out of Austria's 2,096 municipalities,[13] 316 municipalities (or 15%) are not equipped with an ATM. Given the close proximity of municipalities in certain areas of Austria, this does not necessarily mean that ATMs are far away. Table 5 shows that the average distance to the next ATM is 3.8 km in municipalities without an ATM compared to an average distance of 1.6 km in municipalities with an ATM. Similar results are obtained for the median

[13] *As of January 1, 2019.*

Table 5

Distance to the nearest ATM by municipalities with or without ATM access

	Municipality with ATM access	Municipality without ATM access	Difference
	(1)	(2)	(2)−(1)
(1) Average distance (in km)	1.6	3.8	2.2
(2) Median distance (in km)	1.0	3.6	2.6
(3) % of population traveling more than 5 km	3.0	25.8	22.8

Source: OeNB.

Note: The table shows how the distance to the nearest ATM varies between municipalities equipped with an ATM and those not equipped with an ATM. For comparison purposes, the results only refer to municipalities with less than 3,000 inhabitants. Results are population-weighted.

distances and the share of the population that has to travel more than 5 km, which is 23 percentage points higher than the share in municipalities with an ATM.

It is important to note that when comparing travel distances in municipalities with or without an ATM, one should also take into account other characteristics (e.g. population densities) of municipalities. To partly account for this, we also conducted conditional analyses in which we controlled for fixed effects for province x municipality size categories as well as for fixed effects for the urban/rural classification system provided by Statistics Austria. Quantitatively, the results are very similar, which suggests that the results described above are not driven by large selection effects.

4 A comparison with straight-line distances

From a methodological perspective, it is of interest to evaluate how actual road network distances compare with straight-line (Euclidean or "as the crow flies") distances which are considerably easier to compute and which represent an alternative and computationally efficient way of assessing ATM access. We expect the differences between the two distance types to be small when the ATM network is dense, i.e. when the distance to an ATM is low. This is typically the case in more densely populated areas.

To assess the differences between the two distance types, we computed the straight-line distances to the nearest ATMs. This allows us to determine coverage ratios, such as the share of the population that resides within a certain radius of an ATM. The results show that 75.1% of inhabitants live within a 1 km radius and 99.3% within a 5 km radius of an ATM (table 6). In villages with less than 2,000 inhabitants, the share of people living within a 5 km radius is slightly lower but still impressive (97.6%).

Three comments are warranted regarding these results. First, the straight-line distances can be compared internationally, at least roughly. NFPS (2017) reports, for example, that in 2017 99.7% of the population in the Netherlands resided within a radius of 5 km from an ATM, which is very similar to the ATM coverage found for Austria. Interestingly, in 2019, Austria had 3.5 times as many ATMs per million inhabitants as the Netherlands.[14] This suggests that unadjusted statistics,

[14] *See https://sdw.ecb.europa.eu/browse.do?node=9691546; entry "Number of ATMs – provided by resident PSPs – located in the reporting country – per million inhabitants;" Austria: 1,009; Netherlands: 288.*

Table 6

Share of population living within a straight-line distance of 1 km or 5 km of an ATM

	Within 1 km of an ATM	Within 5 km of an ATM
	%	
Austria	75.1	99.3
by municipality size (number of inhabitants)		
up to 2000	49.4	97.6
2,001–3,000	56.1	99.2
3,001–5,000	61.1	99.3
5,001–10,000	68.6	99.7
10,001–50,000	83.9	99.4
50,001–1 million	94.5	100.0
>1 million (Vienna)	98.3	100.0

Source: OeNB.

e.g. on the number of ATMs per capita, could be misleading (at least with respect to assessing ATM access), as factors, such as topology or population density, may bias comparisons between countries.

Second, the bias induced by straight-line distances can be substantial. Table 4 showed that 8.6% of the population of villages with less than 2,000 inhabitants have to travel more than 5 km to reach the nearest ATM. In contrast, the results based on straight-line distances suggest that this share is as small as 2.4%.

Third, box 2 presents a brief assessment of how straight-line distances differ from road network distances in the context of this study. Straight-line distances yield rather accurate results for average or median travel distances (table B2). For smaller travel distances, differences between the two distance types are not substantive and almost negligible (in absolute terms). However, as expected, the absolute bias induced by straight-line distances can become substantial for larger travel distances. For a straight-line distance of 10 km, the corresponding actual road network distance is estimated to be 4.5 km longer on average (chart B2). Overall, these results confirm the presumption that straight-line distances are reasonably appropriate for measuring smaller travel distances, i.e. for densely populated areas. However, when the goal is to identify areas with limited ATM coverage, straight-line distances may be less reliable.

Box 2

Comparing distance types

This box provides a brief comparison between straight-line distances and road network distances. Specifically, table B2 shows the differences between the summary statistics based on the two distance types broken down by municipality size categories.

At 0.3 km (0.2 km), the mean (median) difference between the two approaches is very modest (see table B2). This reflects the fact that the underlying travel distances were not large. However, the differences between the two distance types increase with the average straight-line distance to the nearest ATM. One way to illustrate this is to plot straight-line distances against the differences between road network distances and straight-line distances. We can then observe from chart 1 B2 that the absolute bias increases with the straight-line distances. For a straight-line distance of 0.5 km, for example, the predicted road network distance is 0.2 km longer, while the predicted bias for a straight-line distance of 10 km comes to about 4.5 km or 45%.

Table B2

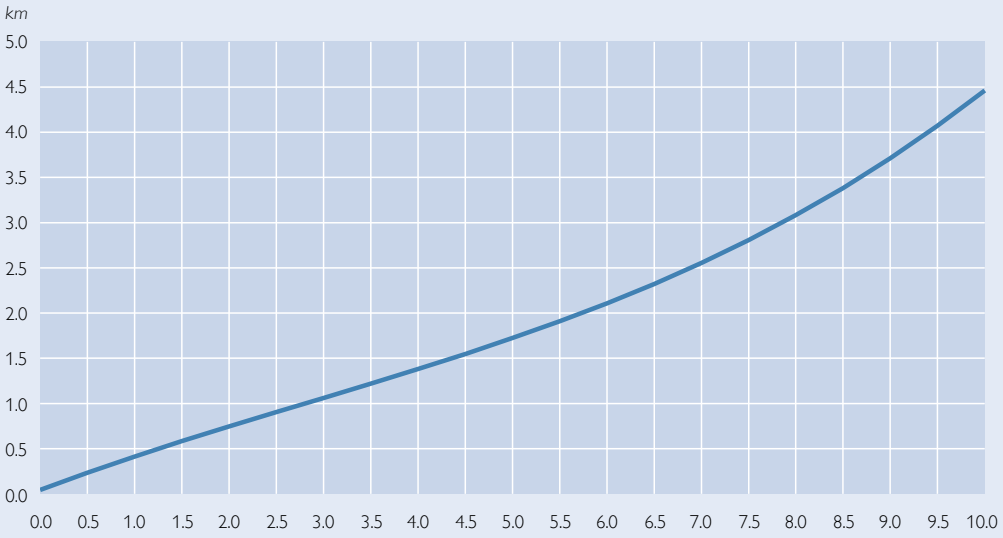
Difference between road network distances and straight-line distances

	Mean	Median	P95	P99
	km			
Austria	0.3	0.2	1.3	2.7
by municipality size (number of inhabitants)				
up tp 2,000	0.6	0.3	2.1	3.9
2,001–3,000	0.5	0.3	1.7	3.3
3,001–5,000	0.4	0.2	1.5	3.0
5,001–10,000	0.4	0.2	1.3	2.5
10,001–50,000	0.3	0.2	1.0	2.1
50,001–1 million	0.2	0.1	0.6	1.1
>1 million (Vienna)	0.1	0.1	0.4	0.8

Source: OeNB.

Chart 1 B2

Difference between road network distances and straight-line distances



Source: OeNB.

Note: Chart 1 B2 shows the difference between road network distances and straight-line distances (in km, y-axis) as a function of straight-line distances (x-axis). The results reflect predictions from an OLS regression in which the difference (in levels) is regressed on a third-degree polynomial of straight-line distance.

5 Summary and conclusions

This paper presents a first – and certainly incomplete – assessment of the Austrian ATM network from a spatial perspective. It provides detailed results on travel distances and times to the nearest ATMs for both small geographical areas and Austria's 2,096 municipalities. In doing so, this paper aims to contribute to the debate on access to cash and to provide a benchmark for international comparisons and for evaluating changes to the domestic ATM network.

There are two broader conclusions emerging from this study. First, although normative judgments about the quality of ATM access are problematic – owing to a lack of historical values and appropriate theoretical frameworks – our results suggest that travel distances to ATMs are, on average, reasonable across the country and its population. This assessment holds true for both small and large municipalities and is further supported by an OeNB survey which shows that 96% of Austrians consider it "very easy" or "fairly easy" to access ATM services. Second, our fine-grained geographical approach allows us to identify regions with higher shares of the population that have to travel larger distances to reach an ATM. Typically, these municipalities are rather small in population size (about 840 inhabitants on average).

Several directions may be pursued to extend our analysis. First, in addition to ATMs, further studies may also take into account cash-back services provided by retailers. Second, in contrast to focusing on only one aspect of accessibility (i.e. the physical distance to the closest ATM), further studies may consider more aspects. This could be done by combining the results obtained from this study with geographically fine-grained data on the socioeconomic composition of the population and on the structural characteristics of specific regions (i.e. by accounting for e.g. the proportion of older people in the population, the availability of public transport or the availability of high-speed internet, see Evans et al., 2020; Náñez Alonso et al., 2020). Such analyses could thus shed light on the demand for ATMs in areas where people have to travel larger distances and look into how ATM access in these areas may be improved. We hope that the results presented in this paper provide a useful basis for such analyses.

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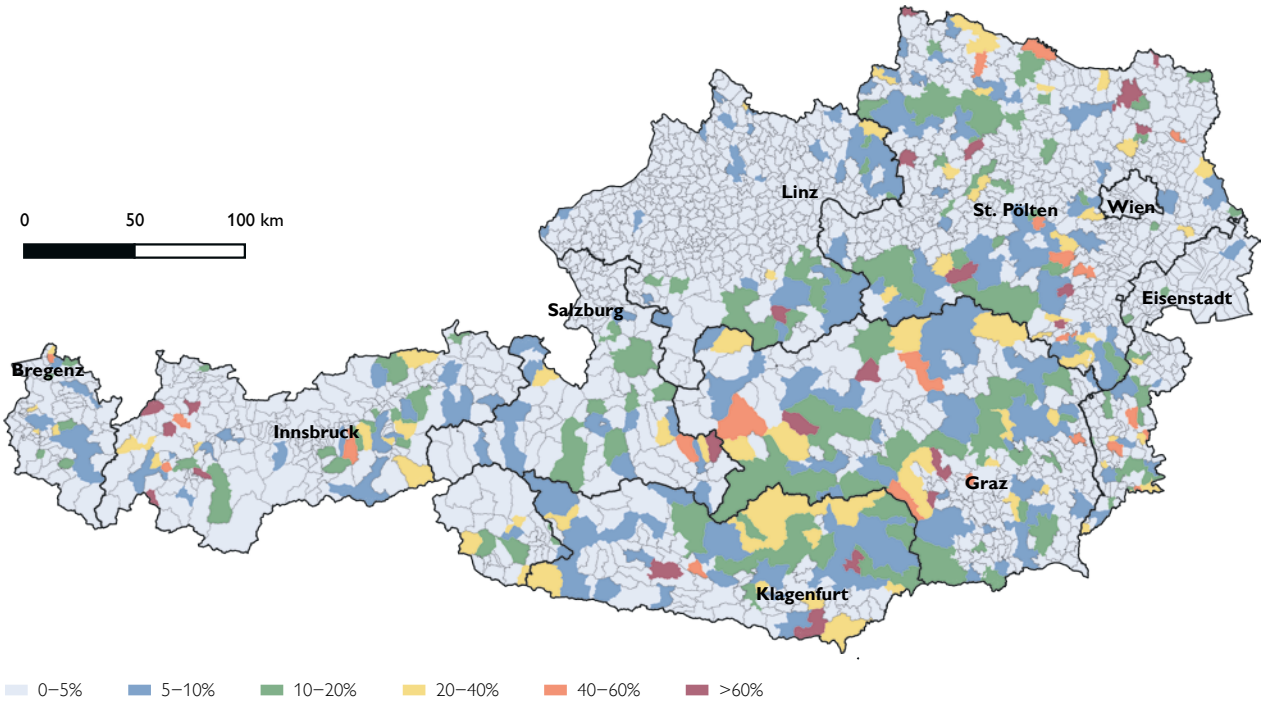
Annex

Chart A1

Share of population traveling more than 10 minutes to the nearest ATM by municipality

Share of population in %



Source: Statistik Austria – data.statistik.gv.at, OeNB.

Note: Municipality borders as of 2019.

Table A1

Overview of average travel speed assumptions for different street types

	Average speed in town	Average speed out of town
Street type	*km/h*	
Motorway	100	100
Main federal road	40	65
Federal road	40	55
State road	40	55
Connection road	25	45
Thoroughfare	25	45
Local street	15	30
Small street	10	15
Alley	10	10

Source: WIGeoGIS Softwareerstellungs- und Handelsgesellschaft m.b.H.

Table A2

Travel time to the nearest ATM by municipality size and province

	Mean	P25	Median	P75	P90	P99
	min					
by municipality size (number of inhabitans)						
up to 2000	4.1	1.7	3.2	5.7	8.5	16.0
2,001–3,000	3.7	1.6	2.9	4.9	7.4	13.8
3,001–5,000	3.5	1.5	2.8	4.7	7.0	13.8
5,001–10,000	3.2	1.5	2.6	4.3	6.3	12.2
10,001–50,000	2.7	1.2	2.1	3.4	5.1	11.0
50,001–1 million	1.9	0.9	1.6	2.6	3.8	7.3
>1 million (Vienna)	1.6	0.7	1.3	2.0	3.1	5.9
by province						
Burgenland	3.3	1.5	2.6	4.4	6.9	11.4
Carinthia	3.9	1.6	2.9	5.1	8.2	18.3
Lower Austria	3.4	1.5	2.6	4.5	7.0	12.3
Upper Austria	3.0	1.4	2.4	4.1	5.9	10.0
Salzburg	2.9	1.2	2.2	3.9	5.8	12.7
Styria	3.6	1.4	2.7	4.8	7.6	15.8
Tyrol	2.7	1.1	2.0	3.3	5.3	12.6
Vorarlberg	2.4	1.2	2.0	3.1	4.6	10.1
Vienna	1.6	0.7	1.3	2.0	3.1	5.9

Source: OeNB.

Note: Results are population-weighted. Total population: 8,858,775. "P25" denotes the 25th percentile, which means that 25% of the population have to travel less long than the value specified.

A new long-run consumer price index for Austria (1800–2018)

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Indices of the development of consumer prices in Vienna or Austria date back to the year 1800. This article presents the first systematically documented and chained consumer price index for Austria spanning the period from 1800 to today. The selection of the series and the problems that arise in chaining them through wars, currency reforms and changes in index methodology are discussed in detail. We also propose adjustments to the constituent series which, compared to previously used series, yield significantly higher inflation rates during the Napoleonic Wars and a more pronounced deflation after their end, as well as a steeper price increase in 1948 and 1949. Finally, this article will examine the suitability of consumer price indices for the conversion of historical prices. This article includes a table containing annual index values. Monthly series are available online.

JEL classification: C82, E31, N13, N14
Keywords: cost-of-living index, consumer price index, Austria, historic reconstruction, inflation

Price indices are key indicators of national economic activity. Long-run price indices are also indispensable in deflating micro- and macroeconomic series to make them more comparable over time. And they make it possible to compute current equivalents of historical prices, which is a recurring issue. Price indices come in different shapes and forms, including wholesale price indices, retail or consumer price indices, export or import price indices as well as price deflators for GDP and its major components. This article deals with the prices paid by end users.

Background: The case for recalculating Austria's long-run consumer price index

In Austria, official surveys of prices were introduced in the 18th century, but the construction of indices measuring the change in the prices of selected goods did not commence until much later, and the systematic compilation of consumer price indices was not tackled until after the end of World War I (Mühlpeck et al., 1979a). The first consumer price indices were calculated back to 1914, the last year of peace before World War I, resulting in the continuous availability of index time series from 1914 onward, albeit combining different methodologies (ÖStZ, 1997).[3] Mühlpeck et al. (1979a, 1979b) later broadened the picture by making a back-calculation of

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[2] *This article is the English version of a German paper entitled "Ein neuer langer Verbraucherpreisindex für Österreich, 1800–2018," as published in January 2020 in the German social and economic journal VSWG – Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte 107(1), pp. 47–85. The English version benefited from an initial review by Markus Lampe, prior to submission to the journal, and from the blind peer review process preceding publication in the journal. We also wish to acknowledge the support received from the journal's editor, Mark Spoerer, and his further comments. – Cut-off date for data: May 15, 2019.*

[3] *ÖStZ = Österreichisches Statistisches Zentralamt (Austrian Central Statistical Office), the precursor of today's Statistics Austria.*

consumer price indices for the period from 1800 to 1914 for the territory of the Republic of Austria as it exists today.

These efforts made it possible to chain-link existing indices and track price changes in Austria from 1800 onward – a possibility that Mühlpeck et al. (1979a) highlighted by calculating the 1979 schilling value of the equestrian statues erected between 1858 and 1865 in Heldenplatz square in Vienna.[4]

While guidelines and examples for creating such chained indices have also been published by the Austrian Central Statistical Office (ÖStZ and WIFO, 1959; ÖStZ, 1998), the actual construction of continuous series has so far been left up to data users. Thus, there are still no official index series for the period covering the two world wars.

The only chained index for Austria ever published, to our knowledge, was developed by Butschek (1996, 2011). Yet, this index comes without a documentation and entails several methodological problems, which we outline below and to which we suggest possible solutions. The result of our exercise is a new long-run price index for Austria that chain-links indices for individual subperiods. It should be made clear at the outset, however, that we do not provide an official index; much rather, we offer a tool for conducting historical research and for illustrating the volatility of the currency's purchasing power as experienced by average households.

Compared with Butschek (1996, 2011), we left most annual inflation rates unaltered for the new index. We recalculated the index values for the periods from 1800 to 1820 and from 1945 to 1948. The ensuing adjustments are substantial, though, causing the price level to rise by as much as 20.15 million times (rather than 1.25 million times) during the 218 years from 1800 to 2018. As a consequence, the average annual increase in prices for this period rises from 6.65% to 8.02%. These averages essentially reflect the impact of three periods with steep price increases: the period during and after the Napoleonic Wars (until 1820), the First World War including the post-war period until 1925, and the period after the Second World War until 1952. The remaining 180 years – the periods between 1820 and 1914, between 1925 and 1945, and after 1952 – yield an average annual increase in prices of 1.49%, whereas the 38 high-inflation years come with an average annual increase of 45.16%. In other words, the considerable surge in prices since 1800 is predominantly attributable to turbulences that occurred in just one-sixth of the period under review. The median inflation rate of 2.02% for the years from 1801 to 2018 likewise shows that price changes were predominantly moderate.[5] (See chart 1 in section 2 for an illustration of these developments.) The recalculation we undertook may also impact other economic indicators which use the consumer price index (CPI) for deflating, to the extent that such time series have been reconstructed or exist at all for the relevant time periods. Cases in point are time series

[4] *For more details on converting historical prices and other more suitable examples concerning the development of consumer prices (after all, average households rarely acquire equestrian statues), see section 4.*

[5] *From 1800 to 1820, prices increased by a factor of 10.53 (an average annual price increase of 12.49%); from 1820 to 1914 by 1.67 (0.54%); from 1914 to 1925 by 15,043.03 (139.75%); from 1925 to 1945 by 1.12 (0.58%); from 1945 to 1952 by 8.93 (36.72%); from 1952 to 2018 by 7.62 (3.13%). From 1801 to 2018, the annual inflation rate was positive 166 times, negative 51 times, and there was one year with zero inflation (1937). In terms of ranges, the annual inflation rate exceeded 2% 110 times, 10% 28 times and 100% 7 times, whereas it dropped below –2% 29 times and below –10% 5 times (with all 5 incidents falling into the period from 1812 to 1823). (Average annual price increases based on geometric means.)*

for nominal wages, nominal interest rates and economic output for the period from 1800 to 1820. Finally, the GDP figures for the period from 1945 to 1948 are not based on the CPI used by Butschek (1996, 2011) but on a dedicated GDP deflator; therefore these figures remain unaffected by the revision (Kausel et al., 1965).

This article is structured as follows. In section 1, we introduce the existing indices for the different subperiods. Section 2 explains how these indices can be chained together, addressing underlying considerations, and illustrates the differences between the new chained index we created and the chained index developed by Butschek (1996, 2011). Section 3 discusses to what extent indices covering only the city of Vienna and fewer goods and prices than today's CPI can reflect price developments for all of Austria. Section 4 examines the recurring issue of converting historical prices into current prices. In this respect it should be stressed that the index presented here does not lend itself for directly converting historical prices into current prices, because the period under review was characterized by seven different currencies in circulation and because all exchange rates between any two successive currencies need to be taken into consideration for the purpose of conversion.[6] This technical

Table 1

Annual indices used and the price of silver (1800–1914)

Term used here	Term used in source	Data available for	Data used for	Base year	Note	Source	Circulating currency
All-items index[1]	Index der Verbraucherpreise 1800–1914	1800–1914	1820–1914	1914 = 100	Here we used the index labeled "Generalindex" by Mühlpeck et al., which is a Vienna-only index for reasons of data availability. (For more information, see main text.)	Mühlpeck et al. (1979a, 1979b)	Florins, crown
Silver price in paper florins	Silberkurs in fl Bankozettel	1800–1811	1800–1811	–	Price of 100 silver florins in the circulating florin currency; the currency reform of 1811 introduced new (Vienna standard) florins worth 5 paper florins	Pribram (1938)	Paper florins (Bancozettel)
Silver price in (Vienna standard) florins	Silberkurs in fl Wiener Währung	1811–beyond 1820	1812–1820	–	Price of 100 silver florins in the circulating florin currency; the currency reform of 1811 introduced new (Vienna standard) florins worth 5 paper florins	Pribram (1938)	(Vienna standard) florins (silver price drops to one-fifth ceteris paribus)
Index-based silver price	–	–	1800–1820	–	Calculated from silver prices published by Pribam (silver price of paper florins and (Vienna standard) florins)	Authors' calculations	Florins
New all-items index	–	–	1800–1914	–	For the period from 1800 to 1820, we adjusted the existing all-items index for the price of silver. The data for 1820 remained unchanged; 1820 is included for formal reasons (as the retrograde adjustment base year).	Authors' calculations (adjustment of existing index)	Florins, crown

Source: Authors' compilation.

[1] *For the 1800–1820 period, Mühlpeck et al. used the changes in goods prices in silver rather than in the circulating currency. Hence, the all-items index failed to adequately reflect the volatility of the circulating currency, as the movements of the circulating currency were broadly masked by the exchange rate between the circulating currency and silver. To be able to use this series for the creation of a long-run index for Austria, we therefore had to factor in the exchange rate impact. The existing all-items index works fine from 1820 onward, by which time the relationship between silver florins and paper money had stabilized.*

Note: "fl" = florin. All indices relate to Vienna and are assumed to be representative of modern-day Austria.

[6] *See table 7 for the currencies used in Austria since 1800, as well as "Selection of the currency for the base year 1938 in the 1948 retail price index" in section 2 for evidence of bias introduced by not taking into consideration individual exchange rates.*

issue apart, there is the fundamental issue of limitations of CPI-based conversions. To address this issue, we compare CPI-based conversions with alternative methods based on nominal GDP and wages. The fifth and final section concludes.

1 Selection of constituent indices

For Austria, indices of consumer prices and living expenses have been regularly calculated and published since the 1920s. As consumer behavior changes with time, the basket of goods and services and underlying weightings have been adjusted periodically to ensure that the index continues to accurately reflect the trends in the general price level. In addition, price survey and index calculation methods have been developed further since the 1920s. The key changes in the indices constructed for Austria since the 1920s most notably include adjustments in the interval between basket changes in view of changing consumer behavior, changes in the number of items contained in the basket, and changes in the geographical coverage of price collection. Moreover, for some periods, we had to choose among alternative indices based on different methodologies. In other words, the creation of a long-run price index involved the selection and subsequent chaining of the most suitable indices. Tables 1 and 2 briefly illustrate the key characteristics of the constituent indices we used and the selection criteria we applied.[7]

Methodological considerations

Before delving into the description of specific indices, it is important to differentiate between the concepts of consumer price indices (CPI) and cost-of-living indices (COLI). While the CPI is a measure of changes, over time, in retail prices of one constant basket of goods and services, COLIs measure the changes in the price of maintaining a constant level of utility. This (constant) level of utility is based on a basket of goods and services regularly adjusted to reflect current consumption patterns. The idea is that households seek to minimize costs by replacing items that have become relatively more expensive with cheaper alternatives or switch to other goods or services as they become available if they provide the same level of utility at a lower cost. As the COLI approach is more complex and elaborate, CPI-based inflation rates – which primarily reflect changes in prices rather than changes in consumer behavior – have prevailed for practical purposes. Nevertheless, the composition and weighting of the CPI basket of goods and services are also subject to periodical adjustments. In other words, there are methodological overlaps between CPIs and COLIs.[8]

Yet, the CPI concept fails to work in times of rapidly changing consumption patterns, as is the case in periods of crisis during and after wars, since some goods included in the basket of goods might be temporarily unavailable. Consequently, indices for the years after World War I were geared toward amounts of calories, and the composition of the basket of goods was adjusted according to the availability of food items. Nonetheless, indices based on constant baskets of goods are preferable for a long-term study of price developments that includes periods of crisis, as discussed in this article. These indices permit the direct comparison of the costs of

[7] *For a more comprehensive illustration of the indices available for Austria, see Fluch (2016).*

[8] *For a more detailed discussion of the characteristics of and differences between CPIs and COLIs, see Fluch (2016, p. 38). For a more comprehensive theoretical and practical consideration of CPIs, see the International Labour Organization (ILO) handbook (ILO, 2004).*

pre-war and post-war baskets of goods (e.g. indices of the inter-war and post-war periods with the base years 1914 and 1938; see below), in a way skipping the methodologically problematic times of crisis. It should be stressed, however, that price developments and indices for times of crisis must always be interpreted with caution.

On top of that, even terminological issues need to be taken into consideration. Some price indices referred to as consumer price indices or cost-of-living indices are not consistent with today's conceptual frameworks. For example, two so-called cost-of-living indices compiled by the Austrian Institute of Economic Research

Table 2

Monthly "retail price indices" used (1914 to date)

Term used here	Term used in source	Data available for	Data used for	Base month	Note	Source	Circulating currency
1926 RPI (crowns)	Preisindexzahlen aufgrund der Kleinhandelspreise[1]	July 1914–Jan. 1925	July 1914–Jan. 1925	July 1914 = 1	Monthly data from 1920 onward; data for 1914 refer to July; data for 1915–1919 available for January, April, July and October. Broken down into four (somewhat overlapping) index sections in line with changing currencies. "1926 RPI" is a reference to the underlying consumption table, which relates to 1926.	ÖStZ (1950), section XV. 4. a) *a*), p. 145 ff.	Crowns
1926 RPI (old schillings)		Jan 1925–March 1938	Jan 1925–March 1938	January 1925 = 100			Schilling (old) (1 old schilling = 10,000 crowns)
1926 RPI (reichsmark)		March 1938–Dec. 1945	March 1938–Dec. 1945	March 1938 = 100			Reichsmark (1 reichsmark = 1.5 old schillings)
1926 RPI (new schillings)		Jan. 1945–Dec. 1949	Jan. 1945–July 1948	March 1938 = 100 (prices in reichsmark)			Schilling (new) (1 reichsmark = 1 new schilling)
1948 RPI[2]	Kleinhandelspreisindex (Basis: März 1938)	From July 1948	From July 1948	March 1938 = 100 (prices in old schillings)	This index continues to be chained with current indices (most recently the 2015 CPI). "1948 RPI" is a reference to the first year for which the index was published.	Statistics Austria	Schilling (new), euro
1948 RPI (new)	–	–	From July 1948	–	1948 RPI recalculated based on reichsmark prices from 1938. Measures multiplied by 1.5.	Authors' calculations (adjustment of existing index)	Schilling (new), euro
Stretched 1926 RPI	–	–	March 1938–July 1948	–	Stretching the "1926 RPI (reichsmark)" and "RPI 26 (new schillings)" enables us to align the July 1948 figure of the stretched index with the "1948 RPI (new)" measure.[3]	Authors' calculations (adjustment of existing index)	Reichsmark, schilling (new)

Source: Authors' compilation.

[1] *For the period from January 1947 to December 1949, the source publication also contains prices in old schillings with March 1938 as the base year, without providing any reasoning or explanation. Additional index figures (schilling prices for March 1938 = 100) are also provided for the period from January 1948 to December 1949 (section XV. 4. b), p. 148), citing "Statistische Nachrichten" as the source. From July 1948 onward, these additional index figures match the RPI figures (Kleinhandelspreisindex) with March 1938 as the base year – see below. Before July 1948, these figures do not match any of the other available index figures. Here, too, we were unable to find an explanation.*

[2] *The index is based on prices in old schillings for March 1938 = 100. In other words, the conversion from old schillings to reichsmark in March 1938 (1 reichsmark = 1.5 old schillings) was not taken into account. To be able to use this series for chain-linking, we therefore had to recalculate the index series (see below).*

[3] *The "1926 RPI 26 (new schillings)" and the "RPI 48 (new)" overlap during the period from July 1948 to December 1949. However, the "RPI 48 (new)" measures are 3% higher on average, reflecting differences in the basket of goods. The "1926 RPI (reichsmark)" and "1926 RPI (new schillings)" use the same base (reichsmark prices for March 1938 = 100). The "1948 RPI 48 (new)" is methodologically more sophisticated, but not available before 1948. This leads us to the assumption that the "1926 RPI (reichsmark)" and the "1926 RPI (new schillings)" do not reflect the increase in prices from March 1938 to July 1948 in full. Our technical solution is to stretch the time series by distributing the difference evenly across the period of observation, to make up for the methodological differences. Formula: monthly_value_new = (final_index_new – 100)/(final_index_old – 100)*(monthly_value_old –100) + 100, final_index_new = "1948 RPI (new)" figure for July 1948, final_index_old = "1926 RPI" figure for July 1948.*

Note: Geographical note: All indices relate to modern-day Austria. Note on the data sources: "Statistische Nachrichten" published by the Austrian Central Statistical Office constitute an alternative historical source. Minor differences between figures taken from different publications may be due to revisions made in the historical sources and due to rounding. When computing the long-run index, we always selected the figures from the newest known publication. Note on retail prices published in "Statistische Nachrichten" from September 1946 in the sections on retail prices and general economic conditions: The reports published from December 1948 to March 1949 (volume IV/1949) provided the index data based on old schilling prices in the retail price index sections (see page 56 f and later) while also indicating reichsmark-based index figures in the sections on the general economic situation (see page 49 f and later).

(WIFO) – "Lebenshaltungskostenindex (LHKI) 1938" and "(LHKI) 1945" – actually constitute consumer price indices as they are based on a constant consumption table.[9] It is therefore important to always be mindful of underlying descriptions when using historical indices. Similarly, as far as Austria is concerned, any reference to an index that translates as retail price index – "Kleinhandelspreisindex (KHPI)" – is actually a reference to a consumer price index; this particular index is calculated on the basis of a relatively constant end user consumption table and also comprises goods that do not qualify as retail goods, like housing and electricity.[10]

Index reconstruction for the 1800–1914 period by Mühlpeck et al.

The groundwork for studying price developments in the 19th century was laid with the time series published by Mühlpeck, Sandgruber and Woitek for the period between 1800 and 1914 in an anniversary publication on the history and work of centralized official statistics in Austria for the period 1829–1979.[11] They built upon the systematic collection and publication of prices, which had started in the 19th century, for instance with the production of Statistical Tables ("Statistische Tafeln") for the Austrian Monarchy from 1828 onward. The benefits of consistent, comparable and long-term price series were highlighted by academic research, e.g. for projects in the context of the 1873 Vienna World Fair. The need for statistical information on prices became apparent also in light of the planned conversion to a gold currency in the early 1890s (k.k. Finanz-Ministerium, 1892). In an initial large-scale research project, select price and wage series had been extended back to the 14th century by Pribram (1938).[12] Yet, he had focused exclusively on compiling individual prices rather than on constructing a proper index. Mühlpeck et al. (1979) deserve credit for having developed a modern CPI from the variety of existing price data, taking 1914 as a starting point for back-calculations to 1800. They used data from Vienna, Linz, Graz and Innsbruck for the entire period,[13] with their basket of goods comprising food items, rent data, textiles and other commodities. While they managed to establish food price indices for individual regions, the all-items index had to be calculated from the data for Vienna only due to data availability issues. Thus, the time series they created, and which we used for our chained index, de facto represents a CPI for Vienna (disregarding regional data for Linz, Graz and Innsbruck).

[9] *For further details, see ÖStZ and WIFO (1959, p. 23).*

[10] *As opposed to indices aimed at measuring changes in the prices of end users' constant baskets of goods or end users' utility levels of consumption (CPI, COLI), wholesale price indices, producer price indices as well as import price indices relate to different levels of the economic process and are thus not covered in this article.*

[11] *Mühlpeck (1979a and 1979b) are part of this anniversary publication entitled "Festschrift "Geschichte und Ergebnisse der zentralen amtlichen Statistik in Österreich 1829–1979." In earlier publications, Hubbard (1973) calculated the CPI for Graz from 1861 to 1914 and Good (1976) did so for Vienna from 1874 to 1913. The calculations provided by Mühlpeck et al. (1979) cover the entire 19th century.*

[12] *The time series available for Vienna and Klosterneuburg were evaluated and new data for Salzburg were gathered in the context of an Austrian Science Fund project run from 2017 to 2020 at the Universities of Salzburg (Reinhold Reith) and Vienna (Thomas Ertl). This project served to develop and calculate adequate baskets of goods and real wages for the period from 1450 to 1850.*

[13] *In the first half of the 19th century, missing prices for Innsbruck (Tirol) and Linz (Upper Austria) were complemented by data from Rattenberg (Tirol) and Wels (Upper Austria). For additional surveys of prices and wages for areas of the Austro-Hungarian Monarchy beyond today's borders of the Republic of Austria, see Cvrcek (2013).*

Basket of goods and component weightings

The composition of the basket of goods used by Mühlpeck at al. is based on a consumer survey among Viennese working-class households conducted between 1912 and 1914. Based on the relative proportions of average household expenditures as reflected by this survey, Mühlpeck et al. established the following weights: food (50.5%), housing expenses (13.7%), clothing and linens (8.5%), drinks and tobacco (6.5%) and lighting and heating (4.3%). All "other purposes" (cultural expenses, fees, recreation, vacation, services) amounted to 16.6% of the total expenses. The basket of goods was established with the base 1914 = 100 and used without adaptations for the period from 1800 onward. The all-items index was calculated as a Laspeyres index.

In doing so, Mühlpeck et al. assume that consumer behavior did not change significantly over the course of the 19th century, corroborating this hypothesis with data from various sources. In practice, Mühlpeck et al. selected only those goods and services from the 1912/1914 consumer survey that were known and available over the entire period from 1800 onward, skipping rarely consumed goods as well as taxes and insurance payments. While leaving unchanged the weighting of consumption categories, Mühlpeck et al. did adjust individual goods around the middle of the 19th century. Thus, the price series for candles and wood were replaced with series for petroleum and coal, respectively. In total, the basket comprises 37 goods in eight consumption categories.

Underlying data and calculation of index

In compiling price data, Mühlpeck et al. above all built on the work done by Pribram (1938), supplementing his findings with data from statistical yearbooks, market office records as well as records from chambers of commerce and trade. Observed prices and quantities were converted into uniform units of measure and all currencies in circulation at any one time were denoted in crowns and heller to improve comparability over time. These measures served to track changes in food prices in a fairly good manner, as food items accounted for 24 out of all 37 price series included. The bigger challenge was estimating expenditures for rent, textiles (represented by wool, loden and cotton) as well as body care products (soap). Here, the corresponding prices were either calculated as simple averages or extrapolated from other data. Missing prices were interpolated from trends of available prices. From the range of indices calculated by Mühlpeck et al. from the prices they compiled, we selected their "all items index" series ("Generalindex"; created using data for Vienna only, see above) as the chain-link covering the period up to 1914 in our long-run index for Austria.[14]

The beginning of systematic price index creation after World War I

Given rapidly rising inflation rates in the years during and after World War I, an official price index for Austria was launched in 1921 for the purposes of public administration and the courts by the Central Statistical Commission (Statistische Zentralkommission). Subsequently, the Federal Statistical Office (Bundesamt für

[14] *For the all-items index, Mühlpeck et al. (1979) disregard the positions "letter postage" and "newspaper," as they do not consider the only continuously available series in this context to be representative of the expenditure items "public charges and fees" and "intellectual purposes," respectively (p. 680). We adopt this approach as well.*

Statistik), as the statistical authority was known from October 1921 onward, and the Parity Commission for wages and prices (Paritätische Kommission für Preis- und Lohnfragen) responsible for the provision of price data for collective wage bargaining experimented with the creation of different CPIs (Kamitz, 1949).[15]

Calculating price indices for war periods and immediate post-war periods, characterized by bottlenecks in supply, rationing and the existence of black markets, is challenging for several reasons.[16] When the price of a basket of goods is assessed for changes over time, the resulting outcomes will allow for a meaningful analysis only if the composition of the typical consumption basket has remained broadly unchanged. This was of course not the case during and especially immediately after the war. A general scarcity of goods, rationing and profound changes in relative prices in conjunction with a decline in the level of consumption led to marked changes in the composition of consumption expenditures. Furthermore, many goods included in the consumption table became unavailable or were only available in comparably poor quality as the war progressed. This holds equally true for the post-war period (Kravis, 1948). Moreover, the constraints of price collection added to the challenge of creating meaningful indices. Especially right after the war, only a fraction of the basket of goods was available at official or officially tolerated prices, while households were compelled to satisfy basic needs through illicit trade on the so-called "gray" or black markets at rates substantially exceeding official prices (Klezl, 1925; Kravis, 1948; Suppanz, 1976).

Under such constraints, a price index can basically be calculated in two different ways, which were both pursued in the case at hand. First, the index may be limited to reflect spending on food items (which is easier to track) by calculating the costs of minimum food intake requirements rather than the costs of fixed basket of goods. Thus, this strategy consists in defining a minimum reference amount of calories and protein and fat, to be provided by different foodstuffs depending on availability and relative prices. This means that the consumption table may vary over time (Klezl, 1921b). The resulting index reflects the change in the cost of securing the required minimum food intake. In this vein, the Federal Statistical Office began publishing a required food intake index for Vienna ("vierwöchige Kosten des notwendigen Ernährungsaufwandes in Wien") in January 1921 or, to be precise, the four-week costs of securing a daily intake of 3,000 calories for an adult male. The composition varied from month to month and was based on the available foodstuffs. Rationed quantities were calculated with official prices, while any additional quantities were calculated with open market prices.[17]

[15] *The Parity Commission was established by the Federal Act on the reduction of food subsidies of December 21, 1921, and remained active until May 1925.*

[16] *This was an issue both after World War I (Klezl, 1921a) and World War II (WIFO, 1949; ÖStZ and WIFO, 1959).*

[17] *1914 was not used as the starting year for the 1921 index series as it was not possible to ascertain the market conditions prevailing in 1914. Still, the cost for July 1914 was calculated for comparative purposes, using the last consumption table. This index using 1921 as basis was last published in December 1925. See Statistische Nachrichten from December 1925, pp. 250–251. In parallel, a broader index of the "increase in total spending required to support a family in Vienna" (Verteuerung des notwendigen Gesamtaufwandes einer Familie in Wien) was calculated for a short period of time from March 1921 onwards. The intent was to show changes in the consumption expenditures of a family of four. The basket contained five consumption categories, with foodstuffs being taken from the required food intake index for Vienna. The four other groups were clothing, housing, lighting/heating and other. This index was only calculated for the months of January, March, June, October and December 1921. The index figure for July 1914 was set at 1.*

While the required food intake index provides meaningful insights into the supply situation the population faced and can therefore be a useful tool for social policy, this approach quickly reaches its limits when it comes to a long-term assessment of price developments that also takes into account needs beyond nutrition. A second strategy therefore consists of assessing price changes with regard to a constant but broadly defined basket. Since this approach masks the widespread use of substitute items, the resulting index values may appear ahistoric in the short term. If, on the other hand, we assume that the improved supply situation, the end of rationing and the return to market prices were accompanied by a normalization of consumer behavior, the fixing of the basket allows price levels to be consistently compared over a longer period of time – with the exception of periods marked by deficiencies in supply and rationing. This second strategy was used for the cost-of-living index based on the weekly consumption of one person ("Index der Kosten der Lebenshaltung nach Maßgabe des Wochenverbrauchs einer Person"), published from January 1922 onward by the Parity Commission and the Federal Statistical Office. Using July 1914 as starting point, this method relied on a fixed basket of goods based on consumption estimates.[18]

The extent to which the price developments of fixed and variable baskets of goods can vary in times of acute distress, such as those during the years following World War I, is evidenced by Klezl (1921b). Starting with July 1914 = 1 as the base, Klezl calculated an 89-fold increase in the price of a fixed basket of goods by December 1920, but "only" a 67-fold increase in the price of a certain number of calories in a variable basket of goods. A further possible distortion stems from changes in quality. By assuming a consistent consumption table, the index underestimates the true increase in consumer prices during the war and post-war years as the quality of goods available at a given price worsened. During the gradual normalization following the war, then, the reverse occurred. Neither phenomenon is taken into account in the calculation of the indices.

Thus, a constant but widely defined basket of goods is clearly preferable for a long-term price index. Since it is safe to presume that consumption patterns did not change fundamentally between the last year of peace and the return to market prices after the war, the index correctly shows the change in prices between these two years. This means that it is also possible to assess long-term price developments over the wartime period. At the same time, the figures for the war period and its immediate aftermath need to be interpreted with caution.

1914–1958: The 1926 consumption table as the basis for long-term price comparisons

The need to compare price developments for the period covering the two world wars is best met using an index initially labeled "index of living cost changes" (Statistische Nachrichten, 1926(1), p. 13) and later referred to as "retail price index" ("Kleinhandelspreisindex" – KHPI) in Central Statistical Office publications

[18] *The methodological foundations of this index are given in No. 1 of Volume II of the Notices "Mittheilungen" of the Bundesamt für Statistik (Federal Statistical Office; see also Statistische Nachrichten, 1923, p. 14).*

after 1945[19] – or, to be precise, "1926 RPI," because it is based on the consumption table of 1926.[20] To complicate things further, this retail price index is technically a consumer price index, as outlined above. The "index of living cost changes" was introduced to replace the required food intake index covering the needs of male adults and the cost-of-living index based on the weekly consumption of one person, which were terminated at the beginning of 1926, following the end of hyperinflation, the stabilization of the currency and the introduction of the schilling in 1925. It was published in the Statistische Nachrichten from January 1926 until December 1938.

However, the basket of goods on which the index of living cost changes also known as "1926 RPI" is based was also used for back-calculations to July 1914 and (with minor changes) formed the basis for index calculations for the period from 1938 to 1958. This means that the baskets of goods for 1914 and 1958 are comparable and that the RPI offers the desired stability for the period covering the two world wars. For the creation of our chained long-run index, we therefore do not use the aforementioned indices of the Federal Office and the Parity Commission (required food intake index and cost-of-living index) for the period from 1914 to 1925 calculated at the time, but rather the so-called retail price index subsequently calculated on the basis of the 1926 consumption table and published in ÖStZ (1950).[21]

The 1926 RPI introduced a range of changes compared to the indices which were published immediately following the war. The basket of goods was completely revised to consist of six categories (food, beverages and tobacco, clothing, heating/lighting, housing, other), which covered significantly more index items, including rental costs. Seasonal goods such as fresh vegetables and fruit were still excluded, however, in order to keep the basket consistent throughout the year.

When the new index was introduced, it was made clear that it did not tie in with the previous index series (Statistische Nachrichten, 1926(1), p. 13). Already in March 1926, however, the Federal Statistical Office decided to address the general need for long-term comparative series and to calculate and publish a parallel series starting in 1914 (1914 = 1) alongside the January 1926 = 100 series.[22] For this purpose, the pre-war prices gleaned from the cost-of-living index based on the

[19] *See ÖStZ (1950) or ÖStZ (1998). The index of living cost changes published in the Statistische Nachrichten between 1926 and 1938 matches the retail price index in later publications of the Statistical Central Office. ÖStZ and WIFO (1959, p. 22) explicitly state that it is the same index under a different name. The name change may lead to confusion since the Statistische Nachrichten also contained monthly "retail prices of major consumer goods" (Kleinhandelspreise wichtiger Bedarfsgegenstände) since they first appeared in 1923. The information provided included absolute prices in kronen (and later schillings), index figures for individual goods as well as the unweighted arithmetic mean of all indices, a measure that was referred to as "Meßziffer." However, this is clearly not the index later referred to as the RPI.*

[20] *ÖStZ and WIFO (1959) state that the label "retail price index" should not lead to the assumption that this is a real index of prices paid in retail. It is rather an index of those prices that are relevant to the standard of living. This is indicated by the inclusion of fees (prices for services) as well as by the title of the publication in which the index was first presented to the public: The new index calculation of changes in living costs.*

[21] *ÖStZ (1950) does not expressly confirm that the so-called retail price index for the period from 1914 to 1925 was calculated on the basis of the 1926 consumption table. While this does seem probable, it would need to be verified using the price series for individual goods (ÖStZ, 1997) and the weighting pattern in the Statistische Nachrichten (1926, p. 13).*

[22] *Statistische Nachrichten, 1926(3); p. 69. Publication based on July 1914 = 1 also allows for comparisons with the wholesale price index based on 1914 = 1.*

weekly consumption of one person were reweighted using the 1926 consumption table. The two consumption expenditure totals from the two goods baskets were used to calculate the ratio between the two index levels. From then on, both index series were published monthly. The monthly articles published in the Federal Statistical Office's Statistische Nachrichten always provided the latest 1926 RPI figures (compared with the previous month), but index overview tables were published only sporadically (for example the indices for the period from January to December 1926 in Statistische Nachrichten 1926(12)). The July 1914=1 index series was published monthly in the Statistische Nachrichten. As of May 1938, the index was converted to reichsmark, based on the official conversion rate (1 reichsmark=1.5 schilling).[23] The basket of goods as such was left unchanged. Publication of the Statistische Nachrichten ceased in December 1938.

Following the end of World War II, regular publication of price indices resumed. As after World War I, the statistical offices were faced with the challenges of adequately reflecting the impact of rationing, goods only being available on the black market and reduced and/or noncomparable quality of the surveyed goods. The WIFO made a cost-of-living index available as early as April 1946,[24] while the Statistische Nachrichten provided only individual prices rather than a full-fledged index. Data on the so-called retail price index ("Kleinhandelspreisindex", see above) for major commodities in Vienna – which we used for the creation of the long-run consumer price index – were provided in the Statistische Nachrichten from July 1948 onward (which is why we refer to this index as the 1948 RPI in the following). The composition of the 1948 RPI was based on the 1926 RPI, subject to certain adjustments.[25] The 1948 RPI was calculated as a weighted arithmetic mean until February 1959 and regularly published in the Statistische Nachrichten. The missing years from 1939 to 1947 were later supplemented by the Central Statistical Office, and a continuous RPI for 1914–1949 was then published in the Statistisches Handbuch 1950 (ÖStZ and WIFO, 1959, p. 23).

1959–present: Consumer price index I and II and subsequent revisions

The 1954/55 consumer survey showed that the consumption table underpinning the retail price and cost-of-living indices no longer corresponded to consumer behavior in the post-war period. This led to a revision and expansion of the basket of goods and to the calculation of two new consumer price indices, labeled CPI I (representing

[23] *Statistische Nachrichten, 1938, Volume 3/4; p. 74 and Statistische Nachrichten, 1938(6), p. 134.*

[24] *The cost-of-living index based on the post-war consumption table for a four-person working-class family was calculated by the Austrian Institute of Economic Research from April 1946 until February 1959 on the price basis of April 1938 = 100 and April 1945 = 100. The basket of goods consisted of nine consumption categories, designed to represent the consumption table for a four-person household.*

[25] *For example, unlike the 1921 RPI, the 1948 RPI did not include a "housing" consumption category. In November and December 1938 (final issue of Statistische Nachrichten/last time the consumption table was published), housing had accounted for a share of 5.6% of the living expenses / the index. Adjustments of this kind raise the question of how comparable and chainable structurally modified indices are. Yet, changes to the consumption tables are driven by the possible range of price collection, which was widening after World War II. For a more detailed discussion of the indices available during the post-war period (1948 RPI, WIFO cost-of-living index, CPI I and CPI II), see ÖStZ and WIFO (1959). We prefer the 1948 RPI to WIFO's cost-of-living index (the consumption table of which includes housing costs, for example) as the 1948 RPI is based on the 1926 RPI, and the 1948 RPI and the cost-of-living index moved broadly in synch from 1938 to 1958 (see ÖStZ and WIFO, p. 23 ff.). Any indices that were launched later use an improved methodology. Using/chaining them requires an explanation only when there are multiple indices among which to choose.*

an average working-class household) and CPI II (representing a four-person working-class household). The survey areas were expanded significantly, including all seven provincial capitals existing at the time in addition to Vienna as well as St. Pölten and Wiener Neustadt (for Lower Austria). Among other things, fresh vegetables and fruit were added to the basket of goods (ÖStZ and WIFO, 1959). The two indices were calculated in parallel from March 1959 to December 1966 and moved virtually in synch. We chose the CPI II for the chained index – just like Statistics Austria did for the chaining of the continuously published RPI series (base: March 1938 = 100). The continuation of the RPI (chaining with current indices) by Statistics Austria thereby conveniently allowed us to use the RPI time series for monthly values from July 1948 onward when creating the new index (see also table 2). No special discussion of the subsequent indices is required.

Over the subsequent decades, the CPI was initially revised every ten years (1966, 1976, 1986, 1996) and later every five years (2000, 2005, 2010, 2015).[26] The composition of the baskets of goods remained in flux, and the expansion of product groups and goods in the collection of prices took changing consumer behaviors and the increasing level of prosperity into account. 1997 saw the launch of the Harmonised Index of Consumer Prices (HICP), which has since been published in parallel to the CPI. The two indices entail minor methodological differences in terms of the basket of goods and weighting. For the purpose of consistency, we used the CPI for our chained long-term index. Until the end of 2010, the CPI was calculated as a fixed-based index, but continues to be calculated as a Laspeyres index. Since the start of 2011, the CPI has been calculated as chained index. As the indices are chained in the December of each year, the baskets of goods can theoretically be adjusted every year.

2 The creation of a long-run index

The way to create a long-run price index for the past 200 years is to chain-link the indices available for the individual subperiods. With regard to chaining, a number of constraints are to be considered. These particularly concern the choice of currency for the period 1800–1820 and the linking of the indices during World War II. In both cases, the published index values must be revised and multiplied by adjustment factors in order to ensure an adequate reflection of price developments. While this issue has been repeatedly mentioned in the literature, it has not yet been explicitly discussed, and the required adjustments have not always been made (in full) in practice. For example, Statistics Austria addressed the issue by multiplying the conversion factors underlying its conversion chart ("Börsenkurier") by 1.5, yet left the index values themselves unadjusted. Mühlpeck et al. (1979a, 1979b) also carried out a methodologically correct conversion of 1858 prices into 1979 prices. In both cases, however, no details are provided regarding the chaining of indices between 1938 and 1948. ÖStZ (1998) refers to the issue in the context of adjusting prices prior to 1820 but does not make any adjustments to the 1938–1948 chaining. It is therefore unsurprising that the chained index in Butschek (1996, 2011) does not take the two problems into account. Instead of subsequently applying adjustment

[26] *See ÖStZ (1967) and the revision articles published in Statistische Nachrichten (04/1977 = volume 32); new series: 05/1987, 04/1997, 05/1997, 05/2001, 05/2006, 05/2011, 05/2017.*

factors, we sought to explicitly address both issues during the creation of the new index. The following section presents this approach in detail.

Selection of the currency for the 1800–1820 period

Since 1800, nine different currencies have been used in Austria: paper florins (Bancozettel), three different florins (Vienna standard, Convention standard, Austrian standard), the crown, the schilling (old), the reichsmark, the schilling (new) and the euro (Jobst and Kernbauer, 2016; see also table 8). The adoption of a new currency name usually entailed a change in the nominal value of the currency units, as was the case, for example, when ATS 13.7603 became EUR 1 in 1999. Note that the changes in nominal prices associated with currency conversion do not constitute inflation (or deflation) and must therefore be excluded when calculating inflation.

One possible approach to dealing with multiple currencies is to convert all prices to a single currency unit. Mühlpeck et al. (1979a, 1979b) adopted this approach when collecting historical prices for the purpose of reconstructing a consumer price index for the 19th century. They converted all prices to crowns. For the period from 1800 to 1820, Mühlpeck et al. opted not to convert the prices into crowns directly from paper florins (or from Vienna standard florins after the 1811 currency reform) – as published by Pribram (1938) – according to the nominal exchange rate but rather into silver florins (Convention standard) first.[27] The reason for this decision was the significant devaluation of Austrian paper money during and immediately after the Napoleonic Wars (Jobst and Kernbauer, 2016). Until 1797, the relative value of silver florin coins and paper florins issued by the Municipal Bank of Vienna (Wiener Stadtbanco) had remained stable. However, repeated issuances of paper florins to finance the war with France fueled the devaluation of paper money, which was ultimately declared legal tender in 1797. Silver florins became a commodity, and the amount of paper money required to purchase silver florins on the market kept rising over the course of the war. The market price of silver florins in paper florins was used by Mühlpeck et al. (1979a, 1979b) to convert the paper money prices published by Pribram and other sources into silver florins.[28] In other words, the prices that entered into their CPI calculations are not expressed in the circulating currency (paper florins) but rather in silver florins. The result of this is that the index does not, at least not fully, show the high inflation during the Napoleonic Wars. Instead, it measures the development of the price of the basket of goods relative to another commodity (i.e. silver).[29]

[27] *The nominal exchange rates for the currencies used in Austria during the 19th century are: paper florins (until early 1811; 100 paper florins (Bancozettel) = 16.80 crowns), Vienna standard florins (from 1811 onward, officially removed from circulation in 1857; 100 florins (Vienna standard) = 84 crowns), Convention standard florins (from 1816 onward; 100 florins (Convention standard) = 210 crowns), Austrian standard florins (from 1857 onward; 100 florins (Austrian standard) = 200 crowns) and crowns (from 1900 onward). For the conversion rates, see also the table in Jobst and Kernbauer (2016), p. 273 f.*

[28] *The conversion to (Convention standard) florins is not discussed in detail in Mühlpeck et al. (1979a). The text merely contains a table showing changes in the market price of silver, calculated by Pribram (1938) based on the exchange rate between Vienna and Augsburg, where silver was actually used for payments. However, the comparison of prices for individual goods given in contemporary currencies (Pribram, 1938) and the relevant series in Mühlpeck et al. (1979b) shows that the conversion took place as described here.*

[29] *Applying the same approach to the period of hyperinflation in Austria following World War I would entail converting all prices from Austrian crowns into U.S. dollars prior to calculating the rate of inflation. Also in this case, the hyperinflation would be visible in the conversion rate to the U.S. dollar but not in the (dollar-based) price index.*

This approach, which remained unaddressed by Mühlpeck et al. (1979a, 1979b), may reflect extensive international research efforts to collect data for prices and wages in grams of silver in order to allow international comparability of e.g. real wages or living standards. In terms of using the CPI to measure general price developments and the devaluation of money as well as the deflationing of nominal amounts expressed in the circulating currency, however, the method chosen by Mühlpeck et al. is unsatisfactory. The fact that the depreciation of the Austrian currency vis-à-vis silver must be taken into consideration to obtain an adequate view of price developments is well known from the literature. Providing an example for the adjustment of historical amounts, ÖStZ (1998) explains that the meaningful use of the Mühlpeck et al. index requires amounts before 1857 to be converted into Austrian standard florins (valid from 1858) using a conversion factor which varies greatly prior to 1820.[30] In other words: The Mühlpeck et al. index alone does not show the price changes between 1800 and 1820 in their entirety.

In order to obtain a series that is easier to interpret and to avoid the intermediate step of using conversion factors, we recommend reversing the conversion of prices expressed in the circulating currencies by Pribram (1938) into silver. In other words, our approach is to use the circulating currencies to recalculate the index. We need to make these adjustments until 1820, because from 1820 onward, the privilegirte oesterreichische National-Bank (founded in 1816) managed to stabilize the relationship between silver florins and paper money at a steady rate of 2.5 to 1 by issuing banknotes redeemable for silver at the central bank on demand as well as by facilitating the gradual exchange of the previous inflationary state paper money into banknotes. Specifically, we take the index value of 1820 as the starting point and adjust it for changes in the rate of silver to the currencies circulating in the period from 1800 to 1819. Note that silver florins once again traded at a premium over paper money in the period from 1848 to 1878. The prices for this period, however, were not converted into silver florins by Mühlpeck et al. (1979a, 1979b), enabling us to use this series without any adjustments. [31]

Table 3 serves to compare Mühlpeck et al.'s index, silver florin prices and the new index presented here for the period from 1800 to 1820. As evidenced by the Mühlpeck all-items index, the Napoleonic Wars were a period during which Austria (and the rest of Europe) witnessed a surge in prices, as expressed in silver (or gold). In Austria, the prices measured in silver peaked in 1811 (up 54% from 1800) before falling back to their 1800 levels by 1819. Austria's use of the printing press to finance the wars also led to a massive devaluation of the national currency vis-à-vis silver, which – apart from the short rise in 1812–1813 – did not reverse sustainably until after 1815, and even then only partially.

[30] *The conversion factors to be used before 1820 are not, however, given in ÖStZ (1998). We used the florin prices (paper florins and Vienna standard florins) stated in Pribram (1938).*

[31] *If necessary, the series can be converted into silver. No adjustment is needed from 1820 to 1847 because of the consistent convertibility of the florin into silver. The price of silver did, however, fluctuate significantly after this period and the annual figures required for converting the CPI into silver depend heavily on the selected calculation method (end-of-year figures or averages of end-of-month figures or of daily figures) or on whether and how the silver prices in Vienna missing for some periods are replaced by exchange rates against silver currencies or London silver prices. For corresponding data, see K.k. Finanz-Ministerium. For monthly and annual figures for the period from 1863 to 1879, see Jobst und Scheiber (2014) – publication and data available at: https://www.oenb.at/Publikationen/Volkswirtschaft/south-east-european-monetary-history-network-data-volume/download.html. On the subject of the rise and fall of the price of silver, see Jobst and Kernbauer (2016, p. 124 ff.).*

Table 3

Comparison of historical price indices for the period from 1800 to 1820

Revision and chaining of existing indices explained; adjustments made for currency reform of 1811 and alignment with silver prices from 1800 to 1820

	Mühlpeck all-items index,[1] 1914 = 100	Silver price in paper florins[2]	Silver price in (Vienna standard) florins[2]	Index-based silver price, 1820 = 100	New all-items index, 1914 = 100	Mühlpeck all-items index	New all-items index
		Currency reform of 1811: 1 (Vienna standard) florin = 5 paper florins		Recalculated[3]	Recalculated[4]		
	Annual indices or annual prices					*Annual inflation rates*	
1800	62.0	114.9		9.2	5.7		
1801	61.6	115.8		9.3	5.7	–0.6	0.1
1802	62.0	121.7		9.7	6.0	0.6	5.8
1803	63.4	130.8		10.5	6.6	2.3	9.9
1804	80.4	134.3		10.7	8.6	26.8	30.2
1805	84.7	134.8		10.8	9.1	5.3	5.7
1806	81.3	173.0		13.8	11.3	–4.0	23.2
1807	76.2	209.4		16.8	12.8	–6.3	13.5
1808	97.6	228.2		18.3	17.8	28.1	39.5
1809	94.8	296.0		23.7	22.5	–2.9	26.0
1810	87.3	492.1		39.4	34.4	–7.9	53.1
1811	95.6	1093.8		87.5	83.7	9.5	143.4
1812	90.2		201.8	80.7	72.8	–5.6	–12.9
1813	82.2		159.2	63.7	52.3	–8.9	–28.1
1814	77.1		228.8	91.5	70.6	–6.2	34.8
1815	70.7		351.1	140.4	99.3	–8.3	40.7
1816	76.8		327.0	130.8	100.5	8.6	1.2
1817	71.6		332.8	133.1	95.3	–6.8	–5.1
1818	71.2		255.4	102.2	72.7	–0.6	–23.7
1819	59.6		249.2	99.7	59.4	–16.3	–18.3
1820	60.0		250.0	100.0	60.0	0.7	1.0

Source: See footnotes, authors' calculations.

[1] Mühlpeck et al. (1979a, 1979b). We selected Mühlpeck et al.'s all-items index (Generalindex). Annual figures from 1800 to 1914 (1914 = 100). For the 1800–1820 period, Mühlpeck et al. used the changes in goods prices in silver rather than in the circulating currency. Hence, the all-items index failed to adequately reflect the volatility of the circulating currency, as the movements of the circulating currency were broadly masked by the exchange rate between the circulating currency and silver. To be able to use this series for the creation of a long-run index for Austria, we therefore had to factor in the exchange rate impact. The exiting all-items index works fine from 1820 onward, by which time the relationship between silver florins and paper money had stabilized.

[2] Pribram (1938). Silver price of paper florins (1800 to 1811). Silver price of (Vienna standard) florins (from 1812, silver price drops to one-fifth ceteris paribus).

[3] Calculated based on the silver price of paper florins and, following the currency reform of 1811, (Vienna standard) florins.

[4] Mühlpeck et al.'s all-items index adjusted for silver prices for the 1800–1820 period. The data for the 1820 remained unchanged; 1820 is included for formal reasons (as the retrograde adjustment base year).

Note: Blank cells = no figures available; see article for further details on the indices; some index terms suggested by authors.

Table 3 also shows the price of silver florins expressed in the respective circulating currency – i.e. paper florins up to and including 1811 and (Vienna standard) florins (redemption and anticipation certificates – "Einlösungsscheine" and "Antizipationsscheine") thereafter. Since redemption certificates were introduced at a ratio of 1:5 to paper florins in 1811, post-1811 prices have to be multiplied by a factor of five in order to adequately mirror the loss of value of the circulating currency in relation to silver. This evidences the dramatic devaluation of the Austrian currency and the pronounced fluctuations over this period (table 3, index-based silver price and new all-items index).

When we adjust the index of prices expressed in silver for changes in the price of silver to recalculate the index for prices in the circulating currency, we arrive at significantly higher rates of inflation and deflation for the period from 1800 to 1820 (table 3, annual inflation rates based on the "Mühlpeck all-items index" versus the "new all-items index"). Moreover, the peak price level shifts from 1811 (Mühlpeck et al. index) to 1816 (new index), representing an increase by a factor of almost 18 from the levels observed in 1800. Following several years of major deflation, characterized by decreasing prices in silver and the rising silver value of the circulating currency, the increase in prices compared with 1800 levels stabilized at a factor of approximately 10 in 1820.

Selection of the currency for the base year 1938 in the 1948 retail price index

Then there is the challenge of how to best capture price changes during the period of World War II. With the slow normalization of supply conditions after the war had ended in 1945, the Central Statistical Office resumed the publication of a retail price index for Vienna in December 1947 (Statistische Nachrichten, 1947(12), pp. 227–228).[32] The calculation of the index figures was based on the prices for March 1938, i.e. the last year of peace with market-based price formation. The prices for March 1938 were stated in reichsmark. Given that the schilling was re-introduced at a ratio of 1:1 to the reichsmark in 1945, this approach is methodologically correct.

In March 1949, the Central Statistical Office started publishing a second set of price/index figures. Henceforth, the data obtained on (new) schilling prices[33] were compared not only with reichsmark prices but also with old (1938) schilling prices (Statistische Nachrichten, 1949(1–3), p. 56). This approach ignored the fact that the two currencies did not have a 1:1 exchange ratio, as 3 (old) schillings had been converted into 2 reichsmark in March 1938. As a result, the prices for the base year appeared 50% higher and index increases appeared one-third lower. Why this change was made in 1949 and why methodologically correct and methodologically incorrect indices were published in parallel for a while is not evident from the available documentation.[34] Much rather, information provided earlier in the Statistische Nachrichten underlined that the only way to capture the full scope of the price increases since 1938 was to compare current prices against reichsmark prices (Statistische Nachrichten, 1947(1) p. 3).[35] Ultimately, the Statistische Nachrichten

[32] *Information on price developments was published earlier, but publication of an all-items index was not resumed until 1947.*

[33] *The terms "old schilling" and "new schilling" are used here to differentiate between the schilling before and after World War II.*

[34] *On this, the Statistische Nachrichten note: The calculation of the index will henceforth no longer be based on the reichsmark prices, but rather on the schilling prices for March 1938. This change in the calculation basis is considered appropriate as, in general, current income levels are not compared with incomes in reichsmark during the war, but rather with incomes in schilling during the pre-war period. (Statistische Nachrichten, 1949(3), p. 56). This explanation is not compelling. The April 1938 = 100 price basis in reichsmark was not changed in 1949 in the cost-of-living index published in parallel by the WIFO. For the period from 1946 to 1949, WIFO's cost-of-living index (WIFO, 1949) shows a progression similar to the new chained index published here.*

[35] *Published in the Statistische Nachrichten section on wholesale prices and indicators. In general, readers are advised to also study the sections on the general economic situation.*

stopped the parallel publication of both index figures in 1951, after which it released only the index based on the old schilling.[36]

In subsequent years, this methodological decision appears to have been at least temporarily forgotten. A publication from 1959 (ÖStZ and WIFO, 1959, p. 22 and footnote 1 on p. 22) informed readers that, following the war, the Austrian Central Statistical Office began to regularly publish the retail price index again from July 1948 (base: March 1938 = 100).[37] Moreover, readers were informed that the 1938 reichsmark prices were compared to current schilling prices at a ratio of 1:1. This is incorrect, as the base was actually underpinned by the old schilling prices.

In contrast, many works that sought to establish comparisons of purchasing power over the 1938–1948 period did correct for the change in the price basis. This is in particular true for the Börsenkurier's conversion chart, the calculation formula of which multiplies the index values after 1948 by a factor of 1.5 and therefore correctly displays the converted amounts. The currency converter provided by the OeNB[38] is based on the Börsenkurier tables and therefore also provides correct conversions. Mühlpeck et al. (1979a) also correctly converted 1858 prices to 1979 prices for their sample calculation for equestrian statues (see above), albeit without providing details for the calculation or the chaining of indices between 1938 and 1948. While these calculations based on the (consecutive) price indices take the 1948 change in the price basis into account, this is not true for the chained index in Butschek (1996, 2011). Depending on the source, the index values may therefore need to be adjusted accordingly for the creation of chained indices.

Change from the 1926 RPI to the 1948 RPI and the index value for 1948

The 1948 RPI was first published in July 1948. The 1926 RPI used previously (on a reichsmark basis from March 1938) continued to be published monthly until December 1949 (ÖStZ, 1950). Butschek (1996) used the 1926 RPI for 1946 and 1947 and then switched to the schilling-based 1948 RPI from the Statistische Nachrichten for 1948. Apart from the fact that, as explained above, the reichsmark-based index should be used here, this raises two further issues.

First, while the 1926 RPI and the 1948 RPI follow the same trend during the months for which both indices are available, the 1948 RPI figures are, with slight fluctuations, 3% higher on average than the 1926 RPI figures. The differences in levels and monthly changes may be attributed to the different baskets of goods, as outlined above. At the same time, the difference in levels raises the question of how best to link the two indices. One possibility would be to link up the indices using a chaining coefficient of approximately 0.97. This would not, however, take into account the fact that both indices use 1938 as base year, meaning that both index figures for 1948 show the price increase since 1938. As the 1948 RPI is

[36] *The Statistisches Handbuch for 1950, which provides an overview of price changes since 1914, also lists two price index series from 1947 onward (ÖStZ, 1950, pp. 145–146). A comparison of the two series makes it clear that the calculation of the changes in purchasing power since 1914 must use the series based on the reichsmark, as the index value would otherwise fall from 161 to 111 from December 1946 to January 1947 rather than increase to 166 (on a consistent price basis).*

[37] *In fact, publication was resumed in December 1947. Regular monthly information on the all-items index was initially only included in the sections on the general economic situation, while regular monthly publication of detailed information in the sections on prices began in July 1948.*

[38] *See https://www.eurologisch.at/docroot/waehrungsrechner/#/.*

Table 4

Comparison of historical price indices for the period from 1946 to 1949

Revision and chaining of existing indices explained; selection of currency for base year 1938; index stretched for the period from March 1938 to July 1948

		1926 RPI (new schillings)[1]	Stretched 1926 RPI	1948 RPI[2]	1948 RPI (new)	New CPI	1926 RPI (new schillings)[1] or 1948 RPI[2]	New CPI
		Price base RM	Price base RM	Price base OS	Price base RM	Price base RM	Price base OS	Price base RM
			Recalculated[3]		Recalculated[4]	Recalculated[5]		Recalculated[5]
		Monthly figures					*Annual figures [annual inflation rates]*	
1946	Jan.	122	123,3			123,3	141	143,2
	Feb.	122	123,3			123,3		
	March	122	123,3			123,3	[26.0%]	[27.5%]
	April	136	138,2			138,2		
	May	136	138,2			138,2		
	June	138	140,3			140,3		
	July	147	149,9			149,9		
	Aug.	147	149,9			149,9		
	Sept.	148	150,9			150,9		
	Oct.	152	155,2			155,2		
	Nov.	158	161,5			161,5		
	Dec.	161	164,7			164,7		
1947	Jan.	166	170,0			170,0	277	287.5
	Feb.	175	179,6			179,6		
	March	177	181,7			181,7	[96.6%]	[100.7%]
	April	178	182,7			182,7		
	May	202	208,2			208,2		
	June	202	208,2			208,2		
	July	276	286,7			286,7		
	Aug.	326	339,7			339,7		
	Sept.	393	410,8			410,8		
	Oct.	393	410,8			410,8		
	Nov.	416	435,2			435,2		
	Dec.	417	436,3			436,3		
1948	Jan.	417	436,3			436,3	329	469.6
	Feb.	416	435,2			435,2	(calculated	
	March	416	435,2			435,2	from July–De-	[63.3%]
	April	435	455,4			455,4	cember figures	
	May	434	454,3			454,3	only)	
	June	434	454,3			454,3	[19.0%]	
	July	437	457,5	305	457,5	457,5		
	Aug.	436		305	457,5	457,5		
	Sept.	434		303	454,5	454,5		
	Oct.	507		349	523,5	523,5		
	Nov.	510		350	525,0	525,0		
	Dec.	528		364	546,0	546,0		
1949	Jan.	527		363	544,5	544,5	402	603.4
	Feb.	527		362	543,0	543,0		
	March	525		361	541,5	541,5	[22.1%]	[28.5%]
	April	527		362	543,0	543,0		
	May	532		362	543,0	543,0		
	June	607		416	624,0	624,0		
	July	606		415	622,5	622,5		
	Aug.	604		414	621,0	621,0		
	Sept.	611		419	628,5	628,5		
	Oct.	628		419	628,5	628,5		
	Nov.	673		463	694,5	694,5		
	Dec.	684		471	706,5	706,5		

Source: Statistics Austria, see footnotes, authors' calculations.

*[1] ÖStZ (1950), section XV. 4. a) **a**), p. 145 f.*

[2] Retail price index (Kleinhandelspreisindex) published by Statistics Austria (base: March 1938; monthly figures from July 1948, annual figures from 1948), annual figures for the period shown here and beyond also available in: Butschek (2011), p. 569 ff. Based on these sources, the annual figure for 1948 is derived only from the monthly figures for July to December 1948, which gives rise to an upward bias in the annual figure owing to the sharp price increase in the second half of the year.

[3] 1926 RPI stretched for the period from March 1938 to July 1948.

[4] 1948 RPI revised (correct currency selected for base year 1938).

[5] Chaining of the recalculated or revised indices. Annual indices calculated as arithmetic means of the respective monthly figures.

Note: Base month for all indices: March 1938 = 100; prices expressed in new schillings, prices based on reichsmark (RM) or old schillings (OS), blank cells = no figures available. Minor differences between figures may be due to revisions made in the historical sources and due to rounding; see article for further details on the indices; some index terms suggested by authors.

methodologically superior, it would be unsatisfactory to change its index value through chaining. In order to avoid a break following the change from the 1926 RPI to the 1948 RPI between June and July 1948, we decided to stretch the 1926 RPI, starting with March 1938 = 100, so as to make it correspond to the index level of the 1948 RPI in July 1948.

The second issue relates to the calculation of the annual value for 1948, given that publication of the 1948 RPI started in July. Butschek (1996, 2011) calculates the annual value for 1948 as the arithmetic mean of the monthly figures from July to December, neglecting the months from January to June.[39] Owing to the significant inflationary pressure prevailing in 1948, the annual figure of the reichsmark-based series therefore appears too high for 1948 and, therefore, too low for 1949. However, the 1926 RPI and the 1948 RPI are comparable in principle and match each other when the 1926 RPI is adjusted by 3% as suggested. Therefore, we can calculate the annual figure by taking the January to June figures from the 1926 RPI and the July to December figures from the 1948 RPI. Table 4 shows the resulting changes to index values and inflation rates.

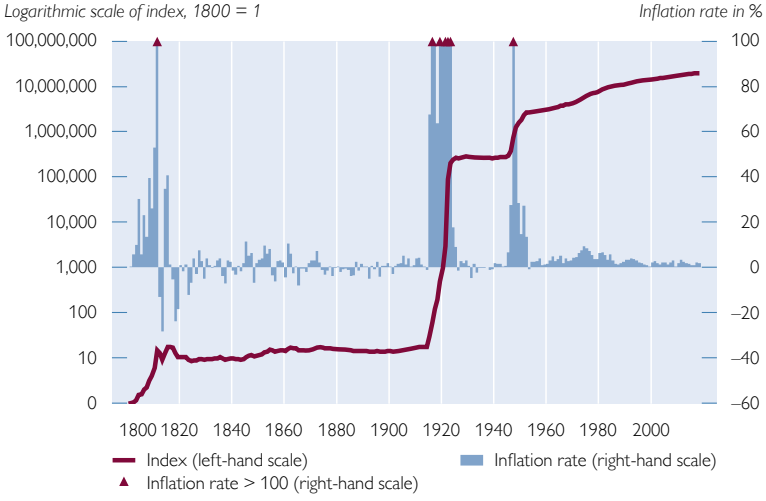
The use of the reichsmark/new schilling-based 1948 RPI and the consideration of all monthly figures when calculating the annual value for 1948 results in corrections to the inflation rates for 1948 and 1949. We thus arrive at inflation rates of 63.3% for 1948 (instead of 19.0%) and 28.5% for 1949 (instead of 22.1%). The inflation rates for subsequent years remain unchanged.[40]

The new index

The following section provides an overview of the new chained index and annual inflation (chart 1) as well as the chaining structure (table 5). Moreover, table 6 lists annual index figures for the new CPI from 1800 onward, and table 7 the corresponding annual inflation rates. Table 8 contains an overview of the currencies used in Austria starting in 1800 and the exchange rates of consecutive currencies.

Chart 1

The new CPI from 1800



Source: OeNB, calculated on the basis of existing time series from numerous sources (see article).

[39] *Butschek (1996, 2011) lists only annual values but no monthly values. Those annual values do, however, correspond to the average of the monthly values from the 1948 RPI as shown in table 4.*

[40] *The annual inflation rates listed here are calculated on the basis of the annual index values. The annual index values are the arithmetic means of the monthly index values. The stretching of the 1926 RPI leads to minor changes to the pre-1948 inflation rates.*

Table 5

Creation of the new CPI through chain-linking (annual figures from 1800, monthly figures from 1914)

Period used		Existing index	Recalculated/chained index		
from	to				
1800	1811	Silver price in paper florins	→ Index-based silver price	→ New all-items index (annual figures from 1800 to 1914)	→ New CPI (years from 1800)
1812	1820	Silver price in (Vienna standard) florins			
1820	1914	All-items index	→ ..		
July 1914	January 1925	1926 RPI (crowns)	→ ..	→ New CPI (monthly figures from 1914)	
January 1925	March 1938	1926 RPI (old schillings)	→ ..		
March 1938	December 1945	1926 RPI (reichsmark)	→ Stretched 1926 RPI		
January 1946	July 1948	1926 RPI (new schillings)			
July 1948	To date	1948 RPI	→ 1948 RPI (new)		

Source: Authors' compilation.

Note: Overlaps of one month or one year between consecutive time series are a technical requirement for chaining. Note on the composition of the annual figures: For the years from 1800 to 1914, we can compile an index with annual index values based on existing annual indices. For the years from 1914, we calculate the annual index values from the new monthly CPI figures (monthly figures from 1914) (annual index values = arithmetic mean of all available monthly values).

Table 6

The new CPI from 1800

	1914=100											
1800	5.7	1831	54.6	1863	92.4	1895	80.5	1925	15,043.0	1955	1,045.3	1987	3,997.9
1801	5.7	1832	54.5	1864	92.6	1896	77.2	*1925=100*		1956	1,075.7	1988	4,074.4
1802	6.0	1833	54.9	1865	85.2	1897	77.8	1925	100.0	1957	1,117.9	1989	4,178.9
1803	6.6	1834	56.6	1866	84.8	1898	78.4	1926	98.8	1958	1,130.6	1990	4,315.2
1804	8.6	1835	58.8	1867	84.4	1899	80.0	1927	101.5	1959	1,146.3	1991	4,459.4
1805	9.1	1836	56.6	1868	82.7	1900	80.4	1928	103.4	1960	1,165.7	1992	4,638.8
1806	11.3	1837	52.6	1869	84.3	1901	78.0	1929	106.7	1961	1,202.8	1993	4,807.0
1807	12.8	1838	54.2	1870	87.0	1902	78.6	1930	107.3	1962	1,261.2	1994	4,949.2
1808	17.8	1839	55.5	1871	89.7	1903	79.9	1931	102.3	1963	1,297.1	1995	5,060.3
1809	22.5	1840	54.8	1872	96.2	1904	81.4	1932	103.8	1964	1,346.8	1996	5,154.2
1810	34.4	1841	53.1	1873	98.3	1905	85.6	1933	101.6	1965	1,418.4	1997	5,221.7
1811	83.7	1842	53.5	1874	97.1	1906	86.8	1934	101.2	1966	1,445.1	1998	5,269.8
1812	72.8	1843	52.6	1875	94.1	1907	90.3	1935	101.0	1967	1,502.6	1999	5,299.4
1813	52.3	1844	53.6	1876	92.7	1908	90.8	1936	100.9	1968	1,544.2	2000	5,424.0
1814	70.6	1845	59.7	1877	93.0	1909	91.8	1937	100.9	1969	1,591.8	2001	5,568.1
1815	99.3	1846	62.8	1878	89.4	1910	95.4	1938	99.7	1970	1,661.4	2002	5,668.5
1816	100.5	1847	66.8	1879	89.3	1911	99.5	1939	99.0	1971	1,739.6	2003	5,745.3
1817	95.3	1848	62.3	1880	89.8	1912	100.8	1940	101.0	1972	1,850.1	2004	5,863.8
1818	72.7	1849	63.5	1881	88.0	1913	101.2	1941	102.5	1973	1,989.4	2005	5,998.9
1819	59.4	1850	65.6	1882	87.3	1914	100.0	1942	104.0	1974	2,178.9	2006	6,085.8
1820	60.0	1851	68.3	1883	87.0	*1914 = 1*		1943	104.3	1975	2,362.8	2007	6,217.8
1821	59.0	1852	75.0	1884	86.0	1914	1.0	1944	105.2	1976	2,535.8	2008	6,417.8
1822	59.8	1853	79.6	1885	82.8	1915	1.7	1945	112.2	1977	2,674.6	2009	6,450.3
1823	52.6	1854	86.2	1886	80.0	1916	3.4	1946	143.0	1978	2,770.3	2010	6,567.3
1824	49.1	1855	83.1	1887	82.0	1917	6.8	1947	287.0	1979	2,873.0	2011	6,781.3
1825	51.0	1856	78.1	1888	80.8	1918	11.2	1948	468.8	1980	3,054.7	2012	6,949.9
1826	49.5	1857	80.2	1889	82.1	1919	27.9	1949	602.4	1981	3,262.6	2013	7,088.9
1827	53.2	1858	82.8	1890	82.2	1920	55.5	1950	692.1	1982	3,440.1	2014	7,202.7
1828	54.7	1859	84.6	1891	82.6	1921	169.0	1951	881.4	1983	3,554.9	2015	7,267.8
1829	52.0	1860	80.9	1892	78.6	1922	5,032.2	1952	1,001.6	1984	3,756.3	2016	7,333.3
1830	54.1	1861	89.5	1893	79.1	1923	11,712.8	1953	993.7	1985	3,876.1	2017	7,485.9
		1862	94.9	1894	78.6	1924	13,788.9	1954	1,019.4	1986	3,942.0	2018	7,635.5

Source: OeNB, calculated on the basis of existing time series from numerous sources (see article).

Note: For ease of reference and clarity, we show the index in three sections: for the period from 1800 to 1914 with the base 1914 = 100; for the period from 1914 to 1925 with the base 1914 = 1 (hyperinflation in the years up to 1925); from 1925 with the base 1925 = 100. Overlaps (1914 and 1925) are a technical requirement for chaining. Furthermore, we use the arithmetic mean of the available monthly figures to calculate the annual figures underlying the index values from 1914 for the new CPI.

Table 7

New CPI – annual inflation rates

1800–1914		1831	0.9	1863	–2.6	1895	2.4	1925	9.1	1955	2.5	1987	1.4
1800	×	1832	–0.2	1864	0.2	1896	–4.1	*1925–2018*		1956	2.9	1988	1.9
1801	0.1	1833	0.7	1865	–8.0	1897	0.8	1925	9.1	1957	3.9	1989	2.6
1802	5.8	1834	3.1	1866	–0.5	1898	0.8	1926	–1.2	1958	1.1	1990	3.3
1803	9.9	1835	3.9	1867	–0.5	1899	2.0	1927	2.8	1959	1.4	1991	3.3
1804	30.2	1836	–3.7	1868	–2.0	1900	0.5	1928	1.9	1960	1.7	1992	4.0
1805	5.7	1837	–7.1	1869	1.9	1901	–3.0	1929	3.1	1961	3.2	1993	3.6
1806	23.2	1838	3.0	1870	3.2	1902	0.8	1930	0.6	1962	4.9	1994	3.0
1807	13.5	1839	2.4	1871	3.1	1903	1.7	1931	–4.7	1963	2.8	1995	2.2
1808	39.5	1840	–1.3	1872	7.2	1904	1.9	1932	1.5	1964	3.8	1996	1.9
1809	26.0	1841	–3.1	1873	2.2	1905	5.2	1933	–2.2	1965	5.3	1997	1.3
1810	53.1	1842	0.8	1874	–1.2	1906	1.4	1934	–0.3	1966	1.9	1998	0.9
1811	143.4	1843	–1.7	1875	–3.1	1907	4.0	1935	–0.2	1967	4.0	1999	0.6
1812	–12.9	1844	1.9	1876	–1.5	1908	0.6	1936	–0.1	1968	2.8	2000	2.4
1813	–28.1	1845	11.4	1877	0.3	1909	1.1	1937	0.0	1969	3.1	2001	2.7
1814	34.8	1846	5.2	1878	–3.9	1910	3.9	1938	–1.2	1970	4.4	2002	1.8
1815	40.7	1847	6.4	1879	–0.1	1911	4.3	1939	–0.7	1971	4.7	2003	1.4
1816	1.2	1848	–6.7	1880	0.6	1912	1.3	1940	2.0	1972	6.4	2004	2.1
1817	–5.1	1849	1.9	1881	–2.0	1913	0.4	1941	1.5	1973	7.5	2005	2.3
1818	–23.7	1850	3.3	1882	–0.8	1914	–1.2	1942	1.5	1974	9.5	2006	1.4
1819	–18.3	1851	4.1	1883	–0.3	*1914–1925*		1943	0.3	1975	8.4	2007	2.2
1820	1.0	1852	9.8	1884	–1.1	1914	–1.2	1944	0.8	1976	7.3	2008	3.2
1821	–1.7	1853	6.1	1885	–3.7	1915	67.8	1945	6.6	1977	5.5	2009	0.5
1822	1.4	1854	8.3	1886	–3.4	1916	104.8	1946	27.5	1978	3.6	2010	1.8
1823	–12.0	1855	–3.6	1887	2.5	1917	99.0	1947	100.7	1979	3.7	2011	3.3
1824	–6.7	1856	–6.0	1888	–1.5	1918	63.8	1948	63.3	1980	6.3	2012	2.5
1825	3.9	1857	2.7	1889	1.6	1919	149.3	1949	28.5	1981	6.8	2013	2.0
1826	–2.9	1858	3.2	1890	0.1	1920	98.7	1950	14.9	1982	5.4	2014	1.6
1827	7.5	1859	2.2	1891	0.5	1921	204.9	1951	27.4	1983	3.3	2015	0.9
1828	2.8	1860	–4.4	1892	–4.8	1922	2876.8	1952	13.6	1984	5.7	2016	0.9
1829	–4.9	1861	10.6	1893	0.6	1923	132.8	1953	–0.8	1985	3.2	2017	2.1
1830	4.0	1862	6.0	1894	–0.6	1924	17.7	1954	2.6	1986	1.7	2018	2.0

Source: OeNB, calculated on the basis of existing time series from numerous sources (see article).

Note: The annual inflation rates correspond to the percentage change of the index value for a given year from the index value of the preceding year. Refer to table 6 for the index values. For ease of reference, table 7 mirrors the structure of table 6.

Table 8

Currencies in in Austria from 1800

	Currency	Subunit	Conversion
Before 1811	Paper florin	60 kreutzer	
1811	Florin (Vienna standard)	60 kreutzer	1 Vienna standard florin = 5 paper florins
1816/1820[1]	Florin (Convention standard)	60 kreutzer	1 Convention standard florin = 2.5 Vienna standard florins
1857	Florin (Austrian standard)	100 (new) kreutzer	1.05 Austrian standard florins = 1 Convention standard florin
1900	Crowns	100 heller	2 crowns = 1 Austrian standard florin
1925	Schilling (old)	100 groschen	1 schilling (old) = 10,000 crowns
1938	Reichsmark	100 pfennige	2 reichsmark = 3 schillings (old)
1945	Schilling (new)	100 groschen	1 schilling (new) = 1 reichsmark
1999/2002[2]	Euro	100 cent	1 euro = 13.7603 schillings (new)

Source: Jobst and Kernbauer (2016), p. 274 f; includes further explanations.

[1] *From 1816, florin-denominated banknotes issued by the privilegierte oesterreichische National-Bank (Convention standard florins) and florin-denominated redemption and anticipation certificates (Vienna standard florins) were circulating in parallel – initially at fluctuating market prices and from 1820 at a stable rate of 1:2.5.*

[2] *First introduced as an accounting currency in 1999; euro coins and banknotes followed in 2002.*

The CPI changes are discussed in detail in Beer et al. (2016).[41] Following high levels of inflation during the Napoleonic Wars and the subsequent rather significant deflation, the period until 1848 saw rather volatile rates of inflation but generally stable prices. The years up to 1873 are primarily marked by inflation, and those from 1873 to 1900 by falling and stable prices. Prices rose again during the decade leading up to 1914. The inflation and hyperinflation during and after World War I were again followed by a period of stable prices during the second half of the 1920s and throughout the 1930s. World War II also led to a major surge of prices, yet without causing another round of hyperinflation. Since then, price developments have been marked by a measured and continuous upward trend, including a period of accelerated inflation in the 1970s.

3 How representative is the new index for price developments in Austria?

Today's standards of consumer price index measurement raise the question of how reliable consumer price indices calculated for a more distant past are and what purposes the chained index may serve.

As shown in Fluch (2016), early indices include a significantly smaller amount of goods and services than current indices. To some extent, the smaller amount is of course a data availability issue, but it can also be argued that the simpler consumption patterns associated with significantly lower standards of living imply that a relatively small number of goods suffice to capture the key price drivers. At the same time, the issue arises how large a bias is introduced by the undercoverage of quality changes – which need not necessarily be quality improvements, as often implied in the current literature (e.g. Hausman, 2003). As mentioned above, the quality of foodstuffs deteriorated sharply above all in war times. However, it is indeed fair to presume that the quality of the goods contained in the basket of goods will have improved on balance over time. Quantifying this effect may therefore be a promising avenue for future research.

Furthermore, there is the issue of how accurate the index values are for periods of rationing, shortages and the absence of prices determined by the free market. As shown above, the index must be interpreted with care in these cases. Yet, the index is a good choice for long-term comparisons between two periods of free market prices, so long as it is reasonable to assume that consumption patterns have not changed too much between those periods.

Another issue is that of geographic coverage. Until 1958, the index only covered prices for Vienna. This leads to the question to what extent the Viennese index can be used to assess trends throughout the area of the Austro-Hungarian Monarchy and later the Republic of Austria. In 1869, the population of Vienna accounted for some 20% of the population of the area of modern-day Austria, but for just 2.5% of the total population of the Austro-Hungarian Empire. Until 1910, this share rose from 2.5% to some 4.5%. Following the dismantling of the Monarchy, the share of Vienna surged to 29% in 1934; and it was still as large as 23% in 1951.[42]

[41] *Beer et al. worked with a preliminary version of the index published here (pending further reviews but already addressing fundamental issues, without documenting the respective issues in detail). The preliminary and the final version differ above all in the pre-1820 period and in the period from 1946 to 1949, with some of the differences being substantial for both the index figures and the inflation rates.*

[42] *On the population of Austria and Vienna based on today's borders, see Butschek (1996), on the Monarchy, see Helczmanovszki (1979).*

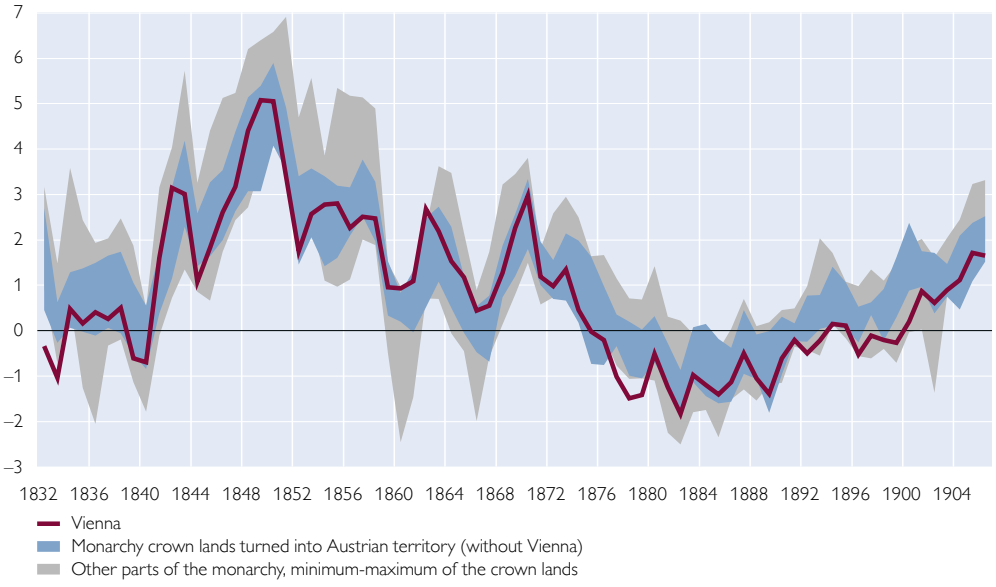
While no regional price data were published for the period of the Austrian Republic, the Vienna series can be cross-checked with regional information for the period before 1914. Mühlpeck et al. (1979a, p. 682) calculated food price series for Graz, Linz and Innsbruck. They were not able to add this series to the all-items index because data on other components of the goods basket were not available. For food, however, the four cities show similar trends throughout the 19th century.

Unsurprisingly, the differences between price levels (and between inflation rates) are greater if other areas of the Monarchy are included in the comparison. Cvrcek (2013) uses the data available for the Monarchy's crown lands to create regional price indices for the period from 1827 to 1910. These regional price indices do, however, run into the difficulties known from Mühlpeck et al. (1979a). While regional prices are available for food, wood and coal, the data situation regarding textiles, soap and rents is much more difficult. Because of the lack of systematic information on regional differences in consumption patterns Cvrcek (2013) therefore applied the weighting used for Vienna to all crown lands. These results must hence also be interpreted with caution. Judging from the median of the price changes observed in the Monarchy's crown lands, price increases were generally lower in Vienna. While inflation in Vienna was comparatively high in the period from the 1840s to the 1860s, Vienna was consistently at the lower end of the distribution after 1870 and until 1913 (see chart 2).[43] This convergence of regional price levels corresponds to the generally accepted notion of increasing integration throughout the Monarchy during the period (Good, 1986; Schulze and Wolf, 2012). For users of the price index published here, this means that the index presented in

Chart 2

Regional differences in inflation from 1832 to 1906

%, inflation rate and fluctuation range of inflation rate, 10-year moving average



Source: OeNB, calulated on the basis of data published by Cvrcek (2013).

[43] *The Vienna index in Cvrcek (2013), which is used in chart 2, is not the one we used for the creation of the new long-run CPI.*

this article tends to somewhat underestimate the general price increase for the entire Monarchy in the final decades of the 19th century.

A similar analysis is not possible for the period from 1914 to 1958 because the available local price data have not been reviewed systematically so far. As the Republic of Austria is significantly smaller and more homogeneous than the Austro-Hungarian Empire, regional differences ought to be less pronounced, though.

4 Conversion of historical prices – CPI and alternatives

Users typically expect long-run price indices to facilitate the conversion of historical prices into current prices. However, as shown here, the creation of price indices is a complex task. Depending on data availability (with regard to an adequate level of granularity and geographic coverage) and the underlying objectives (what is to be measured and compared, and for what reason?), individual indices or index time series will differ more or less from each other. While all indices serve to measure price levels and price developments, they differ significantly in their details and, upon close examination, may be more or less suitable to answer specific questions. An index of consumer prices does not necessarily provide information about the development of real estate prices or wage-based incomes (i.e. the price of labor), even though these may be highly correlated. Other indices are better suited to that purpose.

At the same time, a suitable index or a suitable comparison method should be used for specific questions relating to price developments or price comparisons. We specifically use the term "comparison method" as price comparisons need not necessarily rely on indices. Table 9 compares a range of methods for converting historical prices and values[44] (see also Officer and Williamson, 2006).

The table is intended to show that different indices or methods will be called for depending on the value to be compared (price of a good, wage, asset, etc.) and the issue at hand. Historical construction costs, for example, will be more meaningful for an Austrian living in the 21st century if they are examined in relation to both the historical and current economic output. To give an example: It took eight years (from 1972 to 1979) and approximately ATS 8.8 billion at the time to build the Vienna International Center, one of the UN's four major office sites. In 1979, ATS 8.8 billion accounted for around 0.9% of Austria's GDP, which corresponds to around EUR 3.5 billion in 2018 figures. In other words, the construction effort made in the 1970s would amount to a EUR 3.5 billion construction effort in today's money.[45] If we use the CPI rather than corresponding GDP ratios to convert the 1979 construction costs, the equivalent for 2018 is only EUR 1.7 billion.[46] In other words, different methods will produce significantly different outcomes. This demonstrates the need to always go for the most adequate comparison method, as discussed in detail in Officer and Williamson (2006). In the case at hand, the CPI

[44] *Note that the terms "value" and "price" are not synonymous. The difference in their meanings is not, however, a topic for discussion here.*

[45] *According to the United Nations Office Vienna, construction costs totaled EUR 640 million (https://www.unov.org/unov/en/vic_history.html). This equals approximately ATS 8.8 billion. Nominal GDP for 1979 (EUR 71,315.4 million = ATS 981,321.3 million) taken from Butschek (2011, p. 568); nominal GDP for 2018 (EUR 386 million) taken from Statistics Austria.*

[46] *Construction costs were multiplied by 2.66, which is the factor by which the CPI (as presented in this article) for 2018 exceeds the CPI for 1979.*

Table 9

Sample conversions of historical amounts

Amounts spent in the identified base years converted into 2018 figures

Example	Brown bread, price per kilo	Annual salary of a young civil servant	Building costs of the United Nations' Vienna International Center
Base year	1830	1900	1979 (built from 1972 to 1979)
Historical amount	4.3 kreutzer (Convention standard florins)[1]	2,000 crowns[1]	ATS 8.8 billion
CPI[2]	How much would a 1 kilo loaf of bread bought in 1830 cost today, adjusted for the average rate of inflation? Did the price of bread rise at a slower or at a faster rate than the basket of goods on average?	How much would the goods and services that the civil servant was able to buy in 1900 cost in today's money? How much purchasing power did he have?	If the government had used the money it paid for building the Vienna International Center to buy goods and services, how much would these goods and services cost today?
	EUR 1.55	EUR 13,800	EUR 1.7 billion
Wage index and wage comparisons	How expensive was a loaf of bread for a day laborer in 1830? With a day laborer earning 24 kreutzer (Convention standard florins), how many loafs of bread did his daily wage buy in 1830?	How big a salary would the young civil servant earn today if his salary had risen at an average rate (in other words: "Did young civil servants earn a fairly decent income in 1900, or not?")	How much would building the Vienna International Center cost today, assuming that building costs have risen broadly in line with wages?
	5 ½ kilo of bread[3]	Remains unanswered[4]	EUR 2.4 billion[5]
Nominal GDP[6]	How much did it cost to make 1 kilo of bread relative to the production of other goods?	Compared with national income, how large is the share of resources available to a civil servant? For top salaries, we might ask: Compared with national income, how large is the share of total resources available to top earners?	How big a share of annual value added did Austria spend in building the Vienna International Center? How big would this share be in today's money?
	EUR 82	EUR 191,000 EUR	0.9% of GDP = EUR 3.5 billion

Source: See footnotes; authors' calculations.

[1] Source for historical prices and wages: Mühlpeck et al. (1979b). Price for 1 kilo of brown bread (p. 148): 4.3 kreutzer = approx. 0.07 florins (1 florin = 60 kreutzer; all figures refer to Convention standard florins). No round numbers due to the conversion of prices and weights. Annual salary of a young civil servant (p. 129): 2,000 crowns.

[2] Here we use the new CPI presented in this article.

[3] This example shows that comparing historical prices with the costs of other goods available at the same time may suffice to get a feel for historical prices. Source for day-laborer wages (expressed in crowns there): Cvrcek (2013).

[4] Wage indices are available only for post-World War II periods. While wage indices exist for earlier periods, comparisons over time and between indices for different wages are limited. This is why we opted not to calculate wage indices for the period covering the two World Wars.

[5] In the period from 1979 to 2018, the index of agreed minimum wages rose by a factor of 3.68 (source: WIFO database; 1966 index of agreed minimum wages – total economy, all employees).

[6] Source for historical GDP data: Butschek (2011), p. 565 ff.; source of GDP for 2018: Statistics Austria. 1830: 709 million crowns, 1900: 4,051 million crowns, 1979: EUR 71,315.4 million, 2018: EUR 386,094 million, historical GDP figures in source publications not always expressed in the currency circulating in the relevant year.)

is not the method of choice as it was created for other purposes (to reflect changes in consumer prices) and is specifically geared to capturing price developments (changes in the purchasing power of money) while failing to directly take into account other economic developments (e.g. wages, technology, economic performance and capability). This means that it is not suited for assessing economically relevant projects from the past in a modern context.

Consumer price indices are generally seen as the archetypal indicator of price development. In actual fact, they constitute only one kind of price indicator and are therefore far from suitable for every purpose. Doing a CPI-based conversion of prices or incomes usually provides euro values that seem rather low. This is because major productivity gains over time mean that the same basket of goods (or a basket

of goods yielding the same utility) can be purchased for less money today than was the case 100 or 200 years ago. GDP equivalents are actually a more meaningful gauge for the status or power connected with a certain level of wealth or income, or for the cost of major infrastructure projects, such as the construction of the Semmering Railway or the Vienna International Center. After all, the GDP equivalents show how big a share of the aggregate resources was held by individuals or governments, or how large a share of economic output had to be mobilized to realize a particular project.

5 Conclusion

This article introduces a new chained index documenting how consumer prices have changed in Austria since 1800 – the first such index to have been exhaustively documented and to span two-plus centuries of history. Close examination of existing indices which we linked up raised a number of issues that we addressed in the chaining process. This exercise led to significant adjustments to the inflation rates published earlier for certain years.

We also created a monthly index beginning in 1914, which is another first.[47] The long-run consumer price index should be useful for converting historical price and value data into current amounts, which is a recurring issue. Whether the consumer price index will provide more meaningful insights than other measures depends on the issue at hand. At any rate, conversions of historical prices should generally be interpreted with caution.

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