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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 2021.

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 scholarship program for as long as we cannot resume visits due to the pandemic situation.*

Nontechnical summaries in English and German

Nontechnical summaries in English

Distributed ledger technologies for securities settlement – the case for running T2S on DLT

Alfred Taudes, Jakob Hackel, Wolfgang Haunold, Hannes Hermanky

This paper proposes to use distributed ledger technology (DLT) to make the Eurosystem's TARGET2-Securities (T2S) system for securities settlement more flexible. Specifically, we present a framework where building blocks of information on transactions are replicated and validated by several computers. Apart from technological issues we also address regulatory compliance, performance, cost efficiency and risk. The system we propose is a federated system comprising central banks and central securities depositories, enabling the participating European central banks and central securities depositories to conduct securities settlement according to regulatory requirements. The role of the central banks is to maintain the cash accounts; provide the infrastructure which allows for securities issuance, settlement processes, auto-collateralization, corporate actions such as dividend payments and more. The central securities depositories provide and maintain securities accounts, offer notary services for issuers, perform corporate actions, and carry out settlement. Ledger updates are based on a fully automated process, allowing central securities depositories to conduct settlement while central banks retain regulatory control. The system processes various types of settlement instructions for different security classes using specialized smart contracts, meaning programming code that executes agreements automatically on DLT infrastructure. This provides the flexibility to settle various types of digitally represented assets and to define novel workflows. In particular, the study shows that this also allows for variable settlement times. The proposed DLT architecture also enables central banks and authorized actors to conduct status checks at a granular level and in real time. Furthermore, comparisons show that the proposed system, when implemented with current distributed ledger technology, meets the daily performance goals of T2S. The federated structure of the system would also increase the resilience of operations. Overall, the study proposes one way to approach implementing securities settlement via a novel technology, while conforming to regulatory and operational requirements. The paper aims to contribute to ongoing discussions on the suitability of DLT technology for traditional settlement processes.

The share of zombie firms among Austrian nonfinancial companies

Christian Beer, Norbert Ernst, Walter Waschiczek

Aggregate productivity and economic growth may be reduced by "zombie firms" – weakly performing companies that, instead of exiting the market or being restructured, manage to continue operating over an extended period. We present first results on the incidence of such zombie firms for Austria, based on three definitions that capture different aspects of this phenomenon. Our results suggest that the share of zombies fell substantially between 2009 and 2018, across all industries and firm sizes, albeit to different degrees. The drop of the zombie share was particularly strong for highly indebted enterprises. Still, at the end of our observation period zombie firms continued to have less favorable risk characteristics than non-zombie firms, in particular a distinctly higher probability to default. Further findings were obtained with simulations keeping short-term interest rates stable over the period under review. Under this assumption, the zombie share would have remained roughly constant as well. The difference between the observed and the simulated zombie share is particularly pronounced for real estate-related industries, more highly indebted firms, and larger companies. Finally, the data show that zombie status is not irreversible. Among those firms for which financial statements information is available for the entire observation period, most firms manage to exit from zombie status at some point. One big unknown that remains is, of course, how these patterns may have changed as a result of the current pandemic, because our data do not go beyond 2018.

Austria's labor market during the COVID-19 crisis

Christian Ragacs, Lukas Reiss

The impact of the COVID-19 crisis on Austria's labor market has been huge and a lot heavier than during the Great Recession of 2009 in terms of the increase in unemployment and the drop in employment. Key metrics show that the decrease in employment was broadly in line with the euro area average and that the increase in unemployment went hand with an increase in long-term unemployment and the average duration of unemployment. The generous short-time work scheme rolled out by the government prevented a turn for the worse and also lessened the downward pressure on average wages induced by the strong decrease in average hours worked per employee in 2020. While manufacturing or construction were hit as well, the tourism industry was affected most by the crisis, contributing to a relatively stronger increase in unemployment in provinces with a higher tourism-related share of employment. Younger employees and especially foreigners were also relatively more affected by the increase in unemployment, while employees with tertiary education were relatively less affected. Labor supply, while losing momentum, did continue to grow in 2020, while it had stagnated during the Great Recession.

Nontechnical summaries in German

Modell zur Nutzung innovativer Technologien (Distributed Ledger) für die Abwicklung von Wertpapiergeschäften in Europa

Alfred Taudes, Jakob Hackel, Wolfgang Haunold, Hannes Hermanky

In dieser Studie werden Überlegungen angestellt, die aktuelle Eurosystem-Plattform zur Abwicklung von Wertpapiergeschäften – TARGET2-Securities (T2S) – durch Umstellung auf DLT-Technologie flexibler zu machen. DLT steht für Distributed Ledger Technology. Vereinfacht gesagt ist damit gemeint, dass die einzelnen Bausteine aller Transaktionen auf vielen Computern verteilt gespeichert werden. Konkret behandelt die Studie die Frage, ob das Wertpapierabwicklungssystem auch auf DLT-Basis die gesetzlichen Vorschriften erfüllen kann, und wie es um Leistungsfähigkeit, Kosteneffizienz und Risiken steht. Das vorgeschlagene Modell zur Interaktion der Zentralbanken und Wertpapiersammelbanken ist ein föderales System, das den teilnehmenden europäischen Zentralbanken und Wertpapiersammelbanken die Wertpapierabwicklung weiterhin im Einklang mit den gesetzlichen Vorschriften ermöglicht. Laut Modell führen Zentralbanken die Geldkonten und stellen die Systeme bereit, die für die Ausgabe von Wertpapieren, die Wertpapierabwicklung, die automatische Besicherung der Wertpapiergeschäfte und die Durchführung anfallender Dividendenzahlungen und dergleichen benötigt werden. Die Wertpapiersammelbanken wiederum verwahren die Wertpapiere in Wertpapierdepots, übernehmen im Zuge der Wertpapierausgabe Notariatsfunktionen und wickeln die Wertpapierverrechnung sowie Dividendenzahlungen etc. ab. Der Prozess, auf dem die DLT-Datenaktualisierung im Zuge der Wertpapierabwicklung durch die Wertpapiersammelbanken basiert, ist vollautomatisiert, und die zentralbankseitige Regulierung des Systems bleibt gewahrt. Das System ist auf die Verarbeitung verschiedener Abwicklungsaufträge für unterschiedliche Wertpapierklassen auf Basis sogenannter intelligenter Verträge ausgelegt; das heißt, die Abwicklung läuft DLT-basiert wie programmiert ab. Damit können digital darstellbare Werte auf Basis neuer Workflows sicher den Besitzer wechseln. Das neue System eignet sich weiters dafür, den Abwicklungszeitpunkt variabel zu bestimmen. Die vorgeschlagene DLT-Architektur ermöglicht darüber hinaus den Zentralbanken und autorisierten Teilnehmern Statusabfragen auf sehr detaillierter Ebene und in Echtzeit. Vergleiche zeigen, dass das DLT-System auch die für T2S geltenden Ziele in puncto Leistung erfüllt. Die föderale Struktur wirkt sich zudem positiv auf die Robustheit des Systems aus. Insgesamt zeigt die Studie eine Möglichkeit zur Nutzung einer neuen Technologie für die Wertpapierverrechnung unter Einhaltung der gesetzlichen und operativen Vorgaben auf. Zweck der Studie ist es, einen Beitrag zur aktuellen Diskussion über den möglichen Nutzen der DLT-Technologie für herkömmliche Abwicklungsprozesse zu leisten.

Entwicklung des Anteils von „Zombiefirmen“ am österreichischen Unternehmenssektor

Christian Beer, Norbert Ernst, Walter Waschiczek

Produktivität und Wirtschaftswachstum können unter sogenannten Zombiefirmen leiden – also unter Unternehmen, deren Betrieb eigentlich eingestellt oder umstrukturiert werden sollte – die aber weiter aktiv bleiben. Im Rahmen der vorliegenden Studie wurde erstmals der Anteil der Zombiefirmen am österreichischen Unternehmenssektor analysiert, und zwar auf Basis von drei Definitionen, um den Begriff Zombiefirmen möglichst gut eingrenzen zu können. Die Analyse zeigt insgesamt einen deutlichen Rückgang von Zombiefirmen zwischen 2009 und 2018; je nach Branche und Firmengröße war die Entwicklung aber unterschiedlich. Besonders deutlich war der Rückgang unter den stark verschuldeten Unternehmen. Risikotechnisch betrachtet schneiden die Zombiefirmen am Ende des Beobachtungszeitraums letztlich aber noch immer schlechter ab als gesunde Firmen, insbesondere im Hinblick auf die Wahrscheinlichkeit einer etwaigen Insolvenz. Ferner wurde simuliert, wie sich der Zombieanteil entwickelt hätte, wenn das Zinsniveau im Analysezeitraum auf dem Stand von 2009 geblieben wäre. Unter dieser Annahme wäre auch der Anteil der Zombiefirmen weitgehend stabil geblieben. Am größten ist der Unterschied zwischen dem beobachteten und dem simulierten Zombieanteil bei den Unternehmen in der Immobilienbranche, bei den vergleichsweise stärker verschuldeten sowie bei den größeren Unternehmen. Schließlich lässt sich von Entwicklung der Bilanzdaten (soweit durchgehend vorliegend) ableiten, dass der Zombiestatus meistens nicht unumkehrbar ist. Da die Daten der vorliegenden Studie nur bis 2018 reichen, bleibt die Frage offen, wie sich diese Ergebnisse im Lichte der aktuellen Pandemie verändert hätten.

Österreichs Arbeitsmarkt während der COVID-19-Krise

Christian Ragacs, Lukas Reiss

Die Auswirkungen der COVID-19-Krise auf den österreichischen Arbeitsmarkt waren enorm. Sowohl der Anstieg der Arbeitslosigkeit als auch der Rückgang der Beschäftigung fiel deutlich stärker aus als während der Rezession 2009, wobei der Beschäftigungsrückgang weitgehend dem Euroraum-Durchschnitt entsprach. Mit dem Anstieg der Arbeitslosigkeit erhöhte sich auch die Langzeitarbeitslosigkeit und die durchschnittlichen Dauer der Arbeitslosigkeit. Die von der Regierung eingeführte großzügige Kurzarbeitsregelung verhinderte eine noch schlechtere Entwicklung und verringerte auch den Abwärtsdruck auf die Durchschnittslöhne, der vom starken Rückgang der durchschnittlichen Arbeitszeit pro Arbeitnehmer im Jahr 2020 ausging. Branchenweise wurde der Tourismus verglichen mit dem verarbeitenden Gewerbe oder dem Baugewerbe ungleich stärker von der Krise erfasst, was zu einem überdurchschnittlichen Anstieg der Arbeitslosigkeit in Bundesländern mit einem höheren Beschäftigungsanteil der Touristikbranche beitrug. Vom Anstieg der Arbeitslosigkeit waren jüngere Arbeitnehmende und insbesondere ausländische Personen vergleichsweise stärker betroffen, Arbeitnehmende mit Hochschulbildung hingegen relativ weniger. Das Arbeitskräfteangebot erhöhte sich zwar weniger stark als in den Vorjahren, die Tendenz blieb aber im Jahr 2020 auch in der Krise steigend, im Gegensatz zur stagnierenden Entwicklung während der Rezession 2009.

Analyses

Distributed ledger technologies for securities settlement – the case for running T2S on DLT

Alfred Taudes, Jakob Hackel, Wolfgang Haunold, Hannes Hermanky[1,2]
Refereed by: Fabian Schär, University of Basel

With a view to developing the Eurosystem's TARGET2-Securities (T2S) system further, we propose a system based on distributed ledger technology (DLT) that covers all major T2S settlement functionalities and investigate it with regard to regulatory compliance, performance, cost efficiency and risk. The system we propose is a federated system comprising European central banks and central securities depositories (CSDs) as node operators. The role of the central banks is to maintain the cash accounts; provide regulatory-approved "smart contract factories" defining workflows for securities issuance, lifecycle management and matching, settlement, auto-collateralization and corporate actions; and perform the oversight function. The CSDs maintain securities accounts, offer notary services for issuers, perform corporate actions, and carry out settlement. CSD nodes collect settlement requests from external trading and clearing systems, forward them to other CSDs for cross-border settlement, bundle them into transaction blocks and prepare the blocks for settlement. The ensuing ledger updates occur via a fully automated consensus process between the central banks. In T2S on DLT, specialized smart contracts provide the flexibility to settle a range of digitally represented assets, define novel workflows – and allow for variable settlement times. Rather than having to conform to a uniform settlement time of T+2, participants can choose among smart contracts that settle within seconds or longer periods of time. This feature is expected to reduce capital costs and, given the DLT-based enforcement of settlement discipline, settlement failures. Apart from conforming to the current regulatory requirements, the DLT framework also enables the central banks and authorized actors to conduct status checks at a granular level and in real time. Furthermore, comparisons with similar use cases and benchmarks show that the use of current DLT solutions would allow to meet the current daily performance goals of T2S. Preliminary cost estimates based on available public information indicate that the proposed system could be built and operated efficiently. The federated structure would also support the resilience of operations given the high number of backup nodes.

JEL classification: E44, G21, G23, K22
Keywords: distributed ledger technology, securities settlement, smart contracts, TARGET2-Securities

1 Introduction

In securities transactions, ownership transfer is typically a three-stage process: first, a deal is established via brokers using a trading engine. Second, transactions are cleared through a central counterparty (CCP) to limit counterparty risk and provide netting benefits. Third, the deal is settled by central securities depositories

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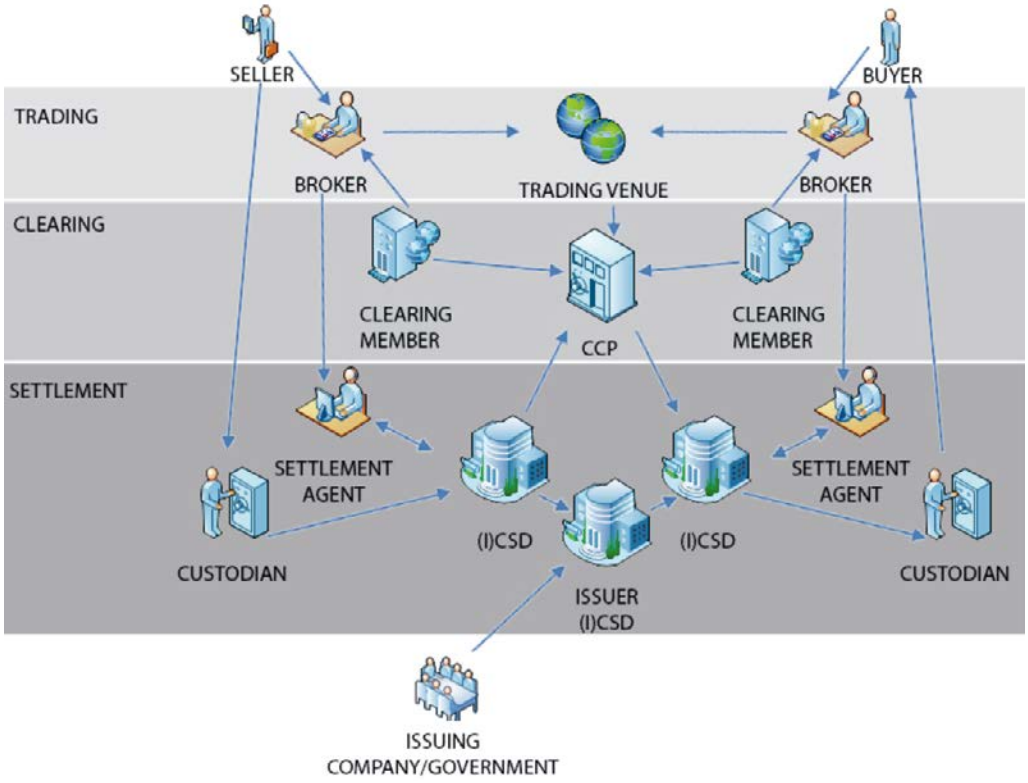
[2] *The work was supported by the Austrian Blockchain Center. ABC – Austrian Blockchain Center is funded within the framework of COMET – Competence Centers for Excellent Technologies by BMK, BMDW and the provinces of Vienna, Lower Austria and Vorarlberg. The COMET program is run by FFG.*

Figure 1

Post-trade processes in the securities leg of current transactions



Source: Pinna and Ruttenberg, 2016.

(CSDs) through the coordinated updating of cash and securities accounts (see figure 1).

1.1 Overview of TARGET2-Securities

In Europe, securities settlement in central bank money was harmonized and centralized with TARGET2-Securities (T2S), the common platform launched by the Eurosystem in June 2015. Before T2S, cross-border securities settlement in Europe was costly and cumbersome due to different settlement practices among countries and complex cross-border settlement procedures. As outlined by the ECB on its website, "T2S lays the foundations for a single market for securities settlement and thus contributes to achieving greater integration of Europe's financial market. It does this by:

- making it easier for investors to buy securities in other EU Member States
- reducing the cost of cross-border securities settlement
- increasing competition among providers of post-trade services (i.e. clearing and settlement services) in Europe
- pooling collateral and liquidity, meaning that banks no longer need to keep these in various locations and can quickly move them to where they are needed
- reducing settlement risk and increasing financial stability by using central bank money for transactions on the platform."

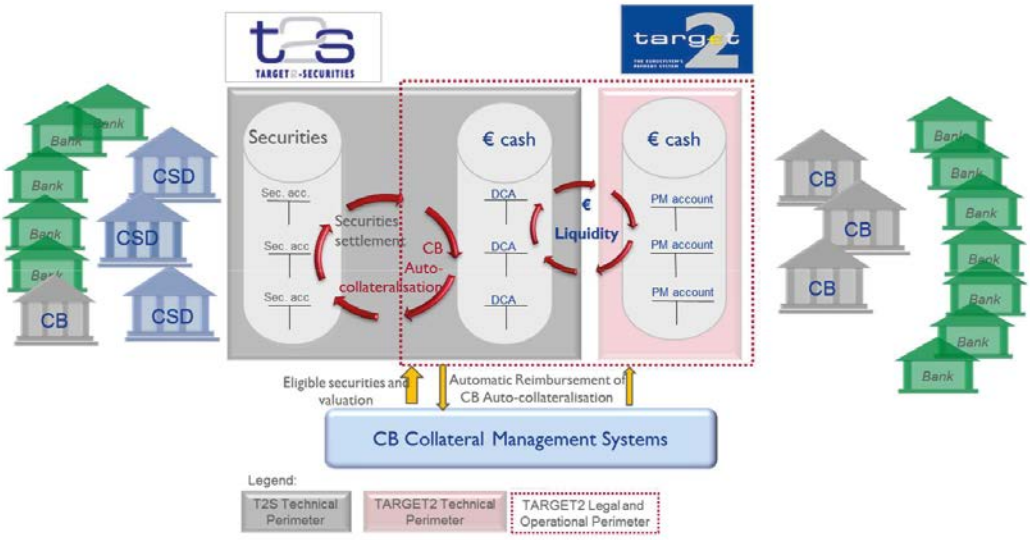
T2S matches settlement instructions submitted by central securities depositories and other directly connected T2S actors and coordinates the updates of the securities and cash legs of the transactions. T2S securities accounts are managed by the 21 participating CSDs while cash accounts are managed by the participating central banks. Of the six transaction categories handled by T2S, delivery-versus-payment (DvP, simultaneous transfer of central bank money and securities) accounted for 66.43% of the volume processed in 2019, followed by free-of-payment (FOP, delivery of securities without a simultaneous transfer of funds) with 30.60% of the volume (ECB, 2021a) (see figure 2). PFOD (payment free of delivery) transactions, SRSE (settlement restriction on securities) transactions, LQT (liquidity transfer) transactions and DWP (delivery-with-payment) transactions together accounted for 2.97% of the daily average volume. In addition to transactions to exchange securities, T2S handles corporate actions such as payments of dividends and administrative functions like the issuing of new securities.

T2S settles trades in four phases within two days. From 6:45 p.m. to 8:00 p.m., securities are validated, and liquidity is transferred from TARGET2, the real-time gross settlement system operated by the Eurosystem, to dedicated cash accounts in T2S. Then the nighttime settlement cycle is performed from 8:00 p.m. to 3:00 p.m. After a two-hour maintenance window, daytime settlement starts, at the end of which liquidity is transferred back to TARGET2 until 6:00 p.m. The time remaining to the next cycle is used for reporting.

If cash or securities necessary for settling a transaction are not available, settlement fails. To enhance settlement efficiency, T2S provides credit through auto-collateralization, either through "auto-collateralization on flow" (with transactions being secured by the securities that are being purchased) or "auto-collateralization on stock" (with transactions being secured by securities already held by the buyer). If settlement fails despite these measures, T2S retries settlement during a 60-day recycling period. In 2019, the percentage of transactions settled by T2S on the

Figure 2

Overview of T2S



Source: OeNB, 2017.

same day was 93.27% (ECB, 2021a). Since 2020, settlement failures have been discouraged by financial penalties and mandatory buy-ins under CSD Regulation (EU) No 909/2014 (EquityClear, 2020).

T2S is owned by the Eurosystem and run by the central banks of France, Germany, Italy and Spain. Following initial development costs of about EUR 584 million, the annual running costs amount to about EUR 102 million. In 2019, T2S processed on average 606,938 securities transactions per day, with a value of EUR 1,106.13 billion. On average, intra-CSD transactions, i.e. transactions within individual countries, represented 99.03% of all trades (ECB, 2021a). As T2S is a central platform, special efforts have been made to ensure robust operation, including rotation between primary and secondary sites. In 2019, the availability of T2S was equal to or above its target of 99.7%.

Notwithstanding major achievements of TS2, including higher security and lower cross-border transaction cost, the following shortcomings remain, as identified by BNP Paribas (2019):

- "The cost of settlement has not reduced. Indeed, it has increased. Even if this is explained by transaction volumes (lower than predicted at the launch of the project in 2010) and by the project's high amortization costs, it is disappointing
- Cross-border settlements (from one CSD to another) are easier and cheaper. However, they still account today for less than 1% of T2S transactions and hence are comparatively insignificant
- We do not yet have a single European capital market – issuers have continued issuing in the markets that they and their investors know best
- Competition between CSDs remains limited. Its impact on pricing is unclear, as some CSDs have increased their asset servicing fees. Nor has competition led to consolidation of CSDs
- Settlement and asset servicing remain interdependent."

1.2 Previous assessments of DLT use for securities settlement

Distributed ledger technologies (DLTs) enable the distributed storage and sharing of data records. At the same time, DLTs ensure data integrity through applied cryptography and distributed consensus-based validation protocols. Furthermore, they enable the execution of complex transactions via smart contracts, i.e. programming code that executes agreements automatically on DLT computer infrastructure. Due to their many functional features, DLTs have a potentially transformative impact on financial services. Implementation of these technologies is currently being considered for many financial services functions, including payments, deposits and loans, market provisioning, investment management, and insurance.

The potential of DLT and blockchains, a specific type of distributed ledger technology, for securities settlement has been studied by several authors from various perspectives.

Pinna and Ruttenberg (2016) analyze the current securities post-trade landscape and point out that the necessity to reconcile silos of information controlled by different intermediaries results in complex and expensive processes. They find that embracing DLT to increase the internal/cluster efficiency of existing players would not lead to substantial gains as long as current business practices remain unchanged. In contrast, a radical transformation of trading, where issuing companies, fintechs and governments would set up a peer-to-peer system in the spirit of

Bitcoin, could radically reduce post-trade cost and trading time – but this approach is in conflict with the current regulatory environment. Therefore, Pinna and Ruttenberg (2016) propose the collective adoption of DLTs by CSDs and central banks as a third alternative, which would yield substantial benefits within the current regulatory environment.

Analyzing the potentials and risks of DLT for payment processing and securities settlement, Deutsche Bundesbank (2017) finds that DLT promises improvements in transparency and immutability, operational efficiency, security and resilience, independence from intermediaries, and automated contract processing. Yet, these improvements come at a cost: privacy may be at risk if current encryption technology becomes unsafe as technology improves, a network with different node types may be more prone to attacks, and links to real assets represented on a DLT have to be established by an intermediary.

The Committee on Capital Markets Regulation (2019) argues that public blockchains like Bitcoin are not suited for real-time settlement of securities transactions. They recommend collaborative efforts of existing stakeholders to improve current systems based on permissioned blockchains, pointing out the integration of the cash leg and reversibility of transactions as important issues. Similarly, Chiu and Koeppl (2019) state that, "For policymakers and regulators, three key themes emerge from our analysis. First, to ensure DvP, it is important to link digital ledgers for asset ownership and payments together to support atomic trades. Second, the feasibility of using a blockchain for settlement depends on a sufficient volume of transactions, high enough costs for tampering with the blockchain (possibly in the form of fines) and a limited default exposure. Here, regulation and supervision could play a role to ensure such conditions. Finally, in the case of a permissionless blockchain, coordination to adjust its design might prove difficult. Here, the regulator can help to coordinate the different participants to reach agreement."

Mainelli and Milne (2016) report the outcome of a series of interviews and focus group meetings with professionals working in post-trade processing and the provision of mutual distributed ledger services. Respondents argued that DLTs for securities transaction processing would need to be permissioned, and that substantial reengineering of business processes is needed to reap the benefits of a transition to DLT.

Another factor to be taken into account is settlement time, as it determines the collateral and regulatory capital necessary to cope with counterparty risk. This would imply that the settlement time should be as short as possible. Yet, a too short settlement cycle may require dealers to pre-fund their trades or to borrow the securities they need to settle. In 2013, for instance, the Moscow Stock Exchange transitioned from real-time settlement to T+2, citing security borrowing costs as the key rationale for this move (see Pavliva, 2013). It therefore makes sense to implement flexible settlement times, letting market participants choose this parameter. However, Khapko and Zoican (2020) argue that flexible settlement speed coupled with mandatory borrowing can lead to an inefficient race to shorter-than-optimal settlement cycles, excessive security borrowing activity, and economic rents for security lenders. They find that this tension is reduced by flexible failure-to-deliver penalties that depend on the cost of borrowing securities, disciplining security lender competition and allowing for real-time settlement. In a DLT based settlement system, such features can be implemented in the smart contracts that handle settlement in a straightforward way (see Szabo, 1994 and 1997, for smart contracts).

The BIS Committee on Payments and Market Infrastructures (2017) provides an analytical framework for analyzing the use of blockchains in payment, clearing and settlement. The framework consists of a method for describing the architecture of a DLT network and a set of questions regarding the efficiency, safety, and market implications of a proposed system.

Parallel to the ongoing theoretical analysis of DLT, several prototypes of DLT systems for securities settlement have been built and studied, the most notable ones being Jasper, Stella, Ubin, Blockbaster and Helvetia (see Bech et al., 2020).

Project Jasper is a collaboration between Payments Canada, the Bank of Canada, TMX, Accenture and R3 (see Bank of Canada et al., 2018). In the project, DvP of equity tokens representing a claim on equity held in Canada's depository system against cash tokens representing a claim on the Bank of Canada was tested using atomic settlement on the same ledger. It was found that the new process was more efficient and less risky when compared to the existing settlement system.

Project Stella is a collaboration between the ECB and the Bank of Japan (see ECB and Bank of Japan, 2018). The project tested single-ledger and cross-ledger DvP using security and cash tokens with a focus on settlement failures. In the single-ledger case, trades were found to fail when trading details had not been agreed between parties or when validation of the transaction failed. In such cases, the tokens remain with their owners, exposing traders to replacement cost risk only. In cross-ledger DvP, trades were found to fail if one leg of the transfer could not be delivered, exposing participants to principal risk, too. Hence, the ECB and the Bank of Japan (2018) conclude that an arbitration function on the ledger is needed to deal with such cases.

Based on these findings, Project Ubin (Monetary Authority of Singapore, et al., 2018) served to build a framework for governing settlement processes, including arbitration processes to deal with settlement fails and a recognized market operator for monitoring and facilitating market functionalities. These new processes were found to compress the settlement cycle and to reduce principal risk.

Project Blockbaster by Deutsche Börse and Deutsche Bundesbank (see Deutsche Bank and Deutsche Börse, 2018) served to investigate the performance of DLT for securities settlement using the Hyperledger Fabric system. In these experiments, DLT was shown to fulfill the performance requirements necessary for building real-life settlement systems. Moreover, Deutsche Börse, Deutsche Bundesbank and Germany's Finance Agency have recently demonstrated that it is possible to establish a technological bridge between blockchain technology and conventional payment systems to settle securities in central bank money with a transaction coordinator in TARGET2 (see Deutsche Bank, 2021).

In Project Helvetia, the BIS, in cooperation with SIX Group AG and the Swiss National Bank, showed that it is possible to provide central bank money to settle securities transactions in a realistic near-live setting using new technologies (see BIS et al., 2020). This exercise confirmed the feasibility of linking up the existing systems and of issuing digital central bank money.

Shabsigh et al. (2020) summarize the findings from DLT prototype projects in settlement as follows: "In general, the DLT prototypes showed that DLT could be viable for post-trade securities processing and all projects concluded that securities settlement is a highly suitable and feasible environment for DLT-based solutions. The experiments showed that different DvP models can be implemented in DLT-based

systems. DLT solutions can vary considerably in features and tools, with which a more efficient processing and account method can be designed and customized for improved efficiency and security in specific markets according to market needs."

Regarding the architectures tested, Shabsigh et al. (2020) state: "In all prototypes, the central bank was given the role of cash instrument provider and could thereby also be the one ensuring DvP requirements. A project assumption appeared to be that securities clearing and settlement systems operate within a market structure close to the current structure—that is, exchanges, dealers, CCPs, CSDs, custodians, and central banks operate in similar or near-similar roles as they do today and in a multilayered registration structure. None of the projects analyzed flatter market structures and DvP processing at the end-investor level or other radical structural changes in the market and associated risks." With regard to open issues, Shabsigh et al. (2020) mention the study of the impact of real-time 24/7/365 processing on the design of the system, the analysis of liquidity and credit risk in a realistic setting and the possible changes in market structures.

In addition to the experimental project discussed above, two DLT-based systems for securities settlement are at the pre-production stage, one in Australia and one in Switzerland. The Australian Stock Exchange has developed a DLT-based system for clearing, settlement, and securities registration to replace its current system, called CHESS (Australian Stock Exchange, 2020). The new system, which builds on a prototype developed in 2016, only covers the securities leg. Development costs were reported to amount to USD 50 million.

The Swiss DLT settlement prototype, developed by SDX, covers the full securities value chain including order entry, order crossing in the matching[3] engine, DvP settlement on Corda DLT and distributed holdings of intermediated securities/tokenized cash. The reported costs are USD 100 million so far. According to SDX (2019) "Test-cases will showcase the potential of SDX's riskless trading model, as well as settlement on DLT. Early-stage functionality will cover digital security token issuance as well as live trading and instant settlement. This will include the cash-leg of the transaction embracing the concept of a payment token as well as access to a distributed portal where it would be possible to monitor transactions across specific DLT member nodes." When moving to the new system, SDX expects costs to decrease due to reduced collateral requirements, lower operational costs, and lower data management costs enabling potentially lower fees per transaction. Further benefits anticipated are an increased asset universe, new primary and secondary markets, a private marketplace for interbank/inter-client trades, real-time information at the client holding level enabled by the link between asset and owner and a significant simplification of corporate event handling.

1.3 Outline

Based on these findings, we present a DLT-based architecture for T2S and describe how T2S would work in this new environment. In the description, we concentrate on delivery-versus-payment (DvP) transactions and corporate actions. The principles discussed here also apply to the other transaction types. Subsequently, we analyze the feasibility and advantages of our design from a technical and economic

[3] *Matching is the process of comparing the settlement details provided by the buyer and the seller of securities in order to ensure that they agree on the settlement terms of the transaction.*

perspective and with regard to compliance with the regulatory environment/framework based on the framework presented by the BIS Committee on Payments and Market Infrastructures (2017). In the conclusion section, we summarize our findings and outline some topics for future research.

2 Specification of T2s on DLT

2.1 Architecture – understanding the arrangement

Type of DLT: Following the findings in literature, the system we propose is not publicly accessible but private and permissioned. It employs a heavily centralized consensus protocol, based on a predefined (closed) set of consensus-relevant nodes, and restricts read access. Unlike with public DLT solutions like Bitcoin or Ethereum, this provides advantages from a regulatory perspective, as public DLT solutions are incompatible with existing case law (Pinna and Ruttenberg, 2016). Moreover, permissioned DLTs have a higher capacity and fewer restraints than current permissionless blockchains. Public blockchains currently have trade-offs in lower throughput to preserve as much decentralization as possible (see Schäffer et al., 2019). Since permissonless networks are incompatible with current regulation regarding EU-wide securities settlement, our system makes a tradeoff in decentralization to achieve higher throughput than decentralized public solutions. Such a tradeoff necessarily comes with the caveat of loosened immutability, since permissioned networks are by design controlled by the parties that are authorized to establish consensus on the state of the network. Additionally, the permissioned model does not allow regular users to verify transactions or the current state themselves, which is a core premise of the permissionless model as used in some public blockchains.

Some of these conditions might change in the future. Regulation might adapt and become more welcoming to decentralized consensus on a European settlement layer, accepting some level of power over the infrastructure by unknown participants while preserving regulatory oversight and final say over settlement on a settlement layer connected to a permissionless blockchain implementation. Moreover, public and decentralized DLTs are steadily improving their base layers, as well as introducing various solutions of off-chain scaling possibilities, such as Layer 2 implementations. Such Layer 2 implementations allow for a fully secure, slower settlement layer while more scalable implementations handle most of the network load. Notably the Lightning Network is an ongoing attempt to outsource load from the Bitcoin network onto a Layer 2 solution, which handles transactions through a network of bidirectional payment channels (Poon and Dryja, 2016). Most implementations attempt to solve scalability issues by conducting off-chain transactions and only committing limited data as proof to the settlement layer. Some of these implementations use rollups, mainly ZK rollups (which commit bundled transactions through more complex "zero-knowledge proof" technology) and optimistic rollups (which leverage users actively monitoring and reporting on invalidly committed proofs) (see Whitehat, 2018, for ZK rollups and Optimism for an implementation of optimistic rollups). Additionally, "decentralized finance" (DeFi) tools might bring forward newer technological innovations, which might allow for a preservation of decentralization with high throughput. DeFi acts under different constraints and is described in detail by Schär (2021).

Nodes: The DLT design proposed comprises two types of nodes:

- Central bank nodes: These nodes are authority nodes and designed to manage the infrastructure and develop it further. They have supervisory duties and are responsible for maintaining cash accounts, regulating access to the cash leg and the trading engine, and updating the ledger of transactions.
- Central securities depository nodes: These nodes are settlement nodes and responsible for maintaining securities accounts, issuing new securities, performing settlement, and handling corporate actions. CSD nodes have selected read access to the ledger.

Users: Users send settlement instructions to be relayed by CSDs and receive reports about their holdings and transactions. They do not have access to the ledger but interact with the system via a dashboard which enables them to access messages, send message requests, and select transaction possibilities and currently available methods for settlement. Users, such as commercial banks, can sign their transactions with a key pair. However, direct access to the ledger, which would allow for independent verification by users, would necessitate either a much higher transparency of other users' actions or highly complex cryptographic methods, which would introduce drawbacks and complexities of their own. In our system, the group of users is still restricted to holders of central bank accounts.

Accounts: We distinguish between user-controlled accounts and smart contract accounts, much like permissionless blockchains such as Ethereum (see Buterin, 2014). Members of central banks, CSDs and user organizations interact with the system via user-controlled accounts, with the control tools being keys for the authorization of transactions with one or multiple signatures, depending on local governance rules. Smart contract accounts contain computer code that sends transactions which constitute ledger updates if included in a block, based on function invocations (see Szabo, 1994 and 1997). For T2S on DLT, we propose smart contracts to ensure that buying and selling instructions are executed (settlement smart contracts), to represent securities holdings and execute corporate actions (securities smart contracts), and to enable auto-collateralization.

Smart contract factories: Smart contract factories enable central banks to offer a dynamic collection of regulatory-compliant building blocks for settlement processes rather than default smart contracts limited to a single type of settlement and security. Smart contract factories serve to generate a range of smart contracts based on predefined standards, a feature already used on public blockchains such as Ethereum by projects such as Uniswap and Authereum. Thus, CSDs can create specific smart contracts to enable transactions with certain assets (e.g. stocks) to be settled in a certain way (e.g. DvP) with certain workflow specifications (e.g. T+1) subject to the prevailing technical and regulatory requirements. In other words, while being responsible for the execution of transactions, CSDs are constrained by the types of assets and workflows available from the smart contract factories managed by the central banks. Allowing for contracts to be made fully flexible without mandatory smart contract factory control might imply too drastic a departure from the way T2S operates today.

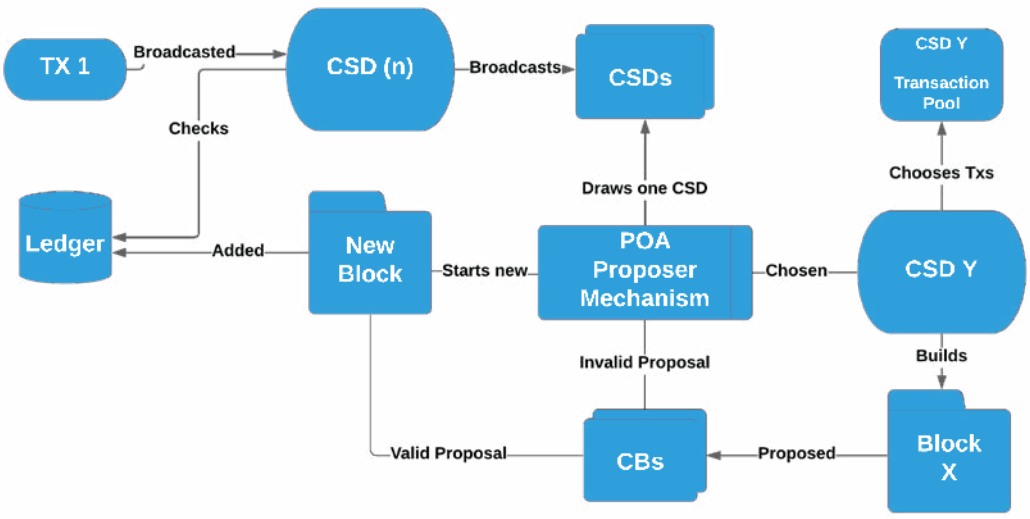
Basic settlement process: Figure 3 provides an overview of the proposed system's consensus and describes the path for a transaction to be included in an update of the ledger's state, by inclusion in a block.

Transactions are broadcasted from one CSD to the next, with each CSD storing transactions to be processed in a pool until they are settled with finality through inclusion in a block, i.e. a permanent record of transactions, by him or another CSD. Whenever a CSD is chosen by the proof-of-authority (POA) selection mechanism to be next in line for block proposition, he selects transactions outstanding from the pool and then proposes his block to the central banks by broadcasting it. The central banks check the block formally for requirements and sign off if the block was formed validly, or refuse their signature if it was formed invalidly. If a block is not accepted, the proposal mechanism chooses another CSD and starts the process again. Blocks that are signed off as valid are stored as an update to the ledger by all parties, who also delete the now-included transactions from their pool, and the process starts again.

In this setting, national banks cannot suggest that a particular transaction be settled. Nor can they reject a transaction for arbitrary reasons, which would be obvious to everyone else. All of this happens within seconds. Unlike in permissionless systems, which currently establish consensus mostly based on proof-of-work (POW, see Nakamoto 2008), in a POA consensus mechanism all participants are known and identifiable. This restricts the participation in settlement to CSDs and central banks, as current regulation demands. As a necessary drawback, the system is highly centralized when compared to open and permissionless blockchains. Most notably, the framework enables CSDs to censor transactions by not relaying them further or by not including them into the blocks they form. This issue is somewhat mitigated by users being able to send their transactions to a different CSD as well as central bank oversight. Additionally, as central banks have final authority over the infrastructure they can roll back transactions to restore a previous state, either if reconciliation is impossible otherwise or if enough central banks were to collude ("malicious nodes"). For a more formal description of POA and its benefits and limitations see De Angelis et al. (2018).

Figure 3

Consensus mechanism



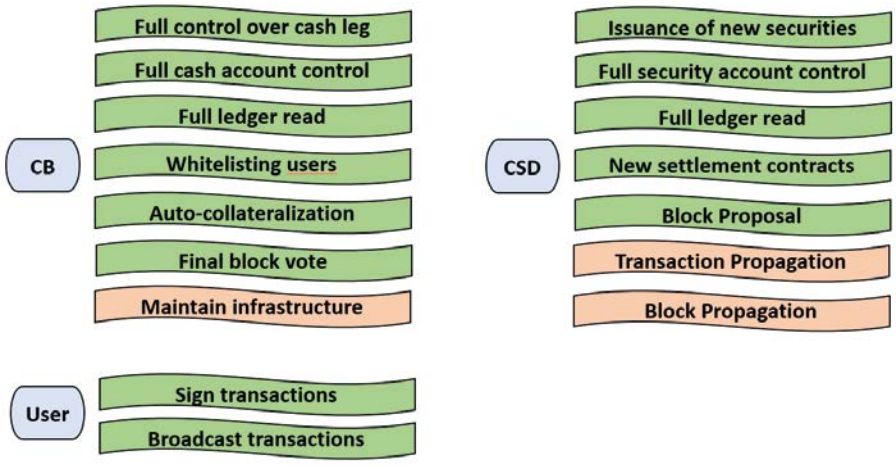
Source: OeNB/Vienna University of Economics and Business.

Cash leg: Each central bank has the right to initiate new cash generation against collateral to provide liquidity to the system. When the DLT system is launched, each participating central bank defines their initial cash balance. This balance is prefunded and serves initial funding requirements. To top up this balance, each central bank can initiate self-funding transactions to be included in the next block; much like Bitcoin blocks include "Coinbase" transactions, which allow for the creation of new Bitcoins. Together, all central banks also operate a multi-signatory account, requiring signatures from all parties, to collect cash that is to be removed from the system. Once sent to said address, the respective funds are locked for anyone and can only be unlocked through a unanimous decision of all central banks. These two mechanisms allow for the creation and destruction of cash in the system. Together, they allow for a flexible cash regime where clients in TARGET2 can deposit cash with their central bank, which in turn creates that amount of cash via a self-funding transaction on the DLT ledger and then sends this cash to the client's cash account on the DLT ledger. Until TARGET2 has been consolidated with TARGET2-Securities, which removes the requirement to net out end-of-day balances, this DLT process can also be used to create and remove daily balances. When the multi-signatory address has a large enough balance, central banks can use this already existing but locked cash to fund cash accounts again or use it for auto-collateralization by unanimous decision and signature.

Overview of roles and obligations: Figure 4 summarizes the roles and obligations in the system. Central banks act as validators and are obliged to propagate blocks. They also mint/burn cash and are able to lock funds. The central banks cooperatively create smart contract factories, keep the infrastructure up to date by building and updating the protocols, handle permissions of CSDs and approve blocks. The CSDs can create new contracts using the smart contract factories provided by the central banks, and handle transactions and corporate actions. Moreover, it is their job to validate the existence of securities and to propagate transactions. Users initiate and sign transactions.

Figure 4

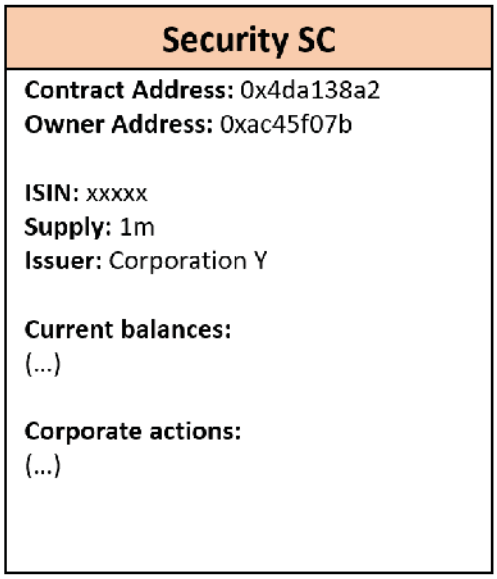
Overview of roles



Source: OeNB/Vienna University of Economics and Business.

Figure 5

Security smart contract



Source: OeNB/Vienna University of Economics and Business.

2.2 Security smart contracts

Creation: Similar to regular token contracts on permissionless DLTs, such as ERC20 (Vogelsteller and Buterin, 2015), which contain standardized functions that, for instance, allow anyone in the system to check the balance of any user, a T2S DLT security smart contract is created by a CSD and contains standardized functions. It consists of building blocks provided by the smart contract factories, which define the possible data structure and entries available to the CSD. This mechanism ensures that newly created securities comply with the relevant regulatory requirements. Factories are used to provide largely harmonized constructs for corporate actions and settlement processes, too. The ability of smart contracts to interact with each other allows for transparent automated processes. Similar security contracts have been proposed for standardization in permissionless blockchains such as Ethereum via EIP/ERC-1400 (Dossa, 2018).

Structure: As can be seen from figure 5, a security smart contract has an address through which it can be called, and through which it can receive/send euro amounts and the contract's security token. Moreover, it stores the ISIN as a link to the CSD database. A security smart contract is owned by the CSD that records the security, and this CSD is the only party that can invalidate the contract by issuing a new one with a copied state (to allow for upgrades). Issuer information is provided either with in-system addresses or stored outside of the system. Ownership is tracked with a dictionary recording the current owners of the respective tokens. These variables are updated by settlement smart contracts (see below). Another variable indicates whether the security is available for auto-collateralization. This variable is set by the central bank controlling the auto-collateralization whitelist contract. Further, the contract can lock and unlock holdings when "called" by either central banks or through auto-collateralization contracts (see below). This prevents owners from sending their balance while the security is locked by auto-collateralization. Finally, contract functions are designed to execute corporate actions. For instance, a dividend function can be called with a certain timestamp/blockstamp set to dividend payout days with a view to distributing the current euro balance to the owners according to current holding structures.

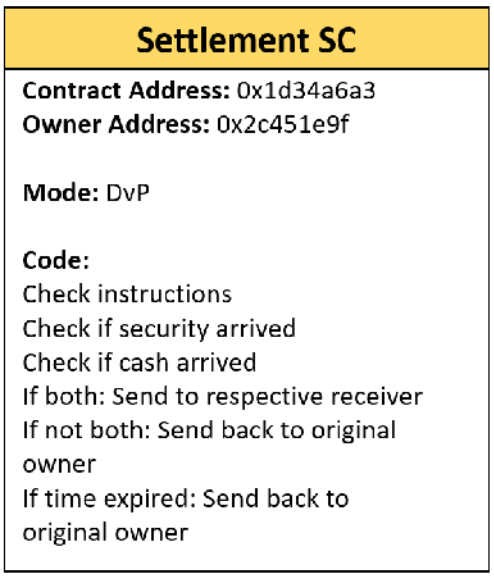
2.3 Settlement smart contracts

Settlement smart contracts serve to trigger exchanges according to defined rules. Contracts are created by the CSD through the smart contract factories to ensure that both instructions of a deal are posted to the ledger or none. In the system we propose, both securities and cash exist on the same ledger, so smart contracts can

be used for atomic settlement. As can be seen from figure 6, an atomic settlement smart contract has an address through which it can be called, and through which it can receive/send euro amounts and security tokens. The contract is owned by the CSD that initially created the settlement contract. This CSD can also invalidate the contract by issuing a new one (to allow for upgrades).

Figure 6

Settlement smart contract



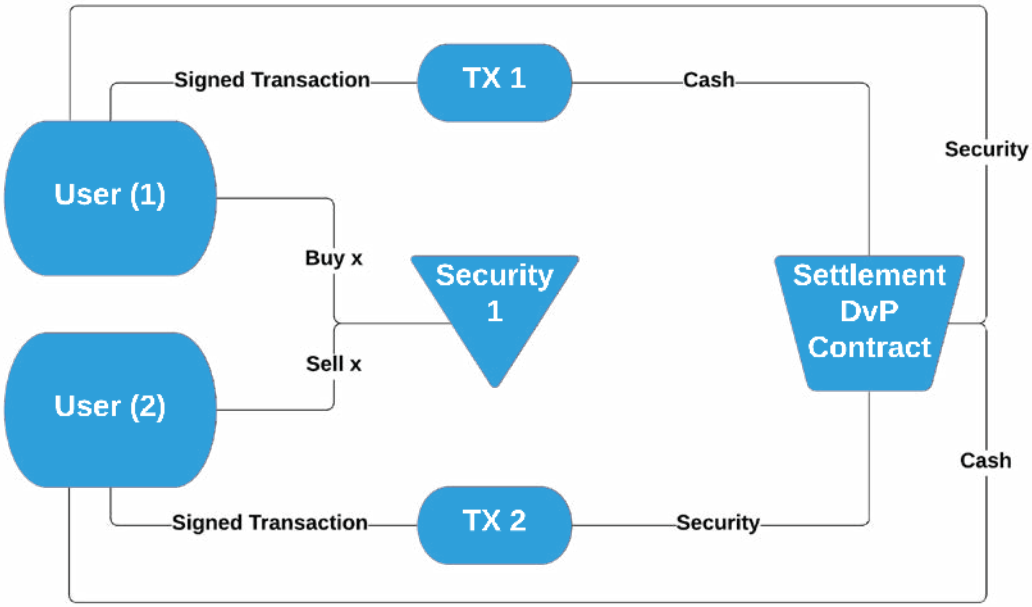
Source: OeNB/Vienna University of Economics and Business.

Such atomic transactions are implemented in permissionless blockchains as swap contracts or decentralized exchanges (see AirSwap or Schär, 2021). The standard contracts serve to trigger two transactions that need to be carried out:

- The first transaction is an initial calling of the contract, which includes the sender's instructions and signature. The instructions include a euro sender address and amount, a securities sender address and an amount and an exit transaction timestamp, which allows terminating the settlement unless both sides have sent their part by a defined time/blockstamp. A blockstamp specifies the settlement time in terms of the number of blocks that have been posted to the ledger following the creation or calling of the smart contract.
- The second transaction, in which the contract receives either euro amounts or security tokens, triggers the contract. The transaction necessitates a signature and a set of instructions that fits the one it references and which was received earlier. If the set of instructions or the amount sent do not fit the initial transaction received, the funds are returned to the sender.
- The contract's transactions are triggered if either the corresponding euro amounts or security tokens are sent, or the timestamp expires. When the correct amount of both settlement parties is received according to instructions sent and signed by both parties the contract fulfills the instructions by sending the respective euro amounts and security tokens to the respective receiver, thus settling DvP in the agreed-upon timeframe. If the correct amounts of both parties are not received by the timestamp recorded in the initial set of instructions, the contract invalidates the initial instructions and returns any funds sent earlier and according to instructions back to the respective sender. In such a case, the contract sends a settlement fail message to the central banks, which allows them to penalize the actor that failed to deliver.

Figure 7

Settlement mechanism



Source: OeNB/Vienna University of Economics and Business.

Figure 7 shows how the security and settlement smart contracts interact with the transaction processing mechanism for the example of a security delivered against cash. The two signed transactions trigger an exchange via the settlement contract if, and only if both parties send their side in full and in time. If either of those conditions is not met, the settlement contract returns any received assets back to the respective owner.

2.4 Smart contracts for auto-collateralization

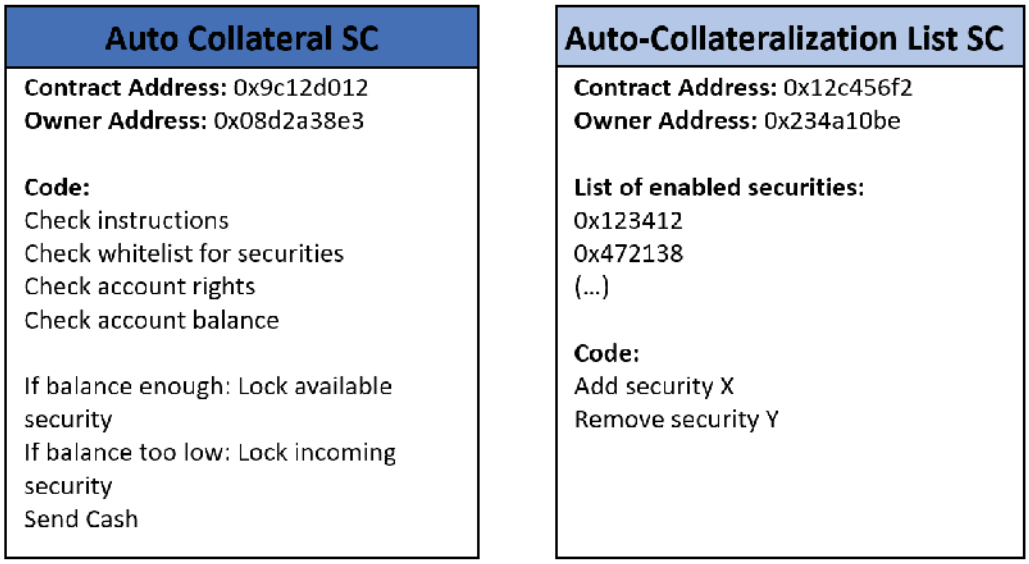
Another two types of smart contracts serve to accomplish credit provision through auto-collateralization via "auto-collateralization on flow" or "auto-collateralization on stock": auto-collateralization and the auto-collateralization list (see figure 8). Auto-collateralization locks securities which are already in the possession of the buyer or after they have been transferred and reverses the lock when the credit provided by the central banks via the respective smart contract has been repaid. Auto-collateralization is owned by the central banks via multi-signature control, meaning that changes must be signed by several central banks. This contract is pre-funded by central banks and recovers its balance as needed to unlock funds previously used in auto-collateralization. To achieve auto-collateralization, the respective smart contracts check several aspects, including:

- the authorization of the address calling the contract to receive auto-collateralization
- the current balances (euro and tokens)
- the auto-collateralization list smart contract, to see if the requested security token is currently whitelisted to be used for auto-collateralization
- the instructions sent to the auto-collateralization smart contract

The contract then sends euro balances to cover the transaction and locks tokens in the respective security smart contract (see figure 9). In case of auto-collateralization on stock, the tokens locked are already in the requesting user's control and will be locked in the respective token contract. In case of auto-collateralization on flow, the respective share of the newly acquired security tokens is locked after the ownership change in the token contract. The smart contract can also be called to reverse the locks when the credit is repaid, where it again checks rights and instructions, and needs to receive the proper amount of euro to unlock the contracted tokens. The auto-collateralization list defines smart contract functions as a whitelist for auto-collateralization. It is owned by the central banks via multi-signature control and has a function that administers a dictionary containing the addresses of security smart contracts for securities that can be used for auto-collateralization on stock or flow.

Figure 8

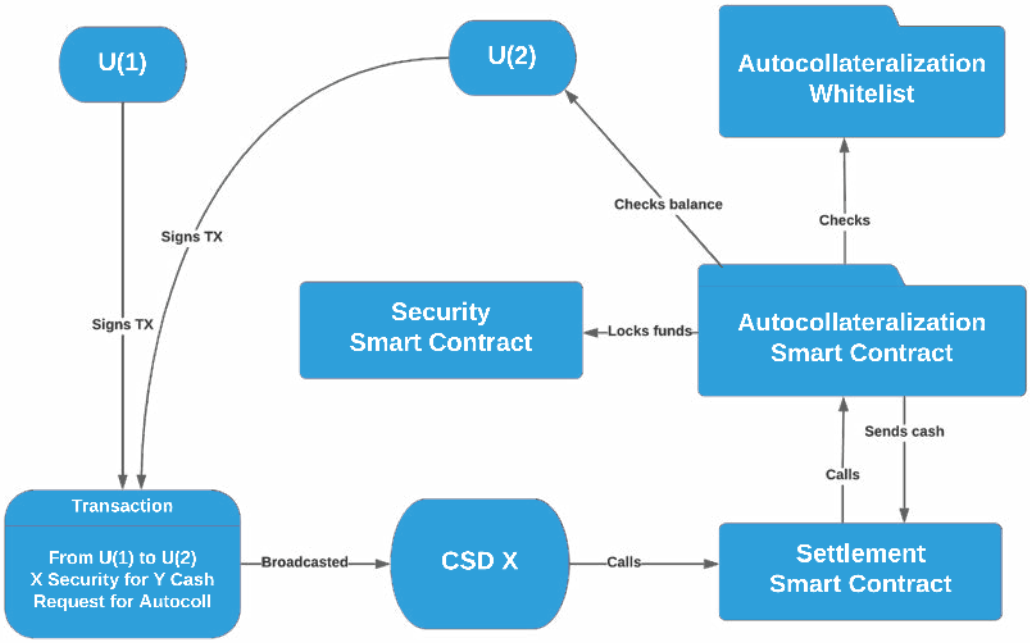
Auto-collateralization smart contracts



Source: OeNB/Vienna University of Economics and Business.

Figure 9

Auto-collateralization mechanism



Source: OeNB/Vienna University of Economics and Business.

3 Evaluation of the design

3.1 Architecture and governance

The system we propose better represents the federated structure of the Eurosystem than the current T2S architecture as every national bank has the same access in its capacity as an authority node – i.e. has access to data, voting rights and authorization possibilities. This means that the infrastructure and database are managed jointly on an equal footing. All participating central banks are thus granted the same rights. The central securities depositories are responsible for DvP and for the settlement of securities accounts. An effective separation of powers is achieved through role allocation and task assignment in the system. With regard to implications for the financial market architecture, the proposed system is evolutionary in the sense that it does not change the role of existing actors and procedures besides making securities settlement more efficient and effective. It is also innovative as it facilitates the integration of other assets in the settlement and allows for flexible settlement times. Moreover, new types of settlement workflows can be integrated in an incremental fashion via the smart contract factories.

3.2 Regulatory compliance

The architecture we propose provides advantages over the current system in the area of supervision possibilities. Banks, in the system as users, and their clients (not in the system) can be represented and controlled on the platform at a granular level and in real time. Auditing and supervision are possible in real time with granular data up to a direct holding level. With every status update of the system, the central banks have immediate access to information about the current state of the system, capital holdings, etc. Furthermore, automated reports are possible: At certain

points in time or for certain events, reports are automatically generated – for example, on settlement failures – and automatically sent to the relevant stakeholders, perhaps even requiring a signature to confirm receipt. In this system, we can also program compliance checks to a certain extent. This means, for example, that one can program assets so that they can only be held by predefined (list) addresses or persons. This list can be updated at hourly, daily, or weekly intervals. This function is similar to the auto-collateralization process where users and/or assets are checked against an associated whitelist.

At the regulatory level, there are two identified hurdles, each of which can be solved by two options. First, paper certificates are regulated at the national level. Central securities depositories can continue to store documents first and then represent them digitally in the proposed concept. Alternatively, regulatory changes would have to be implemented for a purely digital securities certificate, as is currently being considered in Germany. Second, certain functions of central securities depositories are regulated EU-wide. In our case, this concerns, for example, the management of securities accounts and the execution of settlement. Current processes can also be replicated in this case. In the proposed concept, CSDs bundle the transactions to be carried out and propose them as a block, which would then be jointly signed off by the central banks, as required by regulatory standards.

3.3 Performance

Capacity: T2S currently settles 600,000 transactions per day on average. Settlement must also be possible within at least one day, and cash transactions (when the cash leg is included) must be completed in less than ten minutes.

These figures are feasible in the DLT system we propose. As a comparison, even the limited permissionless Ethereum blockchain can process 700,000 transactions per day on average. Performance tests of federated platforms are a more realistic comparison. Other platforms that make a tradeoff in decentralization are achieving much higher throughput than current public and permissionless platforms. Corda can handle more than 50 million transactions per day, with tests showing much higher, Quorum can handle over 60 million and Hyperledger Fabric can support at least 13 million, up to over 100 million in tests (see Creer, 2018, for Corda; Baliga et al., 2018, for Quorum; and Parth et al., 2018, or Chung et al., 2019, for Hyperledger Fabric). These results show that there is enough capacity also in peak times even in a net-settlement system and under the assumption of further restrictions (higher number of transactions per settlement with an external cash leg).

Speed: Meeting time restrictions is no problem from a technical point of view, either. Based on comparisons of existing platforms and the analysis of the technical tests mentioned, the concept assumes possible final DvP settlements under one minute, cash transactions under 30 seconds (see e.g. Baliga et al., 2018; Chung et al., 2019; Thakkar et al., 2018; and Creer, 2018). The proposed concept enables participants to use variable settlement times. This would make it possible to settle most transactions within seconds. In order to offer alternative processes, e.g. short sales, it is possible to integrate selected settlement periods (e.g. DvP+1) as well.

3.4 Cost efficiency

Development and operational costs: In terms of costs, there are very few comparable projects. For example, the Swiss project of the SIX Group is worth about

USD 100 million, including the first prototype and progress implementation (see SDX, 2019). The Australian Stock Exchange ASX project is valued at over USD 50 million with roughly comparable progress (see Australian Stock Exchange, 2020). Otherwise, there are hardly any comparisons for federated DLT projects. Ernst & Young (2019) estimates USD 1.5 million for a simple prototype. This does not take into account the costs of overcoming the regulatory hurdles – which are also a major cost factor when implementing the system we propose.

Based on these media reports on comparable projects, it can be estimated that a comprehensive settlement solution based on DLT would be implemented at much lower cost than the amount spent for T2S. Due to savings through lower complexity in monitoring as well as increased flexibility of the participants, lower costs than the current amount spent for T2S can be expected during operation.

Competition between CSDs can be stimulated by employing a market mechanism to determine the settlement fees. Similar to Bitcoin transaction fees, a maximum willingness to pay can be included in a settlement instruction, which will be collected by the CSD that includes the instruction in the block proposed to the central banks.

Cost of credit and liquidity management: A key benefit of the proposed architecture is the possibility of flexible settlement times. Here, the parties of a transaction can choose a settlement time depending on the conditions of the deal within the regulatory boundaries specified in the settlement smart contract factory. Our design is flexible enough to allow for the implementation of more complex schemes like the flexible failure to deliver penalties proposed in Khapko and Zoican (2020). This should provide for a substantial reduction of the cost of capital; the amount of savings could be determined via a market survey (e.g. Boston Consulting Group, 2012) and through prototyping.

Efficiency gains from automated contract tools: Corporate actions can be automated via security smart contracts. Similarly, all aspects of a settlement transaction including penalties, reporting etc. can be automated with settlement security contracts. Thus, operational costs may shrink substantially.

Users, such as banks, can control various addresses depending on their specific needs. Users, while not able to see the full ledger themselves, are able to request automatic reports on their holdings and history. Such reports are trivial to implement, as they can be easily generated from a full access ledger view (full history of the ledger); and authentication for a user account is given via signature.

Speed and transparency in reconciliation: As shown in figure 3, the system automatically keeps the ledger and the local databases of the CSDs in sync. Therefore, no additional reconciliation steps are necessary, which avoids costs and time for reconciliation. Due to the automatic reports, reconciliation with the users is improved too.

3.5 Operations and security risk

In general, the system we propose is highly resilient due to its federated structure, where nodes can be in every participating country instead of four operating sites in two regions. This can allow for resilience against attacks and prevent downtimes. In attacks attempting to remove certain actors from the system by blocking their infrastructure, the remainder of participating members will keep the system running and active. This allows for continued operations even when several nodes are attacked at the same time.

Introducing fraudulent transactions into the system would require control over the private key of the sender's address and could be rolled back later by CSDs and central banks. Cash leaving the system is controlled by central banks initiating the transfers to TARGET2. Additionally, since all members participating in consensus are known, verified, and bound by regulatory requirements, the potential damage by bad actors is limited. Since full control over the infrastructure lies with the central banks, the system can be halted or stopped if needed.

At the same time, the code of the smart contract factories needs to be thoroughly checked and verified, and key management at the central banks and CSDs must be organized properly to prevent security breaks and attacks. Implementing proper management of cryptographic access to the system and its components will be necessary to limit potential attack vectors. This process does not differ significantly from other financial infrastructures. Yet, DLT systems are still emerging technologies that continue to be under development and need proper verification of all code, especially the logic determining the smart contract factories. Proper infrastructure upgrade processes need to be established early in order to determine a collaborative but secure infrastructure maintenance by the central banks. To achieve high quality levels and transparency, the system should be open source. Depository Trust & Clearing Corporation (2020) provides a comprehensive security framework for DLT applications in the financial industry that offers measures to minimize operational and security risk.

4 Conclusions and outlook

We have shown how the core functionality of the T2S system for securities settlement in Europe could be realized on the basis of DLT. We propose an architecture where the participating central banks provide the infrastructure and regulatory oversight on an equal footing in a federated way, replicating the ledger and providing the digital infrastructure via smart contract factories and signing off settlement transactions. Within this framework, the CSDs perform settlement. The cash leg may either be integrated but payment may also be effected via a separate payment system. The main advantages of the system are shorter and variable settlement times, increased regulatory compliance, reduced reporting, and reconciliation overhead and flexibility with regard to asset types and settlement procedures.

These features may be considered sufficiently attractive to detail the proposal further in the direction of a prototype that allows the assumptions to be tested in a realistic setting. Such a system would be an ideal basis for studying the impact of real-time 24/7/365 processing on the system design, for analyzing liquidity and credit risk in a realistic setting and for further investigating the possible changes in market structures.

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The share of zombie firms among Austrian nonfinancial companies

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Aggregate productivity and economic growth may be reduced by "zombie firms" – weakly performing companies that, instead of exiting the market or being restructured, manage to continue operating over an extended period. This article presents first results on the incidence of such zombie firms in Austria, based on three definitions relating to firms' interest expenses but focusing on different aspects thereof. The main definition measures interest expenses as a ratio of earnings ("interest coverage ratio"). The other two definitions are based on the relationship of interest expenses to liabilities and enhance this information either with firms' probability of default or their interest coverage ratio. According to all three definitions, the share of zombies fell substantially (even if to different degrees) between 2009 and 2018, across industries and firm sizes. The drop of the zombie share was particularly strong for highly leveraged enterprises. Still, at the end of our observation period, zombie firms continued to have less favorable risk characteristics than non-zombie firms, in particular a distinctly higher probability of default. How this pattern may have changed as a result of the COVID-19 pandemic remains to be seen because our data do not go beyond 2018. Somewhat reassuringly, zombie firms are not more prevalent in those industries that were hit particularly hard by the pandemic. Further findings were obtained with simulations keeping the policy interest rate unchanged over the period under review. Under this assumption, the zombie share established with firms' interest coverage ratio would have remained roughly constant. The difference between the observed and the simulated zombie shares is particularly pronounced for real estate-related industries, more leveraged firms, and larger companies. Finally, the data show that zombie status is not irreversible. Among those firms for which financial statements information is available for the entire observation period, most zombie firms manage to exit from zombie status.

JEL classification: D22, E43
Keywords: zombie firms, firm behavior

In a competitive market, weakly performing companies would exit the market, be taken over or restructure. And yet, some firms manage to continue operating over an extended period despite their weak performance – as did Japanese firms after the collapse of the Japanese asset price bubble in the early 1990s, supported by the banking sector. It is in this historical context that the label "zombie firms" was first applied.

The economic literature has since identified several ways through which zombie firms can reduce aggregate productivity and economic growth. For one, zombie firms themselves are often found to exhibit low levels of productivity.[2] Additionally, the literature has pointed to "congestion" effects caused by zombie firms. Congestion effects may occur if zombie firms lock resources and thereby crowd out investment

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[2] *See e.g. Caballero et al. (2008), Adalet McGowan et al. (2017) and Banerjee and Hofmann (2018).*

and growth of more productive firms or if the presence of zombie firms impairs the availability of loans to healthy firms.[3] The latter may occur either directly – given the inability of banks to lend to healthy firms because their balance sheets have been weakened by their zombie exposure – or because zombie congestion has reduced industry profitability and thus the returns on potential projects of healthy firms. Furthermore, it has been argued that zombies add to pressures that healthy non-zombie firms are facing if they want to obtain bank financing. By "absorbing" bank capital at prices below a level that might be adequate with respect to their riskiness they might drive up interest rates on bank loans for non-zombie firms or even reduce access to external financing (see Hallak et al., 2018). Moreover, any financial "subsidies" that zombie firms receive from banks in the form of loans at interest rates that do not reflect their credit rating, allows them to exert competitive pressure on healthy firms on product and factor markets for longer periods than would have otherwise been feasible. However, the notion of zombie firms "congesting" loan markets implies that other firms would stand ready to borrow the very funds that were locked up at zombies. Yet, at least until the onset of the COVID-19 pandemic, relevant surveys such as the WIFO business cycle survey or the ECB's Survey on the Access to Finance showed a decreasing share of enterprises reporting impaired access to bank loans. Furthermore, start-ups are by their very nature not apt for financing in the form of bank loans.[4]

Even if zombies were a drag on productivity growth and hindered the reallocation of labor to more productive uses, in the current situation their existence can be of some benefit as they contribute to employment. Eventually, such companies might fail, but in the current adverse economic circumstances, there is no benefit in forcing them all out of business at once.

In the past decade, monetary policy might have contributed to the emergence of zombie firms in several ways: As low interest rates reduce banks' opportunity costs of cleaning up their balance sheets (the return on alternative assets), cut the funding cost of bad loans, and increase the recovery rate on those loans, banks are more likely to "evergreen" loans to zombie firms. Furthermore, a lower interest rate level may increase banks' incentives for risk-taking (Borio and Zhu, 2012). Since zombie companies are risky debtors, more risk appetite should reduce financial pressure on them (Banerjee and Hofmann, 2018).[5] Acharya et al. (2019) find that the ECB's OMT announcement in 2012 induced banks to extend credit to low-quality borrowers at subsidized rates in euro area periphery countries. In contrast, more stringent regulatory requirements or changes in banks' risk policies might have curbed bank lending to potential zombies, therefore negatively affecting the zombie share (see Gnan et al., 2019).

The COVID-19 pandemic has added fresh impetus to the discussion over zombie firms. With an uncertain economic outlook, the survival chances of firms

[3] *See for example Banerjee and Hofmann (2018) and Adalet McGowan et al. (2017) for the former and Andrews and Petroulakis (2019) for the latter.*

[4] *See Berger and Udell (1998) who postulate a life-cycle theory of small firm finance wherein financial needs and options change as the business grows and becomes less informationally opaque. Likewise, Hall (2009) finds evidence that debt is a disfavored source of finance for R&D investment. See also Bindseil and Schaaf (2020) in the context of zombie firms.*

[5] *Evergreening of loans to zombie firms might also arise because of bank forbearance, as banks might want to avoid realizing losses on their balance sheets.*

in general and of less productive firms in particular have become more uncertain. At the same time, one might argue that massive government interventions in reaction to the pandemic may allow firms to survive that under normal circumstances would exit because of poor performance. Thus, government measures may have created zombies, even if these measures are intended only for firms that were economically viable before the crisis. This could hold back the economic recovery. Moreover, since bank loans have been a central instrument to safeguard corporate liquidity during the pandemic as monetary, fiscal and prudential policies all aimed to uphold the flow of bank lending to the real economy, the support measures will increase the debt of corporations and the number of debt-laden companies which in turn could create additional zombie firms.

Against this background, we take stock of the incidence of zombie firms in Austria, based on a number of firm characteristics, such as size and age, risk characteristics, and industry affiliation. The evidence we provide is, among other things, derived from an OeNB firm database containing annual financial statements information and it relates to the period 2009 to 2018. This implies that our dataset does not include the time since the onset of the COVID-19 pandemic.

This paper is structured as follows: Section 1 describes the dataset. In section 2, we discuss the definition of zombies, particularly in terms of operationalization for our analysis. Section 3 presents our results. We show both the development of zombie firms over time as well as the characteristics of zombie firms for the latest year available. By means of simulation we also discuss how the share of zombie firms would have – ceteris paribus – developed if interest rates had remained unchanged over the period under review. Finally, section 4 concludes and discusses potential caveats.

1 Data

The dataset employed in our analysis is drawn from several data sources. First, we make use of annual financial statements information about nonfinancial corporations domiciled in Austria that the OeNB compiles for the purpose of inhouse credit assessment (ICAS) ratings. These ratings serve to assess the eligibility of credit claims as collateral for Austrian banks' monetary policy operations with the OeNB. As the OeNB accepts only credit claims to firms with a sufficiently high creditworthiness for this purpose, more stable companies are likely to be overrepresented in our sample. Yet, credit claims of a large part of the firms in the sample are not eligible for Eurosystem monetary policy operations. An essential part of the financial statements information is drawn from Austria's public commercial register ("Firmenbuch"). This implies that the granularity of the data is quite heterogeneous, since reporting requirements are much lighter for smaller firms. Therefore, the OeNB additionally collects more granular financial statements information provided by banks and the firms themselves. For the purpose of this paper, we augment the financial statements data with information on the one-year probability of default (PD) for the respective firm-years, as calibrated in the ICAS framework. In those cases where an ICAS-PD is not available we use PD measures derived from IRB ratings of credit institutions. Furthermore, we supplement these data with information on the sector classification and founding date of the companies, which is also available at the OeNB.

We exclude firm-years whose financial statements are not granular enough to calculate the indicators relevant for our analysis. This concerns notably small firms, which therefore are underrepresented in our sample. Records which fail basic data quality checks are also excluded from the sample. Furthermore, we include only nonfinancial corporations (i.e. sector 11) according to the European System of Accounts (ESA). Given the distinct scope of their activity, we omit head offices (NACE group 70.1) and holding companies (NACE group 64.2) based on the Statistical Classification of Economic Activities in the European Community (NACE).[6] Thus, an unbalanced panel containing 70,113 firm-years for the years 2008 through 2018 is available for our analysis. The annual number of companies in our dataset falls over most of the observation period. Starting with 6,792 observations in 2008, the annual number of observations peaked at 8,337 in 2011 and dropped to 3,120 in 2018. This drop is due to an increasing focus of the ICAS data on firms whose assets are more likely to be pledged as collateral for monetary policy operations.

2 Three definitions to identify zombie firms

Our starting point is the specification that has been most commonly employed in the recent empirical literature (e.g. Adalet Mc Gowan et al., 2017; Banerjee and Hofmann, 2018; Andrews and Petroulakis, 2019; Deutsche Bundesbank, 2017), namely the ratio of operating income (using EBIT[7]) to interest expenses. Essentially, the interest coverage ratio (ICR) measures how many times a company can cover its current interest payments with its operating income. The lower a firm's ICR, the larger the fraction of annual operating income it has to use for interest payments. A company with an ICR of 1 will spend its entire operating income on interest payments, while a company with an ICR of below 1 – which is our first definition of zombie firms – will not generate enough operating income to meet its current interest payment obligations. In addition to their low internal financing capacity, firms with a low ICR might face external financing constraints and thus investment constraints. It has been shown that companies with a high interest rate burden (implying a low ICR) have lower investment rates because debt servicing has a strong influence on investment activity (Martinez-Carrascal and Ferrando, 2008).[8]

In order to smooth short-term fluctuations, we assume that the ICR must have been smaller than 1 for two consecutive years in order for a firm to qualify as a zombie firm. In doing so, we follow the practice in the relevant literature, although most of the papers use a period of three years. However, because of frequent exits from and entries to the dataset, a three-year period would have excluded 55% of the available firm-years from the dataset for calculating the zombie indicator, instead of 35% when using two years. As a further criterion, also following the

[6] *Those firms own and control other economic entities within a company group. Head offices oversee and manage these units, while holding companies' principal activity is owning the group, without administering or managing it. Typically, such entities do not produce or sell any products or services or conduct any other business operations. Given the scope of their activities, the structure of their balance sheets and their profit and loss statements differs from other firms. In 2018, a little over 5% of all firms in the dataset were head offices and holding companies.*

[7] *There is some discussion about which metric of the operating income is the most fitting in this respect. See annex A4.*

[8] *Very high ICRs might, however, also indicate that opportunities for borrowing and thus for future growth are not being used.*

literature, we presuppose a minimum enterprise age of ten years in order to prevent falsely classifying young fast-growing enterprises whose profits are still low as zombie companies.[9]

This definition of zombie firms is based on the idea that weakly performing firms are not able to cover their interest expenses with their earnings. However, this definition may also classify some firms as zombies that e.g. have negative profits for a number of years while developing a new product that may later generate profits. Another aspect is the relationship between the ICR and the interest rate environment. Falling interest rates, as observed in the last decade, entail lower interest payments by companies. Thus, by construction of this indicator, it is expected that – ceteris paribus – the share of firms identified as zombies decreases as well, although the fundamentals of the weakly performing firms might remain unaltered.

Alternatively, we identify those companies as zombies that pay lower interest rates on their outstanding debt than would be warranted by their credit rating or their ICR, respectively. This approach has been pioneered by the seminal work of Caballero et al. (2008).[10] We operationalize this definition by following the approach presented by Acharya et al. (2019) for our second and Acharya et al. (2020) for our third definition (see below). For both approaches, the initial step is to identify firms that pay an interest rate on outstanding debt that is below a benchmark interest rate – termed preferential interest rates (PIR) in the following. A company's interest rate in this context is defined as the ratio of its interest expenses according to the profit and loss statement to its liabilities according to its balance sheet. The benchmark interest rate is calculated as the median interest rate paid on outstanding debt of firms with a very good credit rating. Using the harmonized rating scale of the Eurosystem, firms with a very good credit rating are those companies who qualify for the credit quality steps (CQS) 1 and 2 on this rating scale – i.e. companies with a default probability below 0.1%. In other words, the amount of interest paid by a company plays a role both when we use the ICR measure and when we use the PIR measure. However, the effects of a change in interest rates are different. Ceteris paribus, rising interest payments increase the likelihood that the interest coverage ratio drops below 1 (i.e. our first definition of zombie firms) but decrease the likelihood that paid interest exceeds the benchmark interest rate.

In our second definition, we assume that zombie firms are firms that meet the preferential interest rate criterion and also have a low credit rating, and have been in the market for at least ten years. Specifically, the credit rating criterion is met if the firm's probability of default is above 1%, which means that the firm is not eligible for additional credit claims[11] (ACC) according to ICAS. As this definition comprises both access to preferential interest rates and a default probability measure, we call this measure PIR-PD. Credit institutions might agree to such preferential interest rates for companies with a bad credit rating out of concerns that these firms would face further distress and might end up in bankruptcy. Such firms

[9] *It could be argued that applying this criterion leads to the omission of all those firms that exit the market before becoming ten years old. But the aim of this analysis is not to look at unviable firms but on those unviable firms that do not leave the market.*

[10] *Caballero et al. (2008) label this definition as "subsidized credit."*

[11] *The upper level for ACC is set at 1.5% for the Eurosystem in general but modified to 1% for the Austrian ICAS.*

are not identified by the ICR definition as zombies despite their weak economic performance because of their low interest payments. The PIR-PD definition addresses this issue and identifies any firms as zombies whose loan conditions are unusually favorable in the context of their credit ratings. This definition, therefore, relaxes the assumption that on competitive financial markets corporations pay interest rates on their outstanding debt based on their risk profile. A drawback of this definition is the implied link between the probability of default and interest payments. Although this link is very well established in the academic literature (Schierenbeck, 2014), any circumstance that decreases the interest payments as a proxy for expected credit losses while not affecting the rating, such as implicit support (by public entities) or collateral, might lead to incorrectly classified corporations.

Our third definition, finally, combines the ICR criterion and the PIR criterion. Specifically, we assume that zombie firms are companies older than ten years that have an ICR below 1 and pay preferential interest rates. Accordingly, we call this measure PIR-ICR.

A caveat regarding the use of interest rates that applies to all definitions is that relating a flow variable covering a whole year (interest expenses) to a year-end stock variable (outstanding debt) might create some inconsistencies. For example, interest expenses are overestimated in those cases where a firm reduces or pays off its loans before the end of the year so that they are no longer recorded on the balance sheet. Conversely, the opposite effect might occur if a firm takes out a loan late in the year. Similarly, loans that a firm receives from another group member might have different conditions than bank loans.

3 Results

In this section, we present our results based on the zombie definitions presented above. Following a discussion of the overall trend over time using all three definitions, we analyze the results for the ICR definition in more detail.[12] As the ICR definition includes only cases with an ICR below 1 for two consecutive years, the first year for which zombie firms can be identified by this measure is 2009. The percentage of zombie firms for any given year is calculated as the number of zombie firms in that year divided by the total number of firms in the same year which can be either identified as zombie or non-zombie firms (excluding nonclassifiable firms).

3.1 Development of the zombie share from 2009 to 2018

For 2009, the ICR measure identified 10.6% of the firms in our sample as zombie firms against 13.2% according to the PIR-PD metric and 6.0% according to the PIR-ICR indicator. Until 2018, the share of zombies in our sample fell strongly based on all three measures: by 6.5 percentage points to 4.1% based on the ICR indicator, by 11 percentage points to 2.2% based on the PIR-PD indicator and by 5 percentage points to 0.9% based on the PIR-ICR indicator.[13] Even though the zombie share declined for all three measures, the shape of the decline differed. While the zombie share according to the ICR remained relatively stable in the first four years – and even increased by 0.8 percentage points in 2011 – it declined noticeably

[12] *See the appendix for detailed results for the PIR-PD and the PIR-ICR indicators.*

[13] *Using three instead of two years, the zombie share according to the ICR measure would have been 2.6% in 2018 instead of 4.1%.*

in the second half of the observation period. This reduction was especially pronounced in the years 2015 to 2017, when the share of zombie firms fell by more than 1 percentage point each. In contrast, the zombie shares according to the definitions including preferential interest rates exhibit stronger initial declines.

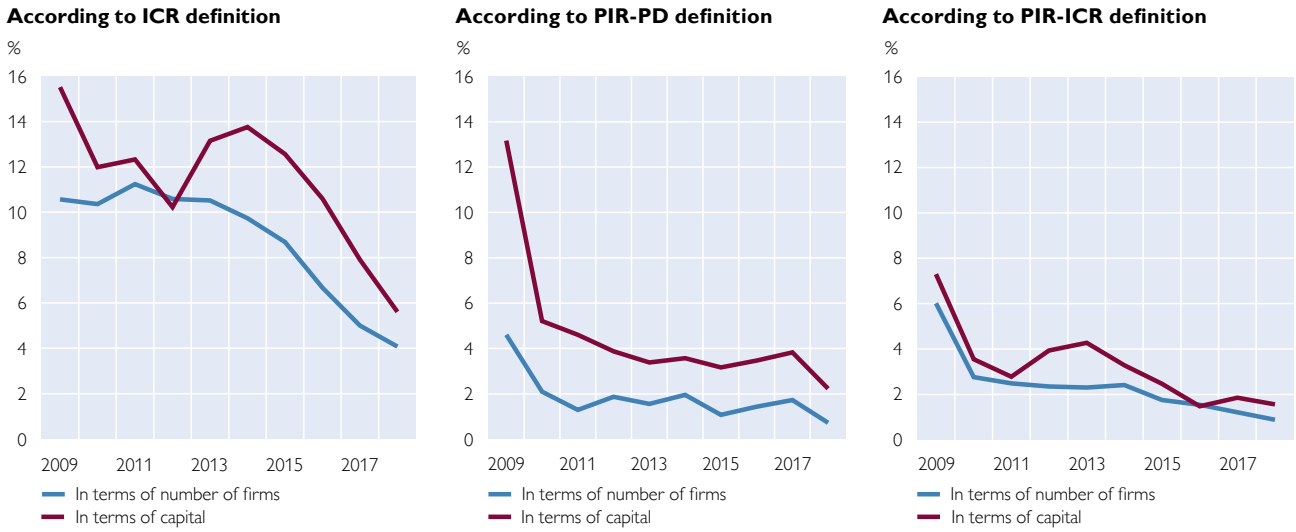
In order to gauge the economic weight of zombie firms for the Austrian nonfinancial corporate sector, not only their incidence in terms of the number of companies is of relevance but also the resources they capture. Based on the balance sheet totals of the firms in our sample, which represent the total capital – both in the form of debt and equity – invested in a company, the share of the capital stock absorbed by zombie firms also fell in the period under review for all definitions. In the case of the ICR, the capital-weighted zombie share fell from 15.6% to 5.6%. In most years, this share was slightly higher than that resulting from the number of firms, implying that the average zombie firm according to the ICR metric is larger than the average non-zombie company. Yet, for both the number of firms and the capital employed the ICR-based zombie share shrank by roughly 60% between 2009 and 2018. Similar to the zombie share in the number of firms, the reduction of the capital zombie share was especially pronounced toward the end of our observation period, namely from 2015 onwards. In the first half of the period under review, the development showed a different pattern than the zombie share in the number of firms, with marked decreases in 2010 and – to a lesser extent – in 2012 and a strong increase in 2013. While based on the ICR, the zombie share using the capital invested was higher than the share in the number of firms; this relationship was inverse in the case of the two definitions that include preferential interest rate payments. Starting from 4.6% in 2009, the zombie share shrank to 0.7% at the end of the observation period according to the PIR-PD measure and from 7.3% to 1.6% according to the PIR-ICR measure.

To some degree, the decrease in the prevalence of zombie firms in the period under review reflected cyclical developments. After a strong reduction in 2009 in the wake of the Great Financial Crisis, the Austrian GDP recovered subsequently, in particular toward the end of the period under review. Moreover, our observation period covers a period of falling interest rates, driven by the Eurosystem's accommodating monetary policy. With the ICR serving as a yardstick, falling interest rates mechanically contribute to a reduction of the number of zombie firms. All else equal, lower interest rates improve ICRs by reducing interest expenses. The relief was all the stronger as a large part of corporate debt in Austria, in particular bank loans, carries a variable rate, mostly tied to short-term rates, which reduces the interest burden swiftly when interest rates fall.[14] Moreover, low interest rates and the accommodating monetary policy in general might have buoyed the economic environment at large and hence corporate profitability, which in turn increased the denominator of the ICR measure. Finally, it is worth mentioning that this development was not confined to Austria. The fall in the zombie share since the Great Financial Crisis in Austria as reported in this study is consistent with falling zombie shares in other euro area countries as reported in Banerjee and Hofmann (2020).

[14] *In 2009, more than 96% of bank loans to nonfinancial corporations had an interest rate fixation period of up to one year; until 2018, this share fell to 84%, according to BSI data.*

Chart 1

Share of zombie firms in Austria (2009–2018)



Source: OeNB, authors' calculations.

3.2 Zombie share by firm characteristics according to the ICR definition

3.2.1 Development of the zombie share from 2009 to 2018

In this section, we explore the development of the share of zombie firms in our sample in greater detail, using the definition that is based on the ICR. For an industry breakdown, we cluster the firms in our sample into four groups, based on the first hierarchical NACE level of the section to which they belong:[15] first, manufacturing, which is equivalent to NACE code C; second, "distributive industries," including trade (NACE G), transportation (NACE H) and accommodation (NACE I); third, real estate-related industries, comprising construction (NACE F) and real estate-related activities (NACE L); and fourth, the category "others" as a residual covering all other industries. Chart 2 (upper left-hand panel) shows that while the zombie share decreased for all industries, there was large heterogeneity as to the degree of this decrease. Over the whole observation period, the reduction was most pronounced for the distributive industries (–9.3 percentage points). For the other industries, the drop of the zombie share was below the value for the whole sample. In the case of the real estate-related industries, the reduction in the share of zombie firms amounted to 6.3 percentage points, and their zombie share surpassed the total zombie share from 2016 onward. The reduction of the zombie share in manufacturing amounted to 5.8 percentage points.

The upper right-hand panel of chart 2 reports the evolution of the zombie shares by firm size. For classification by size, we refer to the standard classification by the European Commission (2003), but due to data limitations, we can classify

[15] *As the number of enterprises in our database is relatively low, there are very few companies in some industries according to NACE. Therefore, it is not meaningful to compute zombie shares for each of the 21 NACE level 1 sections. See annex for details on the industry reclassification.*

companies solely according to their total assets.[16] Over the whole period under study, small firms displayed a lower zombie share than both medium-sized and large companies. While the zombie share fell in all three size classes, the reduction was more pronounced for small firms. In the case of the large firms, the zombie share declined from 11.6% in 2009 to 7.0% in 2018, and for small firms from 9.0% to 2.4%. Thus, the difference between the zombie shares of large and small enterprises even increased over much of the observation period, standing at 4.6 percentage points at the end of the observation period.

Additionally, the two lower panels of chart 2 look at two firm characteristics that are referred to in the literature as being related to the occurrence of zombie firms: the investment ratio and the leverage of the firms, expressed by the equity ratio. For this, we classify the zombie firms into four groups for each year. In both cases, the first quartile contains the firms with the smallest values of the respective attribute and the fourth quartile the largest ones.

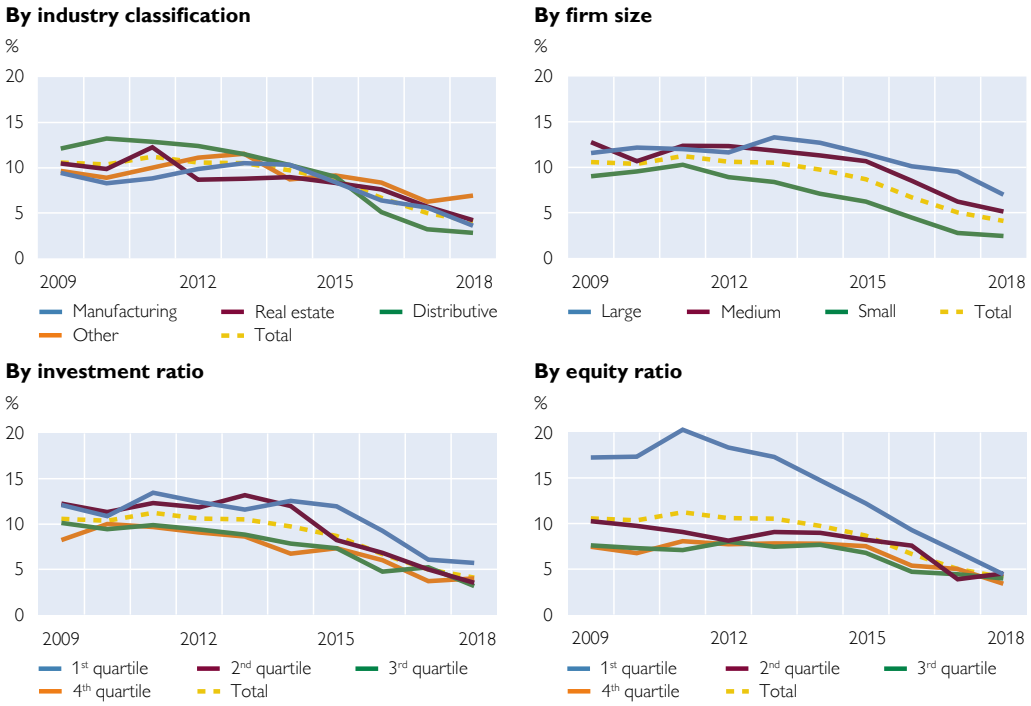
In the lower left-hand panel, we look at the investment ratio, defined as investments divided by the balance sheet total. As pointed out above (in section 2), financially weak firms generally find it harder to invest. In this vein, the literature has pointed out that zombie firms invest less (e.g., Banerjee and Hofmann, 2020; or Storz et al., 2017, who include negative investment into their zombie definition). Over most of the period under review, the two higher quartiles – containing the firms with higher investment ratios – exhibited lower zombie shares than the lower ones. Especially towards the end of the observation period, the firms in the bottom quartile of the distribution, which contains the firms with the lowest investment ratio, had a distinctively higher zombie share. This finding would vindicate the findings in the papers referred to above that zombie firms invest less.

The bottom right-hand panel shows the zombie shares by equity ratio quartiles. Companies with a high equity ratio have to remunerate a smaller share of the capital that they employ in the form of interest. Thus, they pay less interest out of their income than those with a lower equity ratio. Given that the remuneration of debt (i.e., interest expenses) is included in the numerator of the ICR, but the remuneration of equity is not, a negative relationship between zombie share and equity ratio can be expected. And indeed, over most of the observation period, the firms in the quartile with the lowest equity ratios (i.e., the most leveraged companies) had a considerably higher zombie share. Until 2013, the difference in the zombie share between the firms in the lowest and the highest quartile was close to or even more than 10 percentage points. In the following years, the difference shrank rapidly, and in 2018, the difference was just 1 percentage point. Over the whole period under study, the zombie share of the firms in the quartile with the lowest equity ratios fell by 12.8 percentage points, compared to a reduction by 4.1 percentage points among the firms in the quartile with the highest equity ratios. The fact that the difference between the zombie share in the first quartile and the other quartiles is so much bigger than the differences among the other three quartiles suggests that the relationship between leverage and zombie status is not linear. To a large extent, this might reflect the construction of the ICR measure: the amount

[16] *Accordingly, small companies have a balance sheet total of up to EUR 10 million, medium-sized companies of between EUR 10 million and EUR 43 million, and companies with total assets of more than EUR 43 million are classified as large companies. European Commission (2003) also uses staff headcount and turnover for the classification.*

Chart 2

Zombie share in Austria by firm characteristics – ICR definition



Source: OeNB, authors' calculations.

by which income exceeds interest expenses for a company to qualify as a non-zombie is irrelevant. Lower interest rates reduce the amount of interest due on the outstanding debt and thus make it easier to pay those interest expenses out of income. This is especially relevant for companies with a relatively high debt share (and consequently a lower equity share) in the capital structure.

3.2.2 Comparing zombie and non-zombie firms in 2018

Table 1 compares zombie firms and non-zombie firms in our dataset in 2018, the most recent year of our dataset. On average, zombie firms are larger and older than non-zombie firms. Reflecting the high shares of zombie firms among large enterprises over most of the period covered by our sample, the median balance sheet total of the zombie firms was almost three times as large as that of non-zombie firms. Perhaps somewhat related to the differences in firm size, the median zombie firm is about four years older than the corresponding non-zombie, though according to our definition only firms that are ten years and older are classified as zombies, whereas non-zombies include firms that have ICRs higher than 1 for two years but are younger than ten years. Our results are in line with other papers (e.g. Adalat McGowen et al., 2017; Hallak et al., 2018; Schwartz et al., 2018) that find that the share of zombie firms is positively correlated with size and age. These patterns could result from the fact that larger and older firms are less opaque (see Hallak et al., 2018 as well as Beer and Waschiczek, 2019) and are more likely to have established longer-term lending relationships with banks, which might justify financing them from the viewpoint of the bank despite their poor economic performance. Moreover, the sunk costs of loan restructuring and the potential need for additional

Table 1

Comparing zombie and non-zombie firms according to ICR – 2018

		Zombies		Non-zombies	
		Mean	Median	Mean	Median
Characteristics of zombie and non-zombie firms					
Balance sheet total	EUR million	72.0	24.8	51.5	8.8
Age	Years	27.3	22.0	24.4	18.0
Equity ratio	%	33.9	34.2	37.4	36.8
Probability of default	%	1.1	0.7	0.7	0.4
Investment ratio	%	8.8	3.5	9.1	4.9
Industry affiliation of zombie and non-zombie firms					
Manufacturing	%	18.5		20.0	
Real estate-related industries	%	36.1		34.9	
Distributive industries	%	20.4		30.2	
Other	%	25.0		14.9	
Total	%	100.0		100.0	

Source: OeNB, authors' calculations.

capital tend to be higher for large firms. On a positive note, it could be argued that larger firms tend to be more diversified, which reduces their probability of bankruptcy, so that they can afford higher levels of borrowing, even though this increases their interest service burden.

Overall, zombie firms have less favorable risk characteristics than non-zombie firms. First, they have a slightly lower equity ratio than non-zombies (34.2% against 36.8%). Second, zombie firms were found to have a markedly higher PD: At 0.7%, the PD of zombie firms was more than one and a half times as much as the value recorded for non-zombie firms. At the same time, the average zombie firm invested less; at 3.5% of the balance sheet total, their investments were about 30% lower than those of a non-zombie.

Regarding the industry structure, the shares of manufacturing and real estate-related industries are similar for zombie and non-zombie firms. However, in the distributive industries, the share of zombie firms is 10 percentage points lower than is the case of non-zombies. The high share in others (25.0%) was mainly due to financial services (NACE K, without holding companies), arts, entertainment and recreation (R) and other service activities (S). Additionally, we broke down the industries by the degree to which they have been affected by COVID-19, based on an estimation of the impact of the pandemic on the individual industries with a corporate insolvency model developed by Puhr and Schneider (2021).[17] It turns out that the group of industries that this model has identified as being most severely hit by COVID-19 had roughly the same share of zombie firms as the least affected group, with a lower zombie share for the group in the middle. Thus, notwithstanding some exceptions, zombie firms were not more prevalent in those industries that were eventually hit particularly hard by the pandemic.[18]

[17] *The affectedness by the pandemic was estimated as a reduction in output in 2020 compared in 2019.*

[18] *In 2018, the zombie share of the group of industries most affected by the pandemic (which included NACE codes R, I, N, B, S, H) was 5.2%, that of the group in the middle (C, G, M, A, F, P) was 3.0% and that of the least affected group (J, Q, E, L, K, D) amounted to 5.0%.*

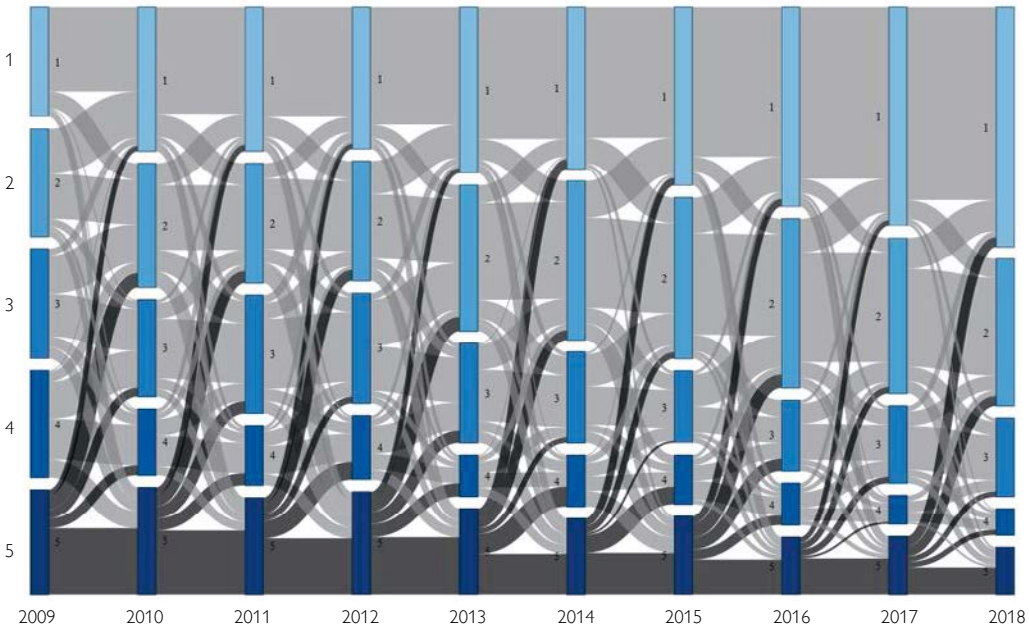
3.2.3 Tracking the ICR in the period from 2009 to 2018

In this subsection, we aim to shed more light on the development of the relation between interest expenses and EBIT, since the ICR definition for zombie-firms is, as described above, only a binary classifier based on a threshold value (EBIT/interest expenses < 1). To this end, we analyze the 468 firms of our sample for which financial statements information is available for each year of the observation period and which were older than ten years at the start of the observation period. For this subsample, the share of firms identified by the ICR indicator as zombies follows a similar pattern compared to the full sample. In 2009, 10.6% (the same percentage as for the full sample) of the firms were identified as ICR zombies. This ratio dropped to 3.6% (full sample: 4.1%) in 2018.

We divide the firms in the subsample into five categories based on their ICR, where category 1 contains the firms with the highest and category 5 the firms with the lowest ICR. Category 5 contains all firms with an ICR below 1, such that any firm which stays in this category for two consecutive years is identified as a zombie by the ICR definition. The other firms are grouped into categories 1 to 4 so that each category contains approximately the same number of firms in the first year. Chart 3 displays the evolution of the ICR categories, whereas the height of the nodes represents the number of firms in the respective year/category, and the lines connecting the nodes represent the transition between the categories. As can be seen, most firms in the lower categories migrate to the higher categories over time. Indeed, the share of firms classified in category 5 decreased from approximately 20% in 2009 to 7% at the end of the observation period. In contrast, the number of firms in category 1 more than doubled. In 2018, about 45% of the firms in the sample were assigned to this category. The increase by 7 percentage points

Chart 3

Tracking Austrian firms' interest coverage ratio



Source: OeNB, authors' calculations.

in the share of firms classified to category 2 is less prominent but still substantial. Thus, it can be said – for those firms that are in the sample for the whole period – that most companies manage to exit from zombie status for a more advantageous category. This finding is in line with the findings of other studies, for example Banerjee and Hofmann (2020) who look at 14 OECD countries and find that about 60% of zombie firms recover, although they remain weaker and more fragile than firms that have never been zombies.

3.2.4 Simulation exercise: gauging the effect of falling interest rates

As pointed out above, the fall in the interest rate over the period under review mechanically reduced the interest burden of existing firms taken their outstanding debt as given, especially in an environment of variable interest rates, and consequently the probability of becoming a zombie firm according to the ICR definition. In order to gauge the effect of the reduction in interest rates, we calculate how the zombie share would have evolved if the interest rate had remained stable over the whole period, assuming that all firm characteristics apart from interest expenses remain unchanged.

To calculate the simulated interest rates, we first define interest rate markups for each year as the difference between the 2009 annual average of the 3-month EURIBOR (=1.223%) and the actual 3-month EURIBOR at the end of the year – if this difference is positive. Otherwise, i.e. if the 3-month EURIBOR in a particular year was higher than the 2009 average rate, the markup is set to 0.[19] We use the 3-month EURIBOR because it is a widely used reference rate for variable rate bank loans. To obtain simulated interest rates for each firm-year, we then add this interest rate markup to the interest rates paid by a firm on its outstanding debt (ratio of interest expenses to its total liabilities). The simulated interest rate is the hypothetical interest rate that a firm would have to pay if the 3-month EURIBOR had remained at the 2009-average level. Hence, the simulated interest rate takes into account the actual evolution of the spreads between loan interest rates and the reference rate. Finally, we calculate simulated interest rate payments by multiplying a firm's liabilities by the simulated interest rate. As in the original ICR definition, zombie firms are identified as firms for which the simulated interest rate payments are higher than EBIT for two consecutive years and their age is ten years or higher.

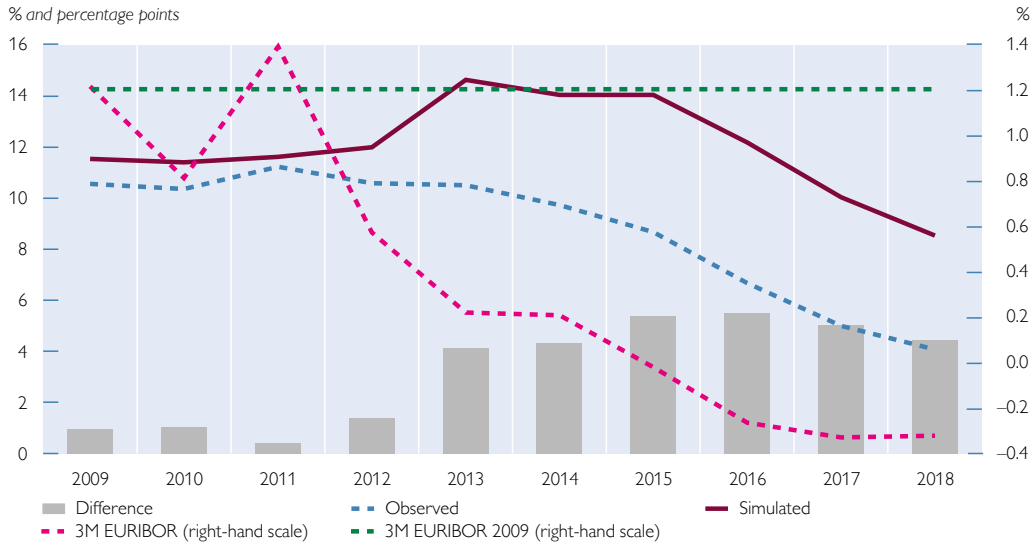
Chart 4 shows how the share of zombie firms based on the ICR definition would have developed if short-term interest rates had remained at the 2009 level. Until 2011, the simulated share of zombie firms in our sample trails the observed ICR share. In the following years, the effect of the lower interest rate on the zombie share became apparent as the simulated zombie share rose to close to 15% (in 2013). Thereafter, the difference to the observed ICR zombie share continued to rise until 2015. In the last three years of the period under review, in which the short-term interest rate no longer decreased, the difference between the two shares remained more or less stable as the simulated zombie share followed the downward movement of the observed zombie share based on the ICR criterion but remained 4 percentage points higher than the observed ICR share.[20]

[19] *This was the case in 2011.*

[20] *The development was similar when using balance sheet totals instead of the number of firms: In the years until 2015, the simulated zombie share rose to more than 20%. Until that year, the difference to the "actual" ICR zombie share likewise increased and remained more or less stable (at around 8 percentage points) thereafter.*

Chart 4

Zombie share in Austria according to ICR definition: observed and simulated



Source: OeNB, ECB, authors' calculations.

In order to analyze which type of enterprises were spared acquiring zombie status by the fall in the interest rates in the period under review, we employ the same classification of zombie firms by firm characteristics and industry affiliation as in subsection 3.2 above. Chart 5 represents the difference between the simulated zombie share and the one according to the observed ICR metric. In the top panel of chart 5, which shows these differences by industry affiliation, the strong increase in the gap between the simulated zombie share and the one based on the observed ICR in the case of the real estate-related industries in the years 2011 to 2015 stands out. In that hypothetical scenario, 16.5% of all firms in our sample affiliated to real estate-related industries would have been zombies in 2015, twice the share according to the observed ICR. In the following years, this difference remained high. This suggests that these industries not only benefited from the strong increase in property prices in the period under review – which some observers have linked to the low interest environment – but that the low interest rates also supported the viability of their business model more directly.[21] Firms belonging to other industries also avoided becoming a zombie thanks to the falling interest rates level, but to a considerably lesser degree. The differences between the simulated and the observed ICR zombie shares of manufacturing as well as the distributive industries also increased (in particular from 2011 to 2015), but less than the difference for the entire population of firms in our sample. Over the whole observation period, the difference between the simulated zombie share and the one based on the observed ICR amounted to 5.8 percentage points in the case of the real estate-related industries, compared to 2.6 percentage points for the distributive industries and 1.2 percentage points in manufacturing.

[21] *The business model of real estate-related industries depends more than that of other industries on bank loans. Their bank loan intensity, defined as the ratio of bank loans to gross value added, is distinctively higher than in other industries (see Waschiczek, 2018). However, if the central bank raises the interest rate level, a number of firms in the real estate-related industry might be seriously impaired.*

Broken down by firm size, the gap between the simulated and the observed ICR share widened much more for the large and medium-sized firms than in the case of small firms. While the differences remained low in the first three years of our observation period, they increased in 2012 and 2013 for all size groups. Already in these two years, the gaps increased to a larger extent for the large and medium-sized firms. From 2014 onwards, the difference between simulated and observed ICR zombie shares continued to widen considerably for the large and medium-sized firms while remaining more or less stable for the small firms. Thus, it was primarily larger and medium-sized companies that were spared becoming a zombie firm.

As to the investment ratio, the differences between simulated and observed ICR shares did not differ considerably. The zombie share would have increased somewhat stronger for the first quartile than for the other quartiles, especially toward the end of the observation period. This would imply that firms with comparatively little capital expenditures would have been somewhat more likely to turn into a zombie if interest rates had remained at their 2009 level.

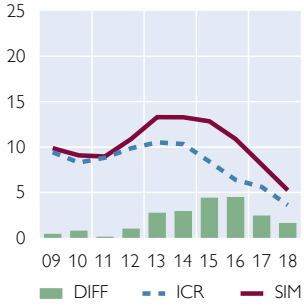
Regarding the equity ratio, among the firms in the first quartile the zombie share would have fallen far less under a constant interest rate level. This is the quartile for which the ICR indicates the highest zombie share by far for most of the observation period. The zombie share of the quartile with the most leveraged firms would have risen to 25% until 2013, and although the difference to the observed ICR zombie share of that quartile fell by more than 10 percentage points in the following five years, the zombie share would have been 10.3 percentage points higher by the end of the period under review under the assumption of a stable interest level. For firms from the other quartiles, the effect of unchanged interest rates would have been much slighter.

Chart 5

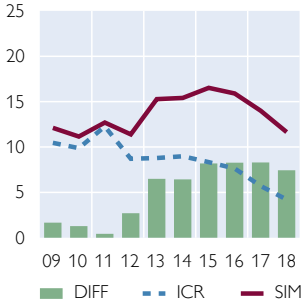
Difference between observed and simulated zombie shares for Austria

By industry affiliation

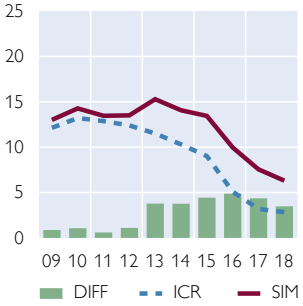
Manufacturing (C)



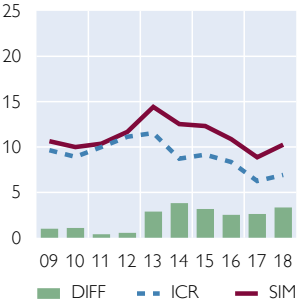
Real estate-related industries (F, L)



Distributive industries (G, H, I)

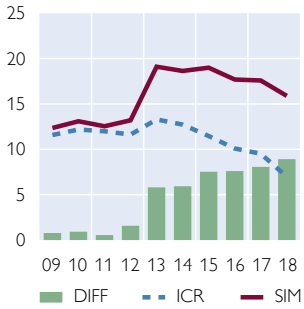


Other

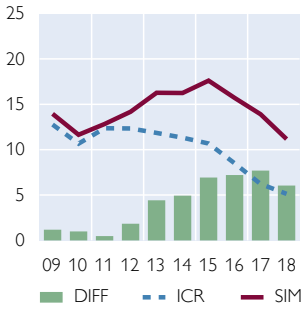


By firm size

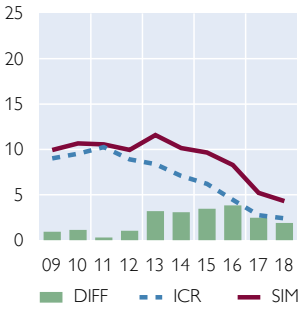
Large



Medium

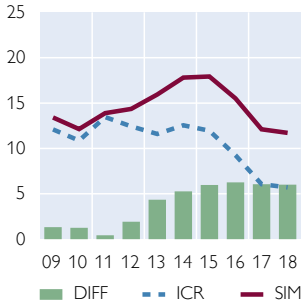


Small

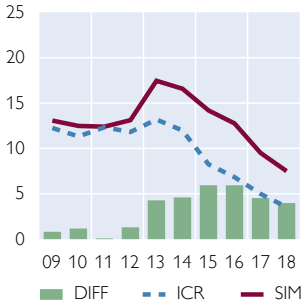


By investment ratio

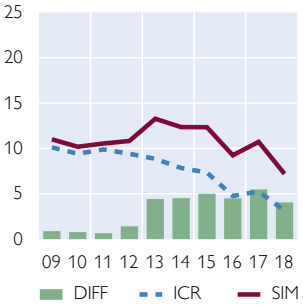
1st quartile



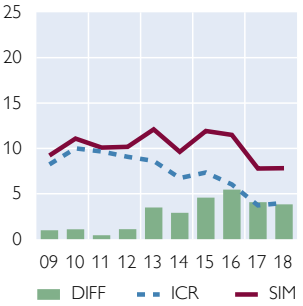
2nd quartile



3rd quartile

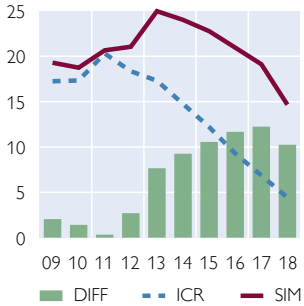


4th quartile

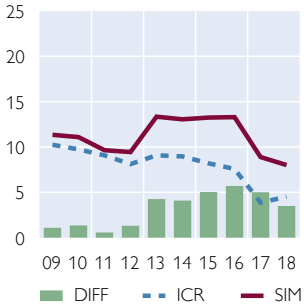


By investment ratio

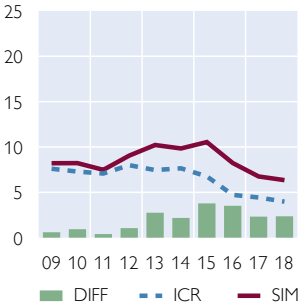
1st quartile



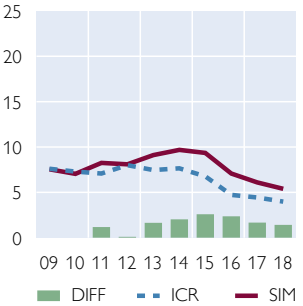
2nd quartile



3rd quartile



4th quartile



Source: OeNB, authors' calculations.

Note: ICR: zombie share according to ICR definition in %, SIM: simulated zombie share in %, DIFF: difference between zombie share according to ICR definition and simulated zombie share in percentage points. The first quartile is the quartile with the lowest and the fourth with the highest values in the respective characteristics.

4 Summary and conclusions

This paper provides first results on the incidence of zombie firms in Austria, based on three definitions. The definitions all relate to companies' interest expenses but address different aspects thereof, namely the relationship of interest expenses to liabilities and enhance this information either with firms' probability of default or their interest coverage ratio. Reflecting these conceptual differences, the definitions employed in this paper identify different sets of companies as zombies, but they all indicate a substantial fall in the share of zombies between 2009 and 2018, concerning all industries and firm sizes, albeit to different degrees. Although the drop of the zombie share was particularly strong for highly leveraged enterprises, at the end of our observation period zombie firms still had less favorable risk characteristics than non-zombie firms, such as a slightly lower equity ratio and a markedly higher probability to default. This can be seen as an indication that our definitions are able to designate financially weak firms as zombies.

A counterfactual exercise suggests that the fall in the interest rate over the period under review played a large role in the reduction of the zombie share according to the ICR definition. Under the assumption of constant interest rates throughout the period under study, the zombie share would have risen especially in those years in which the money market rate fell and would have remained above the observed rate until the end of the observation period. The difference between the observed and the simulated zombie share is more pronounced for real estate-related industries (whose business model is very credit-intensive), more leveraged firms (for which the interest level is more relevant), and larger companies.

Yet, zombie status is not necessarily permanent. Looking at those firms for which we have financial statements information for the entire observation period, we have shown that most zombie firms manage to exit from zombie status.

There are several limitations to the analysis presented here. These limitations include the very notion of what constitutes a "zombie firm." The term goes beyond that of a financially distressed firm and includes the capability to meet interest obligations. The definitions employed here touch upon different aspects of those capabilities, and the differences in the outcomes in our calculations based on the different definitions point to the vagaries of this term.

Another point relates to the data on which this analysis is based. In the database from which our sample is derived, well-performing firms are most likely overrepresented, implying that zombies might be underrepresented in this sample. At the same time, as we had to confine ourselves to a two-year time span with a low ICR when classifying companies as zombie firms instead of three years as used by most other papers, the zombie share is higher than it would have been if we could have extended that time span to three years because firms are less likely to have a low ICR over a longer period and many zombies recover at some point. Besides, as pointed out, data coverage is uneven across years and sample changes cannot be attributed to exit and entry of firms from and to the market, but they are often due to the way the database is maintained. Moreover, the interest expenses variable that we employ cannot distinguish between the type of debt on which interest payments are spent, an aspect that is of particular relevance with regard to calculating preferential interest rates.

As to the implications for monetary policy, the simulation exercise presented above suggests that the share of zombie firms would have been well above the observed

share as a result of non-falling money market interest rates. However, our simulation can only capture the mechanical effects of lower rates on zombie shares and does not take into account the effects of lower interest rates on aggregate demand, sales prospects for firms and economic growth, which have likely raised the denominator of the ICR. At the same time, the low interest rates might have been an incentive for some firms to increase risk-taking and leverage. The low interest rate environment and the search for yield that it caused in general and the compression of credit spreads through loose monetary policy in particular have been of particular benefit to firms with higher credit risks.

One big unknown is, of course, the fallout from the current pandemic. With our data reaching only until 2018, it is not possible to assess effects of the pandemic on the share of zombie firms. Somewhat reassuringly, zombie firms were not more prevalent in the group of industries that were hit particularly hard by the pandemic. In view of the measures taken to support the corporate sector in reaction to the pandemic, there are increasing concerns that some firms may be able to survive only as long as these support measures continue. While over the short term, additional loans are indispensable to make up for lost revenues and to keep enterprises afloat, they are bound to increase interest obligations over the medium and long term, which will increase the number of firms that fall under the ICR zombie criterion. Likewise, to the extent that conditions for government support measures require banks to grant favorable interest rates to companies, the same might be true for zombie firms according to the definitions that comprise preferential interest rates.

The analysis presented here could be enhanced in several directions. First, in order to get a better understanding of the nature of zombie firms, we could dig deeper into the anatomy of the zombie population by including additional firm features (e.g. differentiating between tangible and intangible investment, profitability, ownership). Second, the analysis could be enhanced by looking more closely at the relationship between zombification and productivity to assess if and to what extent zombies are indeed less productive than non-zombies, as well as the implications for overall productivity. A third strand could be the relationship between zombie firms and banks. This could include firms' dependency on bank loans, e.g. their share in total debt as well as, more importantly, combining the dataset employed for this article with bank data in order to study the interaction between bank characteristics (for example their rating) and their propensity to lend to zombie firms. Fourth, the definitions could be further elaborated on. For example, for the simulated ICR zombie share we could use alternative reference rates to track the effects of monetary policy during the period under review, such as a Taylor rule-based rate, instead of the money market rate currently employed. In the same vein, it might be worthwhile to investigate if and how former zombies differ from firms that never had zombie status and which factors contribute to recovery from zombie status.

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Annex

A1 Summary statistics of the sample

Table A1

Summary statistics

		Mean	Standard deviation	25% quantile	Median	75% quantile
Balance sheet total	EUR thousand	44,635	220,696	2,207	7,364	24,101
EBIT	EUR thousand	2,027	15,676	39	260	1,076
Interest expenses	EUR thousand	577	5,277	11	52	217
Age	Years	21	19	8	16	28
Equity ratio	%	22	1,000	15	32	51
Investment ratio	%	8	15	1	3	9

Source: OeNB, authors' calculations.

A2 Industry reclassification of the firms in the sample

Table A2

Reclassification by NACE code

NACE code	Industries
A – Agriculture, forestry and fishing	Other
B – Mining and quarrying	
C – Manufacturing	Manufacturing
D – Electricity, gas, steam and air conditioning supply	Other
E – Water supply; sewerage; waste management and remediation activities	
F – Construction	Real estate-related industries
G – Wholesale and retail trade; repair of motor vehicles and motorcycles	Distributive industries
H – Transporting and storage	
I – Accommodation and food service activities	
J – Information and communication	Other
K – Financial and insurance activities	
L – Real estate activities	Real estate related industries
M – Professional, scientific and technical activities[1]	Other
N – Administrative and support service activities	
O – Public administration and defense; compulsatory social security	
P – Education	
Q – Human health and social work activities	
R – Arts, entertainment and recreation	
S – Other services activities	
T – Activities of hoseholds as employers; undifferentiated goods – and services – producing activities of households for own use	Not in the dataset
U – Activities of extraterritorial organisations and bodies	

Source: Eurostat, authors' reclassification.

[1] *Without head offices and holding companies.*

A3 Zombie share by firm characteristics according to the PIR-PD and PIR-ICR definitions

In annex 3, we analyze the evolution of the zombie share and the characteristics of zombie firms according to the PIR-PD and PIR-ICR definitions, using the same industry breakdown as for the ICR definition in subsection 3.2. The industry breakdown and firm characteristics for the PIR-PD definition are shown in chart A1 respectively table A3. The share of zombie firms according to the PIR-PD definition decreases for all industries, however to a different extent. The drop

between 2009 and 2018 was most pronounced for the distributive industries (–15.4 percentage points) but least pronounced for the real estate-related industries (–7.8 percentage points). In 2018, the shares of firms that are identified as zombies were above the overall average in manufacturing (3.8%) and in the real estate-related industries (2.6%) but below the value for the whole corporate sector in the distributive industries (1.4%), and in particular in other industries (0.7%). This is also reflected in the industry affiliation of zombies and non-zombies (table A3, lower panel). 42.2% of all zombies, but only 35.3% of non-zombies were real estate-related companies. Manufacturing companies were also overrepresented among zombies. At the same time, companies classified as others account only for 4.7% of all zombies but for 14.4% of all non-zombies.

Regarding firm size, according to the PIR-PD definition, smaller firms are more likely to be classified as a zombie than large companies. Accordingly, in 2018 the zombie share was 2.3% for small companies, 3.0% for medium-sized companies but only 0.9% for large companies. Consequently, zombie firms were smaller than non-zombies measured by the average balance sheet total (table A3, upper panel). The median balance sheet total of zombie firms amounted to 93.0% of the median balance sheet of non-zombies; however, the mean balance sheet size is only a third of non-zombies. As a consequence, the asset zombie share was with 0.7% considerably lower than the zombie share in firms (2.2%).

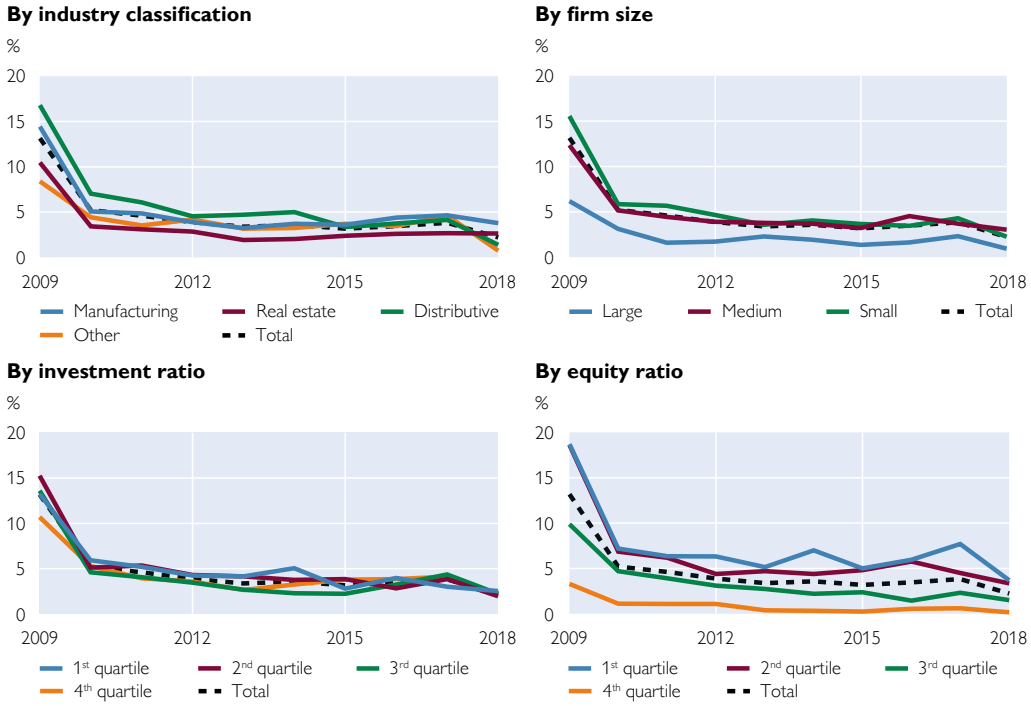
Regarding the equity ratio, over the whole observation period, zombies were more prevalent among companies with a low equity ratio. Consequently, in 2018 the equity ratio of zombies was considerably lower than the equity ratio of non-zombies (median 27.9% against 36.1%). The less favorable risk characteristics of zombie firms is also reflected in the probability of default. The median PD of zombies was 1.3% in 2018 compared to 0.7% for non-zombies. As to the investment ratio, there is no difference between the average investment ratio of zombies and non-zombies. Furthermore, regarding age, zombie firms were slightly older than non-zombie firms.

The industry breakdown and firm characteristics for the PIR-ICR definition is shown in chart A2 respectively table A4. The share of zombie firms according to the PIR-ICR definition decreases, as for the PIR-PD definition, for all industries. The most prominent drop in the share of zombie firms between 2009 and 2018 took place in the distributive industries (–5.9 percentage points) and the least prominent drop in manufacturing (–1.8 percentage points). In 2018, the share of zombie firms is the highest in manufacturing (3.8%) and the lowest in the sector related to other industries (0.7%). Regarding firm size, larger firms are more likely to be classified as zombies than smaller firms, according to the PIR-ICR definition. In 2018, the zombie share for large firms was 1.9% and for small firms 0.4%. Consequently, the median balance sheet total of zombie firms is four times the median balance sheet total of non-zombies.

Regarding the equity ratio, the picture is somehow conflicting. For most years of the observation period, more zombies can be identified among firms with a very low equity ratio (first quartile). However, in 2018 the share of zombie firms is higher among firms with a comparatively high equity ratio (fourth quartile). In fact, the mean equity ratio of zombie firms (41.5%) in 2018 is above the mean equity ratio of non-zombies (36.8%). The median default probability of zombie firms in 2018 is slightly higher than the median PD of non-zombie firms, whereas the opposite is true when mean is used to calculate the average. Regarding age, zombie firms according to the PIR-ICR definition are older than non-zombies.

Chart A1

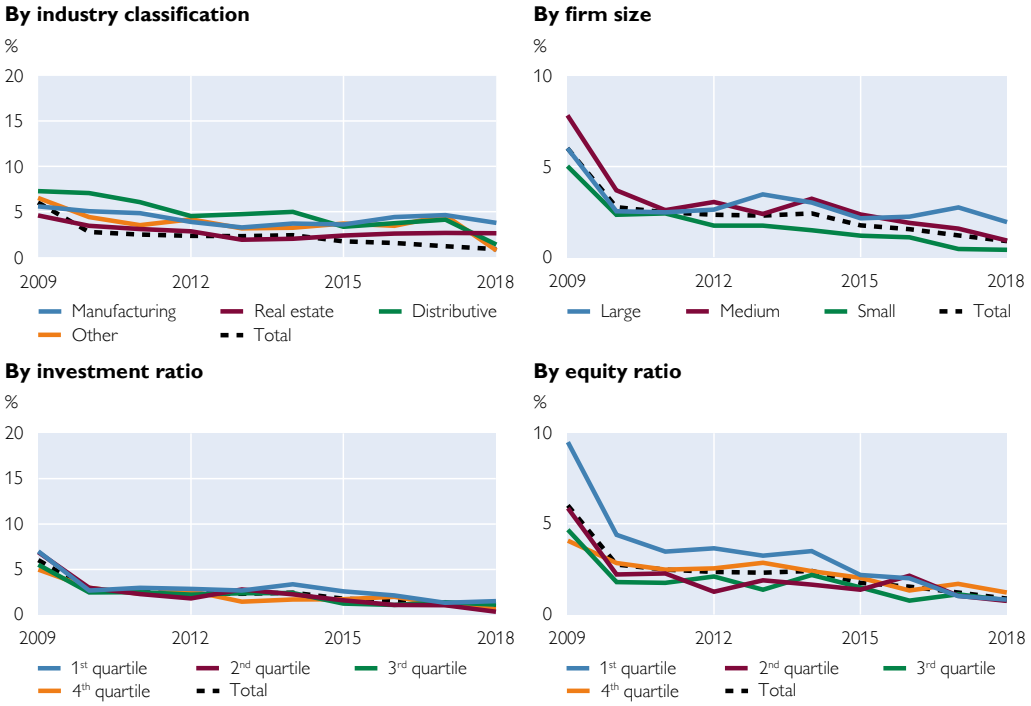
Zombie share in Austria by firm characteristics – PIR-PD



Source: OeNB, authors' calculations.

Chart A2

Zombie share in Austria by firm characteristics – PIR-ICR



Source: OeNB, authors' calculations.

Table A3

Comparing zombie and non-zombie firms according to PIR-PD – 2018

		Zombies		Non-zombies	
		Mean	Median	Mean	Median
Characteristics of zombie and non-zombie firms					
Balance sheet total	EUR million	16.1	8.3	50.5	8.9
Age	Years	27.2	21.0	24.1	18.0
Equity ratio	%	25.0	27.9	36.1	36.0
Probability of default	%	2.1	1.3	0.7	0.4
Investment ratio	%	9.5	4.9	9.5	4.9
Industry affiliation of zombie and non-zombie firms					
Manufacturing	%	34.4		20.0	
Real estate-related industries	%	42.2		35.3	
Distributive industries	%	18.8		30.4	
Other	%	4.7		14.4	
Total	%	100.0		100.0	

Source: OeNB, authors' calculations.

Table A4

Comparing zombie and non-zombie firms according to PIR-ICR – 2018

		Zombies		Non-zombies	
		Mean	Median	Mean	Median
Characteristics of zombie and non-zombie firms					
Balance sheet total	EUR million	98.1	40.6	55.2	10.4
Age	Years	30.0	20.0	25.1	19.0
Equity ratio	%	41.5	43.2	36.8	36.0
Probability of default	%	0.6	0.5	0.7	0.4
Investment ratio	%	6.3	4.6	9.1	4.9
Industry affiliation of zombie and non-zombie firms					
Manufacturing	%	27.3		21.2	
Real estate-related industries	%	40.9		35.4	
Distributive industries	%	13.6		29.6	
Other	%	18.2		13.9	
Total	%	100.0		100.0	

Source: OeNB, authors' calculations.

A4 EBIT versus EBITDA

The choice of the profit measure can affect the calculated ICR and as a consequence the incidence of zombie firms considerably. Most papers use earnings before interest and taxes (EBIT), i.e., earnings net of depreciation and amortization, as operating income. As EBIT comprises operating income and expenses but does not include the financial result (as reflected in financial assets and investments), the interest result or the special tax situation of the company, it gauges a company's operative performance. Since EBIT is formed before interest expenses are taken into account, it is a useful metric to calculate ICR. However, the use of EBIT has not been undisputed. Rodano and Sette (2019) have suggested to use EBITDA (earnings before interests, taxes, depreciation and amortization) instead, arguing that – as EBIT does not include depreciation and amortization – it is more likely to

classify firms as zombies which invested heavily in previous years and amortized that investment quickly. However, depreciation is also a type of cost, namely the cost of consuming productive capacity, which can be substantial for capital-intensive companies. While depreciation and amortization are not actual cash outflows, they reduce the value of a company's capital and/or financial assets and thus the value of its total assets. Using EBITDA would not account for these losses in value. By adding back depreciation and amortization to earnings, EBITDA might be suitable for international comparisons where differences in depreciation or amortization practices, goodwill treatment, taxation and so on may distort bottom line measures. For the purpose of the analysis within one country, the different effects of depreciation and amortization on companies (or industries) with different capital intensity make it advisable to use EBIT.

Austria's labor market during the COVID-19 crisis

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Refereed by: Markus Riegler, Parliamentary Budget Office

The impact of the COVID-19 crisis on Austria's labor market has been huge and a lot heavier than during the Great Recession of 2009 in terms of the increase in unemployment and the drop in employment. Key metrics show that the decrease in employment was broadly in line with the euro area average and that the increase in unemployment went hand with an increase in long-term unemployment and the average duration of unemployment. The generous short-time work scheme rolled out by the government prevented a turn for the worse and also lessened the downward pressure on average wages induced by the strong decrease in average hours worked per employee in 2020. While manufacturing or construction were hit as well, the tourism industry was affected most by the crisis, contributing to a relatively stronger increase in unemployment in provinces with a higher tourism-related share of employment. Younger employees and especially foreigners were also relatively more affected by the increase in unemployment, while employees with tertiary education were relatively less affected. Labor supply, while losing momentum, did continue to grow in 2020, while it had stagnated during the Great Recession.

JEL classification J3, J2, E32, H2
Keywords: COVID-19, labor market, recession, public policy

COVID-19 and the associated containment measures resulted in the worst economic crisis we have seen since World War II. In Austria, real economic output dropped by about 6½% in 2020, which is roughly in line with the average GDP decline in the euro area. As shops, close contact service providers, hotels and restaurants had to close repeatedly for weeks on end, real private consumption shrank by more than 9%. Service exports (real: –19%) and especially travel expenditures (nominal: –40%)[2] were particularly affected by the pandemic-related measures. With the first lockdown in March 2020, the number of unemployed increased by more than 200,000 to 534,000 persons. With the easing of lockdown measures, labor market conditions improved steadily until November, when the labor market got under strong pressure again due to a second lockdown followed by a third one in early 2021.

In this article, we present stylized facts on labor market developments in Austria since the outbreak of the COVID-19 crisis.[3] First, we analyze the changes in aggregate employment and map them to the respective lockdown measures (section 1). Second, we highlight the effects that economic policy measures (especially Austria's short-time working scheme) had on employment and unemployment (section 2) and on wages (section 3). This is followed by an analysis of developments in aggregate unemployment (section 4), a comparative study of the crisis impact on unemployment with respect to different socio-economic groups, regions

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[2] *See Fenz, Stix and Vondra (2021) for details of the development in the tourism sector.*

[3] *Other overviews of labor market developments in Austria in 2020 include Bock-Schappelwein et al. (2021).*

and industries (section 5) and a discussion of the repercussions on domestic labor supply (section 6). The concluding part brings these themes together with a summary of the main results (section 7).

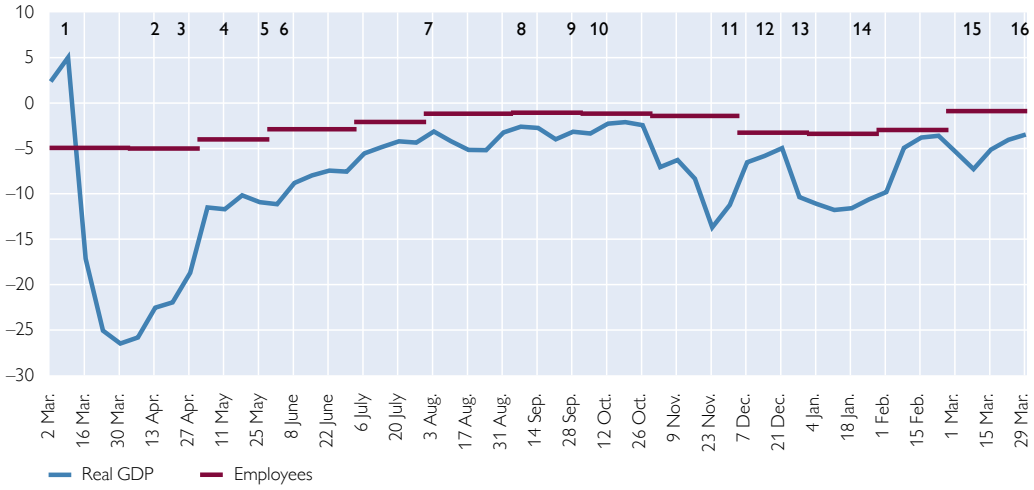
1 GDP growth and employment strongly affected by lockdown measures

Since spring 2020, employment figures have been mainly driven by the health policy measures adopted amid the COVD-19 crisis in Austria as well as in other countries. This is evident from chart 1, which cross-checks data on economic activity with Austria's different lockdown phases. Comparisons are provided for the year-on-year development of real GDP according to the OeNB's weekly GDP indicator (blue line)[4] and the year-on-year development of monthly dependent employment (national definition, red line) based on social security statistics, which exclude self-employment and jobs paying less than the social security income threshold. For a comparison with a broader definition of employment, including information on hours worked, see chart 4, which shows seasonally adjusted figures based on quarterly national accounts data.

Chart 1

Lockdowns, weekly GDP and monthly employment

Annual change in % (March 2021: change to March 2019)



Source: Real GDP: weekly OeNB indicator; employment: Main Association of Social Insurance Institutions. Variables are not seasonally adjusted.

Note: 1: Lockdown (March 16) 2: Small shops reopen (April 14) 3: All shops reopen (May 2) 4: Restaurants reopen (May 15) 5: Hotels reopen (May 29) 6: Borders reopen gradually (June 4) 7: Face masks mandatory again (July 24) 8: Travel warnings (initially for Croatia, the Balearic islands from Aug. 8) 9: Travel warnings for Austria (Sept. 16) 10: Containment measures tightened (Sept. 21, Nov. 25) 11: Partial lockdown (Nov. 3) 12: Lockdown (Nov. 17) 13: Partial lockdown (Dec. 7) 14: Lockdown (Dec. 26) 15: Partial lockdown (Feb. 2) 16: Lockdown in Vienna, Lower Austria and Burgenland (April 1).

[4] *National accounts data are not adequate for producing estimates of the short-term extent and dynamics of the GDP slump, as they are published only at quarterly intervals 30 days after the end of each quarter. For this reason, the OeNB developed a weekly indicator to estimate changes in economic output based on alternative real-time data (payment transaction data, truck mileage data, electricity consumption data or Google mobility data, to name just a few examples). The results correlate well with those of the quarterly accounts published later. See Fenz und Stix (2021) for details. Regular updates are published on www.oenb.at.*

Box 1

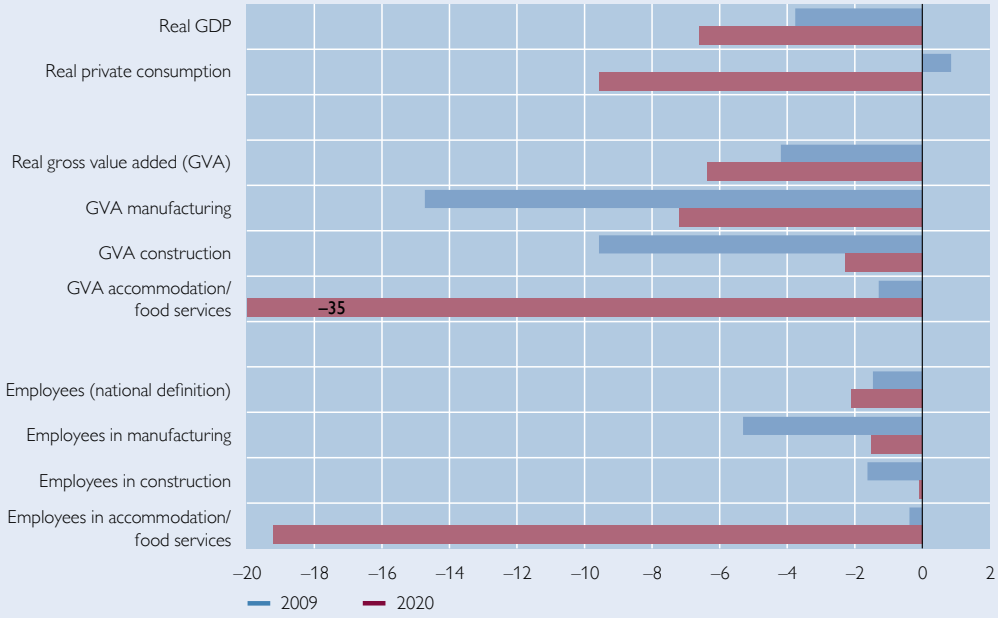
The labor market effects of the current crisis are much more severe than in 2009

The recession of 2020 was not only particularly severe, it was also different from other deep recessions, such as the most recent "Great Recession" of 2009, in terms of its composition by industry (chart 2). During the 2009 recession, private consumption had actually increased slightly in real terms, indicating that the recession was accompanied by some degree of consumption smoothing (also helped by the temporary car scrapping premium). In 2020, the lockdowns contributed to a fall in private consumption which even exceeded the contraction of real GDP. Manufacturing and construction were hit particularly hard by the 2009 recession, while in 2020 the decline in gross value added was about as sharp as for the economy at large in the manufacturing industry and a lot more moderate for the construction industry. The pattern was reversed for accommodation and food services, which witnessed a comparatively modest decline in gross value added in 2009 compared with a decline of about 35% in 2020. This, in turn, contributed to the adverse labor market developments we saw in 2020, given that accommodation and food services are among the industries with the lowest labor productivity (measured as gross value added per person employed). Due to the severe economic contraction and despite the generous short-time work schemes, employment dropped by almost 20% in this sector, while the drop in construction and manufacturing was lower than in 2009.[5]

Chart 2

Development of macroeconomic aggregates during the recessions of 2009 and 2020

Annual change in %



Source: Eurostat, Statistics Austria.

With the beginning of the first lockdown and the associated closures of the retail, catering and hotel and personal service industries on March 16, 2020, economic output collapsed sharply. The year-on-year decrease in GDP of more than 25% in early spring 2020 was the strongest on record since World War II. After strong catch-up effects in summer, the re-intensification of the pandemic ("second

[5] *For details on the Austrian labor market during the Great Recession, see Stiglbauer (2010).*

wave" of infections) and the ensuing adoption of a new set of containment measures (chart 1) led to a further decline in GDP toward the end of the year. The number of employees also dropped below pre-crisis levels, but the drop was more cushioned, among other factors by the short-time work scheme that the government expanded (section 2). Overall, the negative impact on Austria's labor market was stronger than during the Great Recession of 2009 (box 1), but broadly in line with the euro area average (box 2).

Box 2

Austria's decrease in employment close to euro area average in 2020

Like Austria, the euro area was heavily hit by the pandemic. The aggregate decline in employment and real GDP was quite similar to the pattern observed for Austria (chart 3, left panel). France and the Southern euro area member states were hit relatively harder, while especially Germany and the Netherlands observed much smaller declines in employment and real GDP (due to the large share of multinationals in value added in official statistics, the GDP growth of Ireland is difficult to interpret). Austria's increase in the unemployment rate as measured by

Chart 3

Macroeconomic and labor market developments in the euro area in 2020

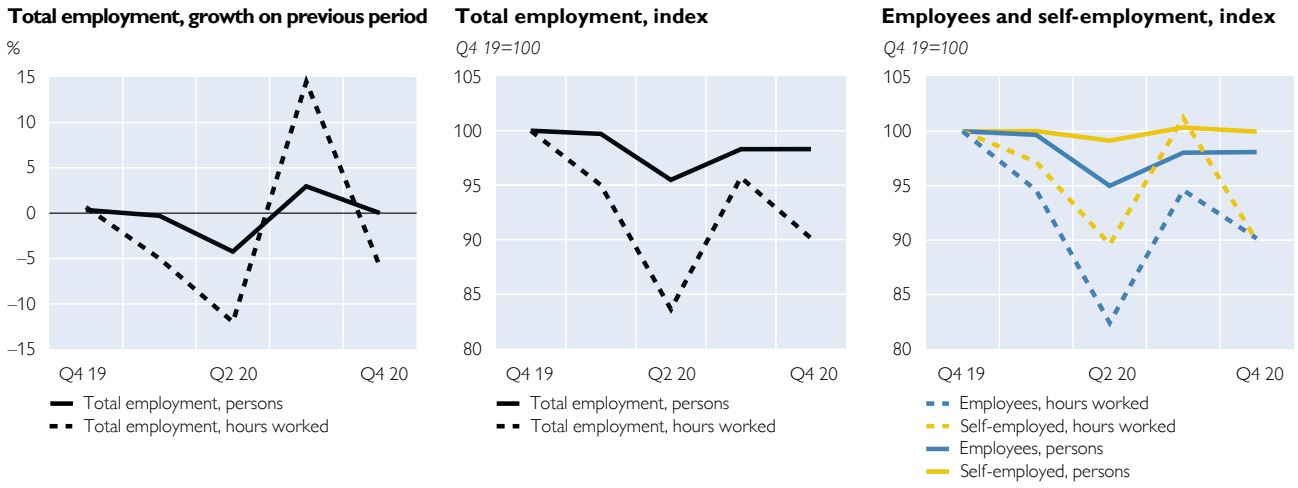
Source: Eurostat.

the EU labor force survey was somewhat above the euro area average as it witnessed a lower increase in the measured number of inactive persons than other countries (see box 4 for a discussion of the underlying measurement problem). Unemployment rates in Greece, France and Italy actually decreased in 2020, even though employment decreased by more than 1% in the former two countries and by more than 2% in the latter. Therefore, changes in aggregate employment are currently likely a more meaningful indicator of labor market developments than changes in the unemployment rate. However, both indicators were strongly influenced by the extent of short-time work schemes, which were implemented across Europe (for a discussion of the influence this scheme has had on the Austrian figures, see section 2).

Total hours worked tend to be more responsive to the business cycle than the number of persons employed. Amid the current crisis, this pattern became particularly pronounced. In the second quarter of 2020, the total number of hours worked collapsed by an unprecedented 12% compared to the previous quarter,[6] while the number of employed persons dropped by "only" 4%. In line with this quarter-on-quarter pattern, the increase for hours worked in the third quarter and the decrease in the fourth quarter was much stronger than for employment in persons. In an economic downturn, firms will generally cut overtime and not require extra hours to be offset before laying off workers. Especially in industries where labor shortages are a recurring issue, firms seek to keep on employees so as not to be confronted with labor shortages in an expected future upswing. Furthermore, the short-time work scheme has been very effective in preventing an even stronger rise in unemployment.

Chart 4

Number of employees more volatile than number of self-employed

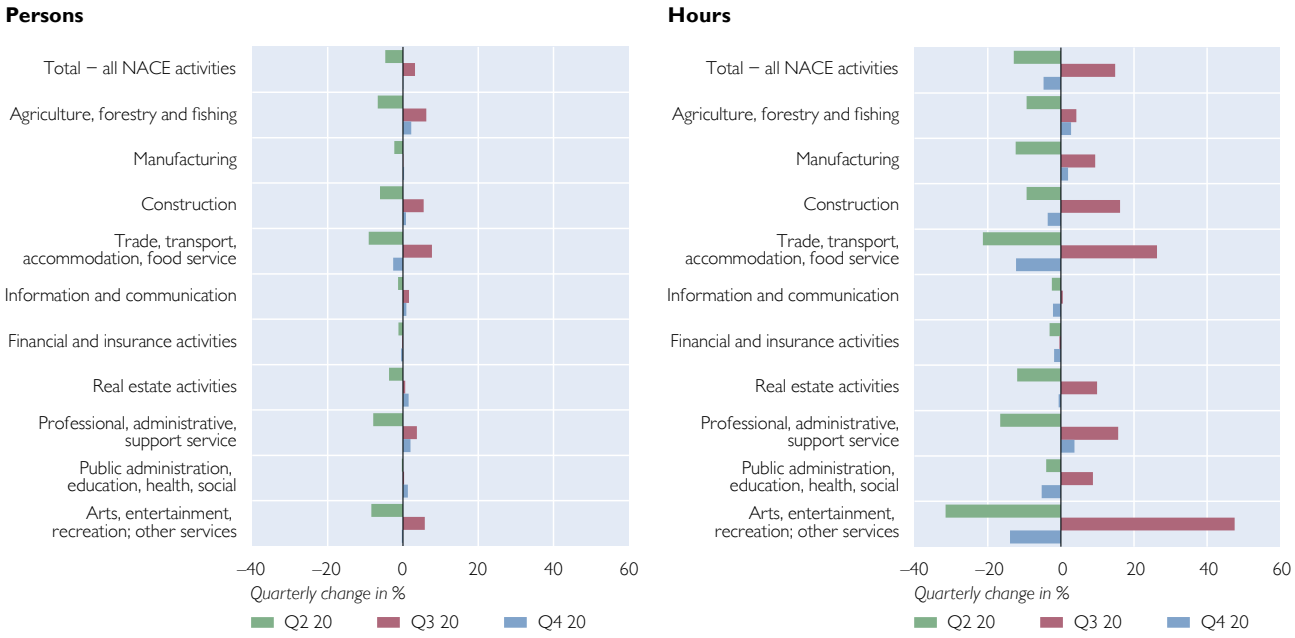


Source: Statistics Austria, National accounts data, seasonally adjusted.

[6] *All growth rates in this section are quarter-on-quarter growth rates of seasonally adjusted variables.*

Chart 5

Hours worked are more volatile than headcount employment



Source: Euostat, national accounts, seasonally adjusted.

The 1.7% drop in total employment observed in 2020 masks diverging developments in the number of employees (which decreased by 2%) and in the number of the self-employed (which actually increased by 1.5%). This gap is also evident from total hours worked, but less pronounced: Total hours worked fell by 8.7%, at a somewhat lower rate than total hours worked by employees (–9.4%) but at a markedly higher rate than total hours worked by the self-employed (–5.6%).

The cushioning of job losses via reductions in average working hours is also evident from industry data (chart 5), especially for industries particularly affected by lockdowns (e.g. accomodation and food services).

2 Employment effects of the pandemic dampened substantially by short-time work

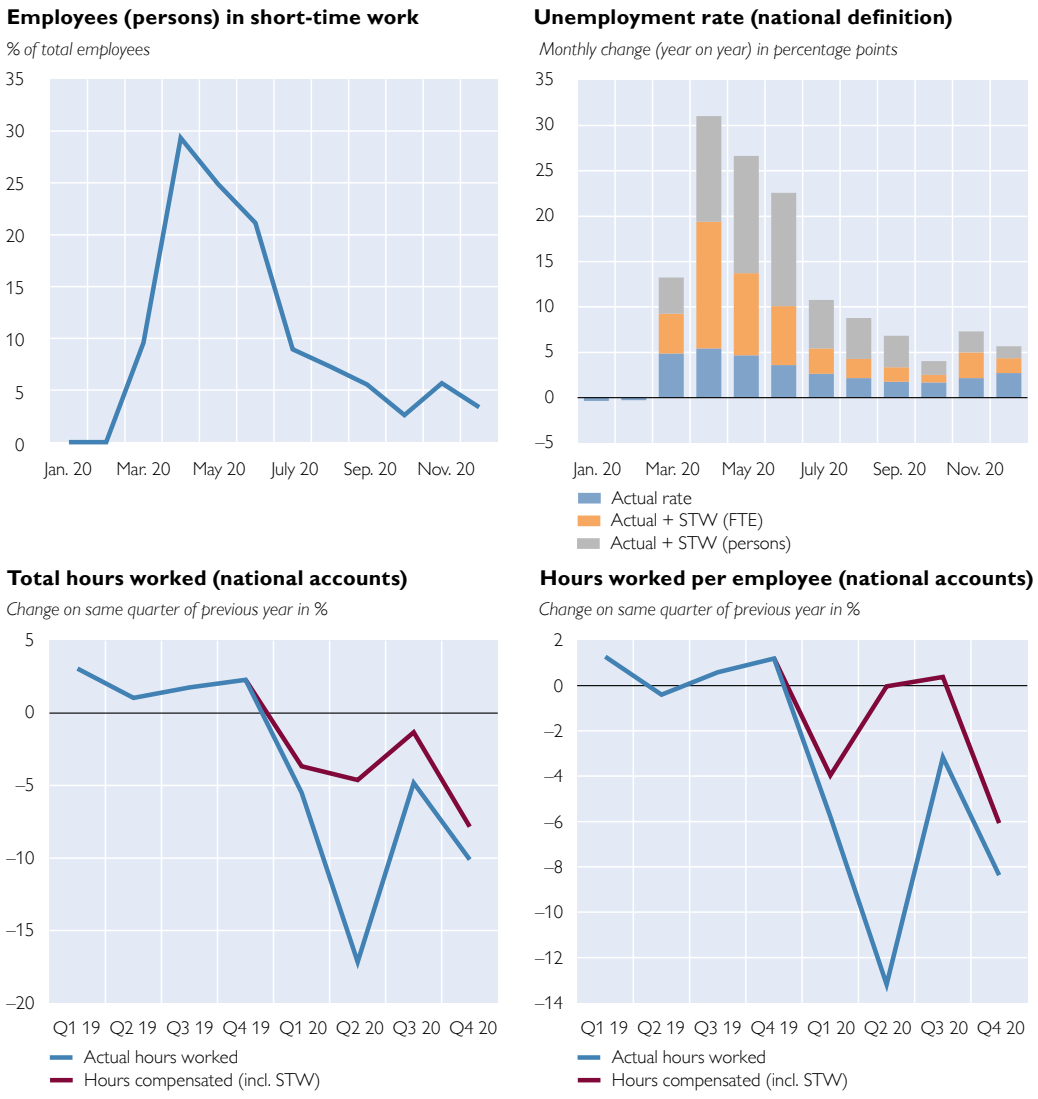
Short-time work schemes are designed to support businesses in severe crisis periods by enabling them to cut working hours but top up the correspondingly lower wages with government aid. In Austria, a short-time-work scheme was in place even before the pandemic hit, but the take-up remained comparatively limited even during the Great Recession of 2009 (Hofer et al., 2020). A reform of that scheme agreed upon in March 2020 between the government and the social partners gave Austria one of the most generous schemes of the EU (Huemer et al., 2021). The new scheme is above all much more attractive from the perspective of employers, among other factors due to a larger scope (social security contributions are covered by the government in full[7]) and a larger flexibility (e.g. working hours may be reduced to zero in some months). Furthermore, keeping staff on the payroll through the short-time

[7] *In the previous short-time work scheme, employers' social security contributions for their employees had to be covered in full by firms for the first four months.*

work scheme was one prerequisite for access to certain other COVID-19-related subsidies. As is evident from chart 6, about 30% of employees were on short-time work in April 2020.[8] This had a tremendous impact on macroeconomic aggregates. Most importantly, it significantly dampened the increase in unemployment. In April 2020, for example, the unemployment rate (national definition; blue bars in chart 6) was about 5 percentage points higher than the rate for April 2019. Taking the extreme case, i.e. assuming that all employees registered for short-time work subsidy would have been laid off immediately, the unemployment rate would have been 30 percentage points higher than in April 2019 (sum of blue, orange and gray bars). The more plausible assumption appears to be an increase by close to 20 percentage

Chart 6

Impact of short-time work (STW) on macroeconomic aggregates for employees



Source: Eurostat, AMS, OeNB.

Note: These charts use year-on-year comparisons of monthly resp. quarterly data as the take-up of short-time work cannot be seasonally adjusted.

[8] *We only show data on the actual take-up of short-time work as initial registrations tend to overstate the extent to which these schemes have been used.*

points (sum of blue and orange bars) given that, on average, employees on short-time work reduced their working time "only" by about 40% to 50%, in the absence of binding dismissal restrictions (which ties in with the calculations made by Public Employment Service Austria (AMS, 2021).

In terms of hours worked, the impact of short-time work has been strong, too, especially so in the second quarter of 2020 (peak use of short-time work). In that quarter, average hours worked per employee were about 13% lower than in Q2/19, while average hours compensated (i.e. hours worked plus hours compensated via short-time work schemes) were about the same as in Q2/19.

3 Average wages dampened by reduction in working hours

The decline in working hours per employee (chart 6) also dampened wage increases (chart 7). After all, employees in short-time work generally receive less than their full-time wage. Under the new short-time work scheme, they are entitled to a net pay of 80% to 90% of what they would have earned otherwise; this replacement rate decreases with the net wage earned before short-time work and is not linked to the actual reduction of hours worked.[9] This has contributed to the sizeable negative wage drift observed in 2020 (chart 7), meaning that average wages per employee (blue line) have increased by less than what would have been expected based on increases in agreed wages (red bars). Reductions in overtime have also contributed to this development, much like in 2009, when the take-up of short-time work was much more limited, however.

In the aggregate, employees were partly compensated for these losses via an income tax cut, which led to an increase in average net wages (yellow line) above the one of gross wages. This tax cut had a much smaller effect than the one during the crisis of 2009 or the one implemented in 2016, though.[10] The effect of short-time work schemes on average wages is difficult to quantify as the number of employees would have dropped more sharply without this scheme, possibly accompanied by a smaller reduction in average hours worked by remaining employees. However, the effect on the aggregate compensation of employees and the impact of all COVID-19-related subsidies on the wage share can be quantified (box 3).

[9] *Under the previous short-time work scheme, employees received the full hourly pay for actual hours worked and a compensation roughly equivalent to pro-rata unemployment benefits for the remainder.*

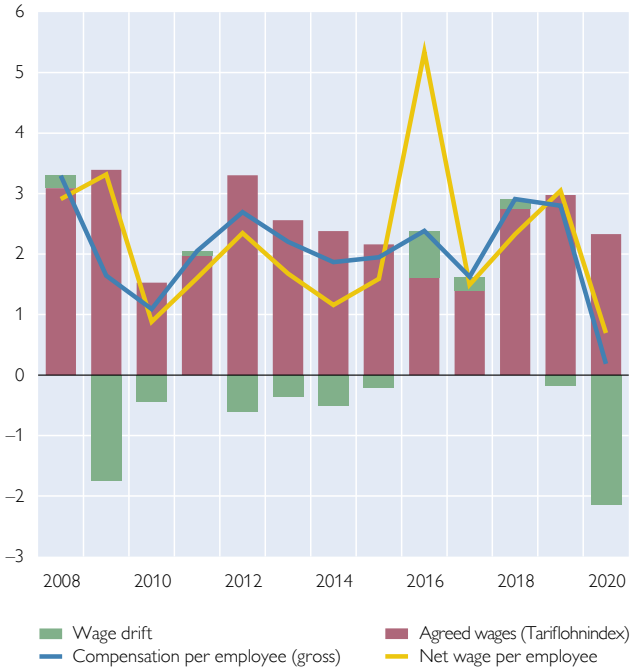
[10] *Note, however, that while the 2020 income tax cut for employees was overall smaller than in 2009 and 2016, its full impact is not visible in chart 7. It was implemented only in September 2020, and refunds for tax overpayments made from January until August 2020 will become available to some employees only in 2021.*

Chart 7

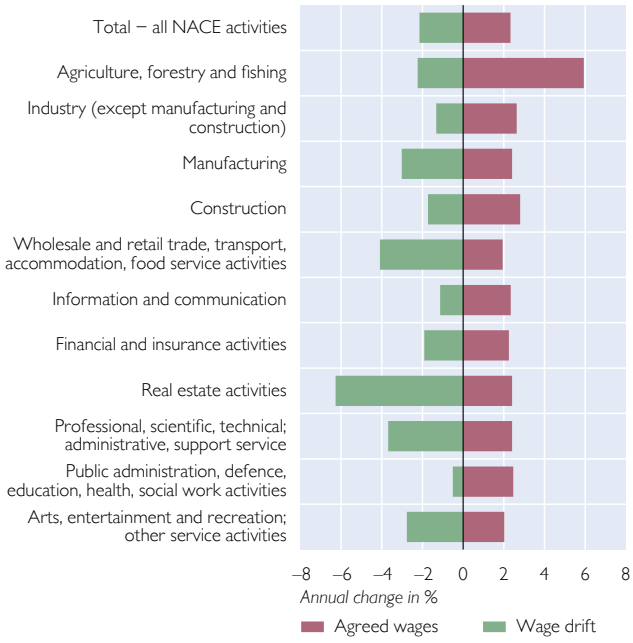
Wage developments

Compensation per employee from 2008 to 2020

Annual change in %



Compensation per employee in 2020 per industry



Source: Statistics Austria, Eurostat, OeNB.

The right panel of chart 7 shows that the wage drift has been negative across all industries, with the effect being smallest (in absolute value) in the extended public sector (which includes hospitals) and the effect being particularly large in tourism and trade as well as in professional services and in the real estate sector.

Box 3

Wage share distorted by fiscal COVID-19 measures in 2020

The adjusted wage share is a standard aggregate measure of the functional income distribution between capital and labor income. It is calculated by multiplying the share of aggregate compensation of employees in GDP by the inverted ratio of dependent employment to overall employment (the term "adjusted" refers to the adjustment for self-employed persons). In 2020, both the aggregate compensation of employees and the gross operating surplus of businesses declined by far less than nominal GDP at market prices (which fell by about 5½%), which is especially remarkable for the gross operating surplus (which declined much more in 2009; see chart 8). The pattern observed in 2020 is due to the substantial COVID-19-related subsidies rolled out by the Austrian government in 2020. According to the government's March 2021 budget notification, subsidies related to short-time work made up EUR 6 billion (about 1½% of 2019 GDP), while other targeted subsidies to enterprises made up EUR 7 billion (about 1¾% of 2019 GDP).[11] Assuming that 100% of short-time work subsidies went to employees (as an alternative to pay cuts and redundancies) and 100% of other subsidies went to businesses, we study the counterfactual developments of the functional income distribution without those

[11] *These large subsidies are also the reason why we plot the wage share in GDP at factor costs.*

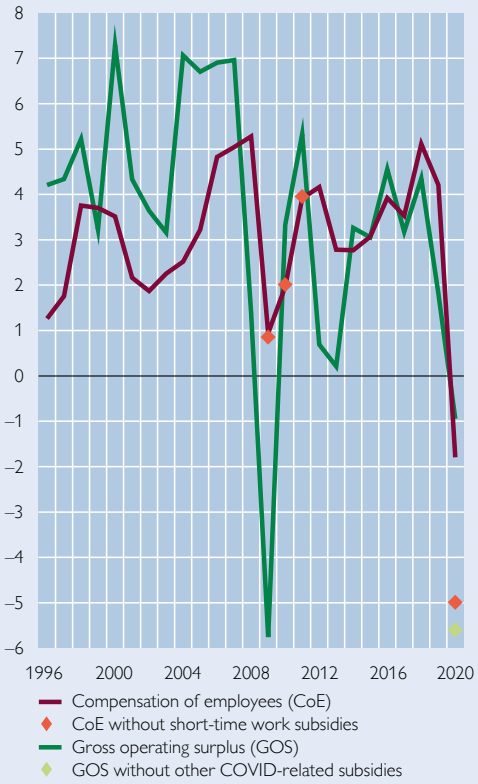
subsidies. The left panel of chart 8 shows that both compensation of employees (red dots) and gross operating surplus (green dots) would have fallen about as much as nominal GDP without those subsidies, while the effect of short-time work during the Great Recession of 2009 was barely visible (when short-time work subsidies amounted to about EUR 0.1 billion, or 0.04% of GDP). Similarly, short-time work schemes had practically no impact on the wage share in 2009/2010, while without these schemes (or when recorded differently in the national accounts),[12] the wage share would have been lower by more than 1 percentage point in 2020 (red dots in right panel of chart 8). However, the wage share would actually have been higher without any COVID-19-related subsidies (actual developments shown with a green dot) as other subsidies were even larger than those for short-time work.

Chart 8

Impact of COVID subsidies on income variables

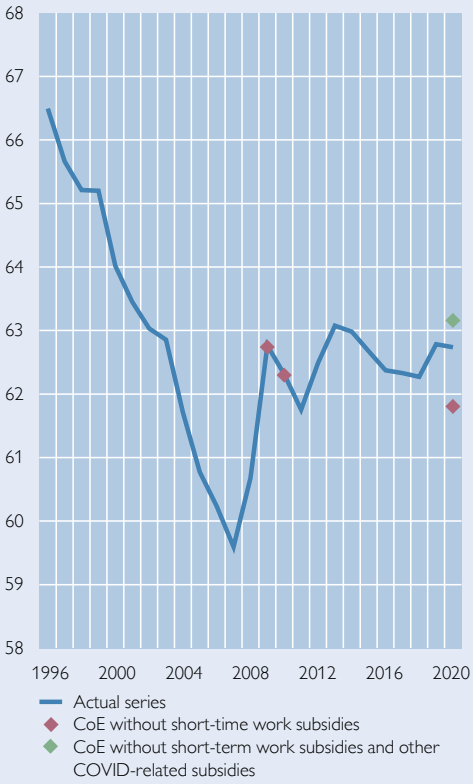
Compensation of employees and gross operating surplus

Annual change in %



Ajdusted wage share

% of GDP at factor costs (= GDP at market prices minus indirect taxes plus subsidies)



Source: Statistics Austria, Eurostat, OeNB.

[12] *Note that in some other EU Member States, government subsidies for short-time work are recorded as direct social benefits to households. For Austria, such an approach would have meant that both subsidies and compensation of employees would have been lower by about EUR 6 billion.*

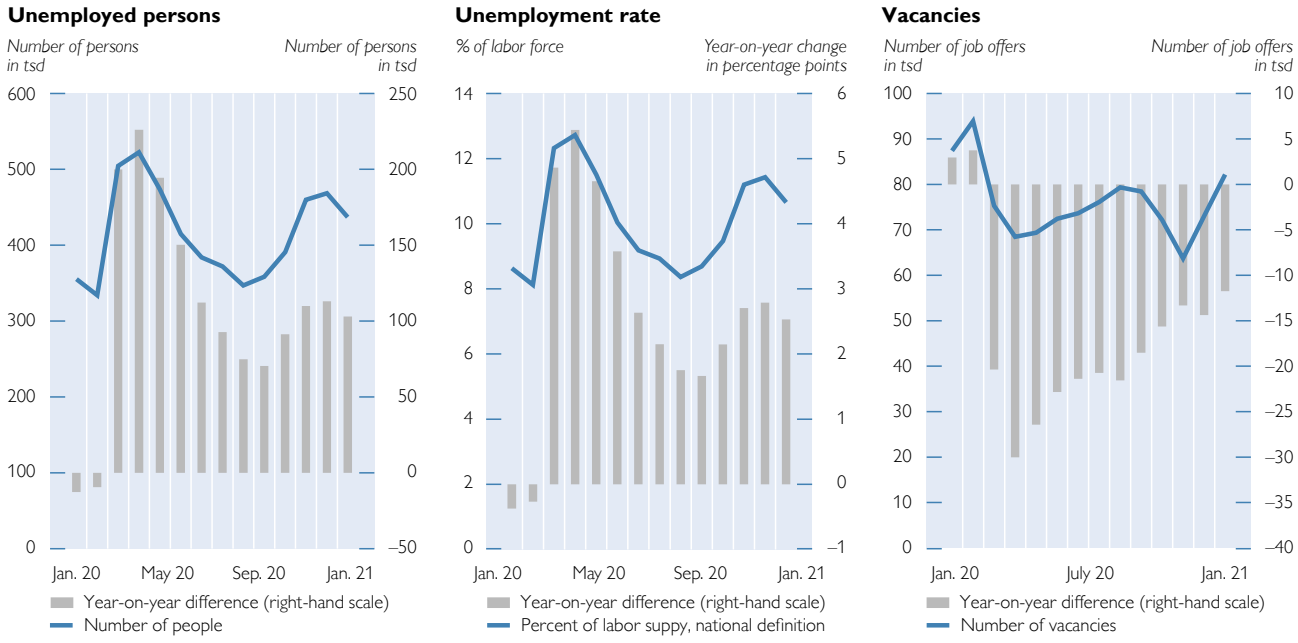
4 Number of unemployed persons and average duration of unemployment substantially on the rise

The drop in employment observed in 2020 was accompanied by a strong increase in unemployment. As the international definition of unemployment used in the EU labor force survey does not adequately reflect conditions in Austria (box 4), we rely on the national definition used by Public Employment Service Austria (AMS, short for Arbeitsmarktservice).

Chart 9 plots the changes observed in the number of unemployed people, the unemployment rate, and the number of vacancies as measured at a monthly frequency (not seasonally adjusted) since the beginning of 2020. In February 2020, before the outbreak of the crisis, about 330,000 people were registered as unemployed.[13] With the first lockdown, this measure rose to more than half a million in April. As the lockdown measures were relaxed at the start of the summer season, we witnessed a decline to around 350,000 unemployed people until September 2020. In turn, the figure bounced back to about 470,000 in January 2021 with the third lockdown. The smaller increase compared to the first lockdown was due to the recovery of the export-oriented industry, which in turn contributed to the much lower GDP effect shown in chart 2. The slight improvement in the labor market is also evident from the number of vacancies, although they remain significantly below pre-crisis levels.

Chart 9

Unemployment, unemployment rate and vacancies



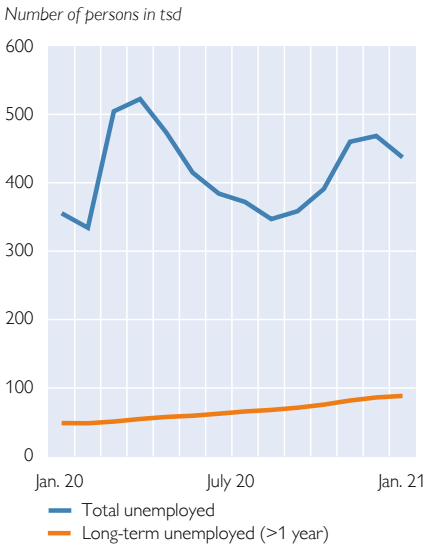
Source: AMS.

[13] *We use the official unemployment figures published by the AMS, which are end-of-month measures. Note that the end-of-month measure for March 2020 was far above the monthly average.*

Chart 10

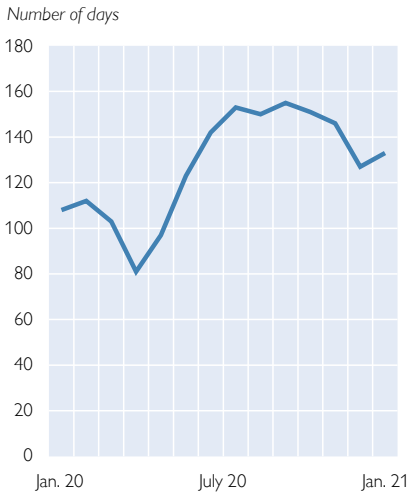
Average and long-term unemployment, duration of unemployment and upskilling measures

Unemployment and long-term unemployment (> 1 year)



Source: AMS. Data are seasonally unadjusted.

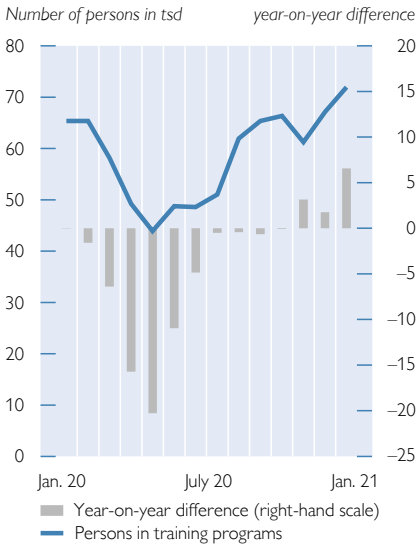
Average duration of unemployment period



Source: AMS. Data are seasonally unadjusted.

Note: Data refers to the length of unemployment spells ending in this month ("Verweildauer").

Participation in training programs



Source: AMS. Data are seasonally unadjusted.

The left panel of chart 10 highlights a possible long-run problem of the COVID-19 crisis. While average unemployment (measured in persons) followed the pattern of economic development (lockdowns and easing of lockdown measures), the long-term unemployment rate showed a steadily rising trend and an increase to more than twice the pre-crisis measure (+80%). Prolonged periods of unemployment are not only problematic from an individual perspective, they can also have negative effects on economic output in the medium to long term as longer redundancies increase the risk of deskilling, turning cyclical unemployment into structural unemployment.[14] Regarding the average length of unemployment spells measured in days (middle panel of chart 10), many temporarily unemployed people quickly found a job again after the first lockdown; thereafter the duration of unemployment doubled as the year progressed before declining again toward the end of the year (in line with the overall rise in unemployment).

In "normal" economic times, increases in the number of people in training programs mirror increases in unemployment. Yet, at the beginning of the COVID-19 crisis, the increase in unemployment coincided with a drop in training program participation (right panel in chart 10) as a result of pandemic-related constraints for training. Since then, the number of people in training programs has risen steadily, though, thus signaling a partial normalization of labor market conditions.

[14] *For a recent empirical analysis of such hysteresis effects in 34 countries see Bluedorn and Leigh (2019).*

Box 4

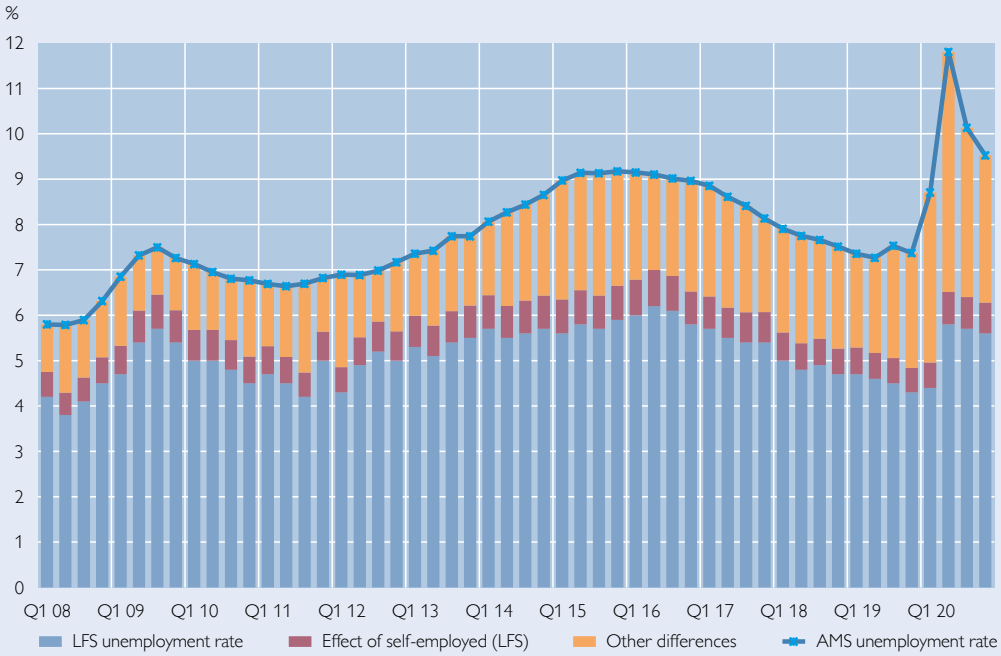
Differences between the national and the international definition of the unemployment rate

In 2020, the unemployment rate that Public Employment Service Austria (AMS) publishes based on the established national definition of unemployment increased far more than the rate published by Eurostat for Austria based on its labor force survey (LFS) (chart 11). While the national rate peaked in Q2/20, the LFS rate actually remained below the peaks registered in the mid-2010s. This raises the question about conceptual[15] differences between these two variables. To begin with, the LFS defines employment[16] more broadly, covering also self-employment (shown by purple bars in chart 11) and dependent employment with wages below the social security income threshold ("Geringfügigkeitsgrenze").

At the same time, the LFS uses a narrower definition of unemployment. For example, it excludes Austrian residents who receive pay below the social security income threshold and draw unemployment benefits at the same time (which is why they will be registered as unemployed according to the AMS definition). Over time, the number of unemployment beneficiaries in this segment has increased substantially, from about less than 4,000 persons in 2008 to about 48,000 persons in 2017 (thus accounting for more than 1% of the labor force; Bundesministerium für Arbeit, Soziales, Gesundheit und Konsumentenschutz, 2018). Furthermore, the LFS definition of unemployed individuals excludes jobless persons who are willing to work but are not actively searching. Cases in point are individuals who are registered as unemployed during the winter season, but may bank on being rehired by their former employer ("Wiedereinstellungszusage"). This discrepancy in the definition of inactive persons (included in the

Chart 11

Unemployment rate: EU labor force survey definition versus national definition



Source: Eurostat (labor force survey – LFS), AMS, OeNB.

[15] *Data collection differs as well: the LFS rate is survey-based, while the AMS rate is based on administrative data.*

[16] *Note, however, that the LFS definition of employment covers Austrian residents, while the AMS definition covers employment in Austria. In recent years, there have been more nonresidents (i.e. persons living abroad) working in Austria than Austrian residents working abroad.*

yellow bars in chart 11) is also the key reason for the increase in the gap between the AMS and the LFS rate in 2020, leading to an implausibly small increase in the unemployment rate and a drop in the participation rate as measured by the LFS. The difference was particularly severe in Q2/2020, such that the LFS unemployment rate barely dropped in the second half of 2020, while the AMS data pointed to a substantial decline. In view of these discrepancies, we only use unemployment data based on national definitions in the remainder of this article (and employment data either based on national definitions or derived from the national accounts).

5 Increase in unemployment uneven across industries, regions and personal characteristics

Employees in tourism and personal services affected the most

The introduction and temporary lifting of measures to contain the different waves of the COVID-19 pandemic was felt above all by the accommodation and food services and the personal service sector. For the tourism sector, the full-fledged lockdowns brought an almost complete loss of activity and income (see Fenz, Stix and Vondra, 2021, for details).[17] As the accommodation and food services industry is also a relatively large employer, it contributed the most to the sharp increase in unemployment in 2020 (chart 12). The varying degree of containment measures led to very large increases in unemployment in spring 2020 and early 2021, while the crisis impact was much smaller in summer and early autumn 2020.

The "administrative and support services" sector, which includes business cycle-sensitive temporary recruitment ("Leiharbeit"), also exhibited a strong increase in redundancies. At the same time, other industries like construction or professional services were much less affected by the containment measures.

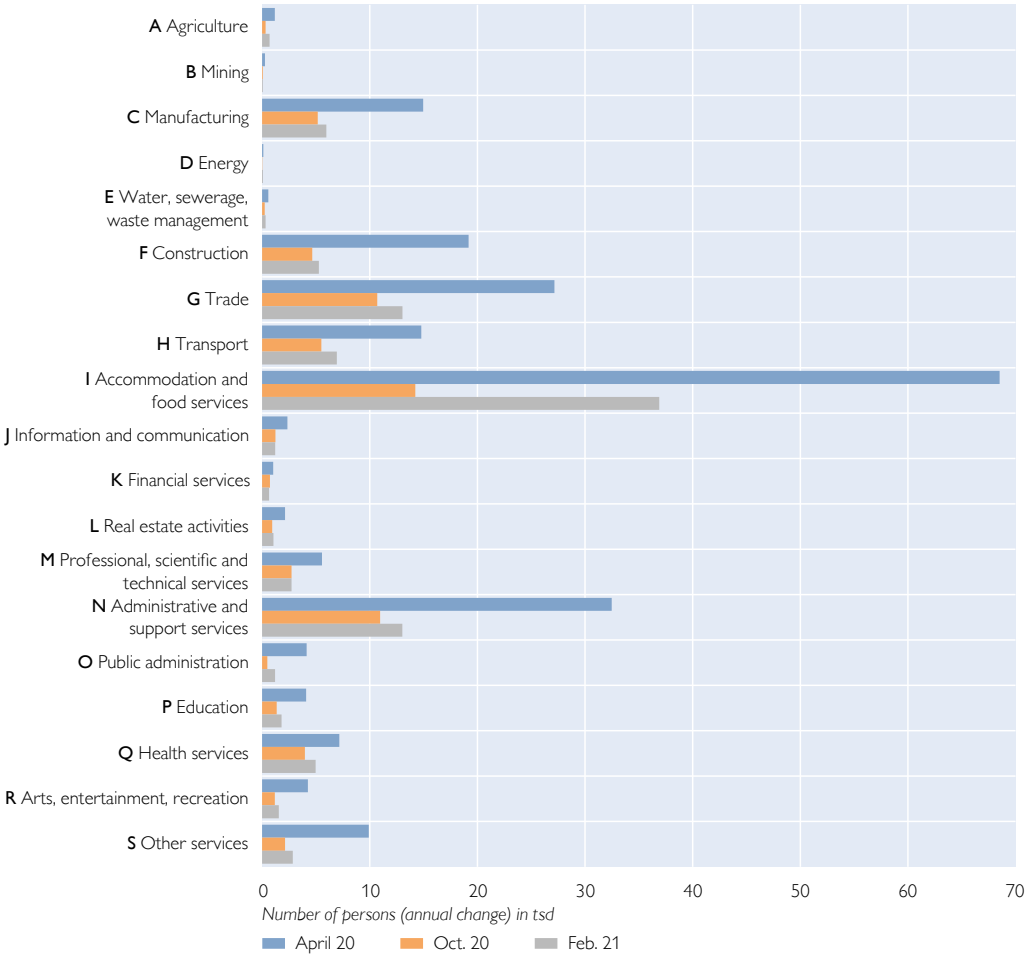
Heterogenous regional impact of the crisis

In Austria, the importance of the severely hit accommodation and food services industry varies significantly from region to region. The provinces with the highest pre-crisis shares of this industry in overall employment and value added are Tyrol and Salzburg. Therefore, it comes without surprise that the increase in unemployment was particularly strong in Salzburg and Tyrol, the two provinces with the lowest unemployment rates in the years before in Austria (chart 13). However, the relatively strong increase in unemployment in Vienna cannot be explained by its industrial structure, as employment dropped stronger within the same industries compared to the Austrian average.

[17] *Furthermore, Bock-Schappelwein et al. (2020) specifically discuss developments in the tourism sector during the summer of 2020.*

Chart 12

Unemployment highest in the accommodation and food services sector



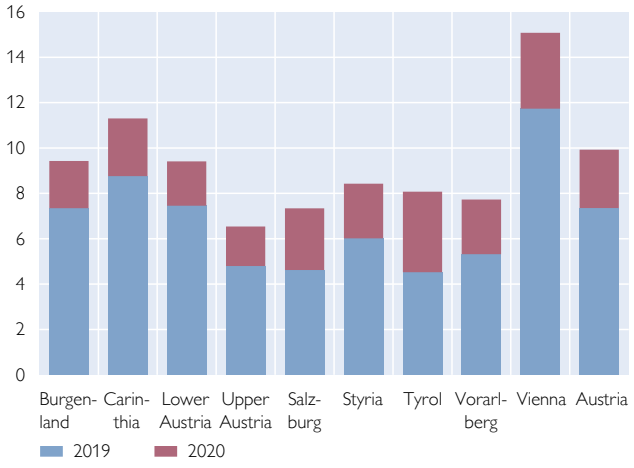
Source: AMS. The data are end-of-month measures.

Chart 13

Unemployment across Austria

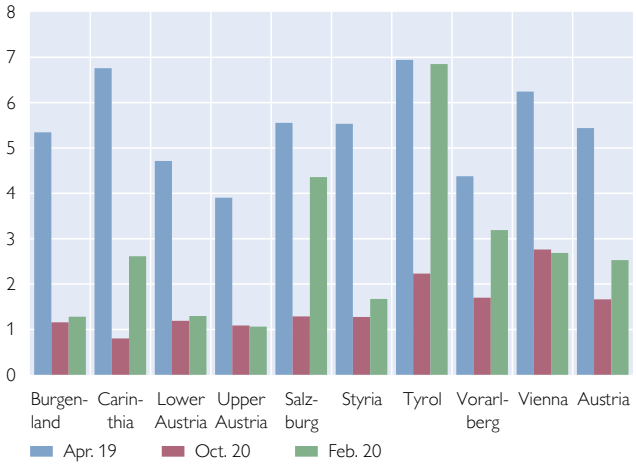
Unemployment rate

% of labor force



Change in unemployment rate

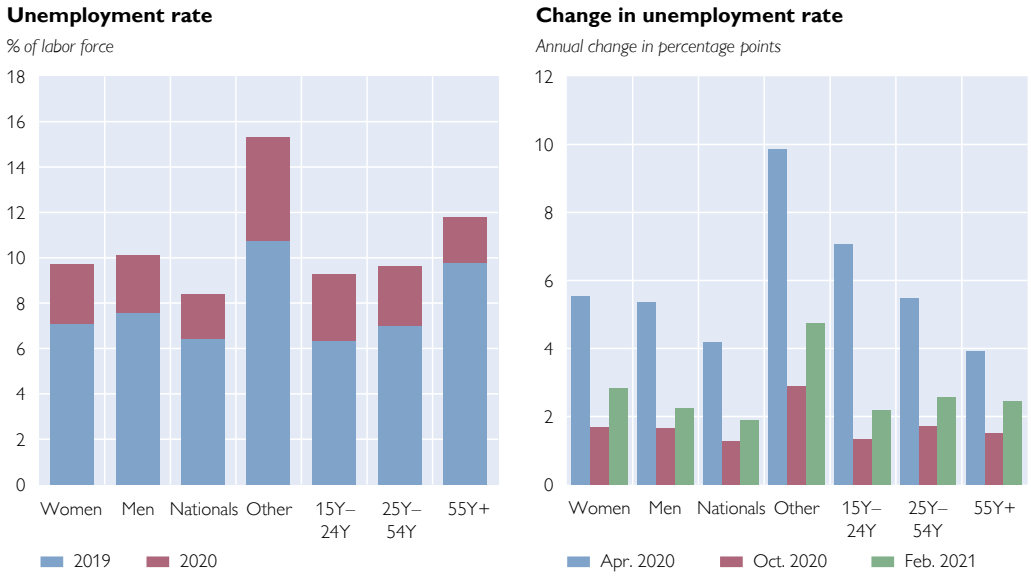
Year-on-year change in percentage points



Source: AMS.

Chart 14

Unemployment by sex, citizenship and age



Source: AMS.

Women and younger employees affected somewhat more; relative effect significantly stronger for foreigners

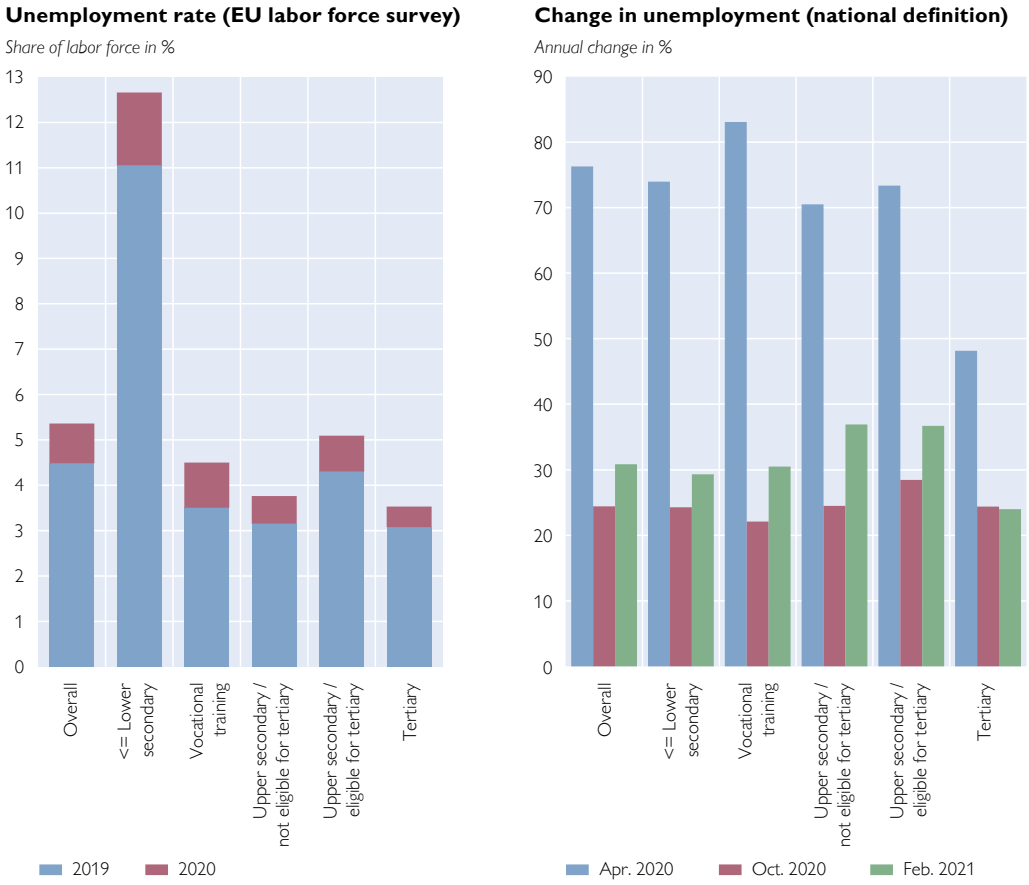
Chart 14 shows the increase in unemployment rates by sex, nationality and age. Starting from higher levels of male unemployment in 2019, the percentage point increase of female unemployment during 2020 somewhat exceeded the increase for men (see Bock-Schappelwein and Hyll, 2020, for the specific situation of women on the labor market).[18] The relative employment of women was was negatively affected by their high share in the heavily hit accomodation and food services industry. At the same time, however, this was broadly compensated by the increase in employment in the public sector, where women are overrepresented.

Employees without Austrian citizenship already had a much higher unemployment rate than nationals before the crisis, and the increase in their group-specific unemployment rate was also about 2½ percentage points higher. They were more affected than Austrian nationals at all stages of the current crisis as they are more likely to work in industries more affected by the crisis (like accommodation and food services). When the crisis first hit, younger employees were relatively more affected by the unemployment spike, but this effect has reversed more recently.

[18] *When comparing unemployment rates in spring 2020 with February 2020 (the last pre-crisis month), we find a much stronger increase for women than for men, though. For example, the unemployment rate of women increased by about 6 percentage points from February 2020 to April 2020, while the increase was "only" 3½ percentage points for men. However, this difference is to a large extent driven by seasonal effects like the decline in unemployment in construction between winter and spring.*

Chart 15

Unemployment by level of education



Source: Statistics Austria, AMS.

Employees with tertiary education were relatively less affected

Unemployment rates also increased across all educational groups (chart 15)[19] in 2020, but the redundancy effect was much smaller for employees with a tertiary degree. While the number of unemployed persons with no more than lower compulsory schooling or less actually increased at a rate similar to the national average and to employees with higher secondary education (right panel of chart 15), they started from a much higher unemployment rate (left part of chart 15), implying that their group-specific unemployment rate also increased comparatively faster. This pattern across different levels of educational attainment is also consistent with results from a survey conducted after the start of the pandemic (Pichler et al., 2020).

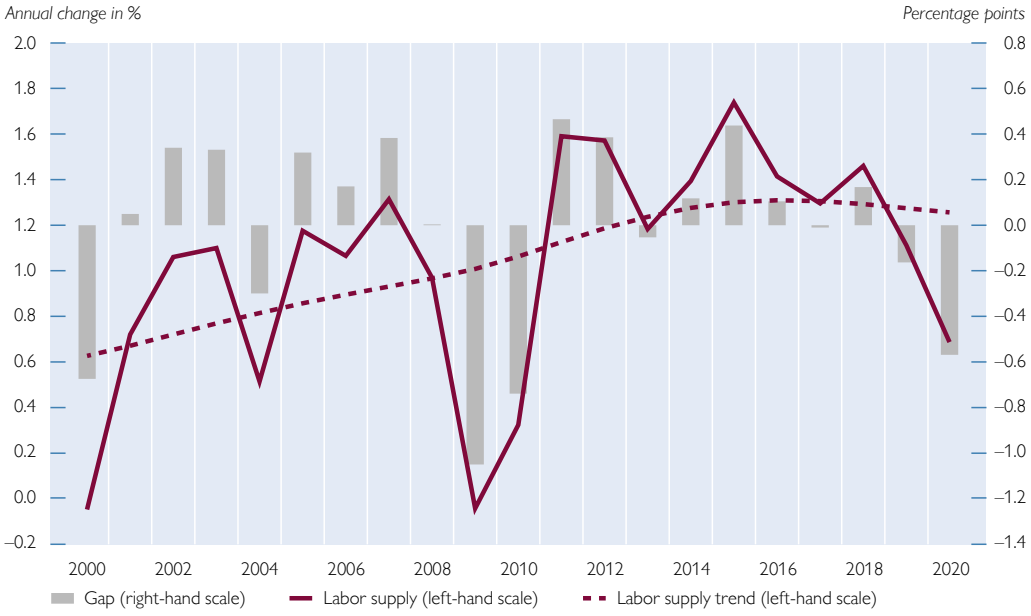
6 How strong was the impact on labor supply?

Labor supply is mainly driven by demographic developments (including net migration) and the participation rate. In Austria, the participation rate exhibits an increasing trend, and net migration has been significantly positive ever since the Austrian

[19] *As there are no administrative data on employment by education, we cannot compute administrative unemployment rates for these groups. Therefore, we rely on LFS data for unemployment rates (left panel of chart 15) and on changes in the number of unemployed (right panel of chart 15).*

Chart 16

Labor supply and "labor supply gap"



Source: AMS, authors' calculations.

labor market was opened to foreign workers from the newer EU member states (EU accession in or after 2004; see Stiglbauer, 2020; Prettner and Stiglbauer, 2007; Stiglbauer, 2005). However, both the participation rate and migration also react to the cyclical position of the economy. Moreover, for a more comprehensive view of the labor supply, it may make sense to go beyond the traditional measures of unemployment (see for instance ECB, 2012). Such wider definitions of unemployment may include unemployed people who have given up looking for a job or part-timers who want to work more hours ("underemployment"). In the context of the COVID-19 crisis, the available data are inadequate for exploring hardly any of these arguments because of the shortness of the observation period and due to data constraints (e.g. the current conceptual issues with the LFS unemployment rate described in box 4). Therefore, we define the labor force as the sum of employees and of registered unemployed persons (based on AMS data), and due to the former issue we look only at the development of labor supply in 2020.

Chart 16 shows the yearly development of the labor force. After an increase of 1.1% in 2019, growth lost momentum in the year 2020 (+0.7%) but the labor force did not shrink. When we compare this pattern with the trend development, we see that the "labor supply gap" was much smaller in 2021 than during the Great Financial Crisis of 2009, when labor supply stagnated.

At this point in time, the long-run effects of the crisis on the supply of labor are still unclear. A longer duration of unemployment could lead to hysteresis effects and drive up structural unemployment (section 4). Moreover, unemployment spawned by the crisis may produce scarring effects given the probability of delayed labor force entry or re-entry, as discussed for instance by Kawaguchi and Murao (2014) or Fuentes and Moder (2020).

7 Conclusions

The 2020 recession induced by the COVID-19 pandemic had huge effects on the Austrian labor market. The drop in employment was much sharper than during the Great Recession of 2009. Compared with developments in the euro area, the decline in employment was broadly average, while the increase in unemployment was somewhat above average as measured by the EU labor force survey, which uses a narrower definition of unemployment, however. At industry levels, the tourism industry was affected more heavily by the crisis than manufacturing or construction, contributing to a stronger increase in unemployment in provinces where tourism accounts for relatively higher shares of GDP. On the positive side, the impact on aggregate labor supply has been comparatively weak so far.

The generous short-time work scheme prevented even worse developments, and thereby also dampened the decrease in aggregate compensation of employees. However, in early 2021, even with the short-time work scheme still in place and a diminished GDP effect of lockdowns, unemployment is still far above pre-crisis levels, in particular for persons without an upper secondary degree and foreign workers. Therefore, the exit from the short-time work schemes should be designed in a way to prevent dismissals in industries which have an intact medium-term growth outlook but are recovering at a relatively slower pace. Furthermore, active labor market policy will be of outmost importance once the pandemic has ended to prevent hysteresis effects from long-term unemployment and scarring effects on labor market participation.

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Economic outlook of the OeNB

June 2021

Economic recovery aided by coronavirus vaccine rollout

Economic outlook for Austria from 2021 to 2023 (June 2021)

Christian Ragacs, Richard Sellner, Klaus Vondra[1]
Cutoff date: May 26, 2021

The easing of containment measures in view of accelerated COVID-19 vaccination rates have put the Austrian economy back on the road to a strong recovery in mid-2021. In 2020, containment measures had caused real GDP to contract by 6.7% year on year. Looking ahead, the Oesterreichische Nationalbank (OeNB) expects annual GDP growth to bounce back to 3.9% in 2021 and 4.2% in 2022, and to return to a normal growth rate of 1.9% in 2023. Amid the catch-up process in 2021 and 2022, industrial production, goods exports and investment are projected to expand in Austria on account of strong global demand. The key drivers of global demand will be the US economy, which is being powered by massive fiscal stimuli, and the robust global industrial production cycle. Exports from Austria are forecast to increase by 7.1% in 2021, by 6.4% in 2022 and by 3.4% in 2023. Gross capital formation is expected to recover sharply in 2021 (+4.7%). Thereafter, investment growth should go down to 3.3% (2022) and 1.8% (2023) as the investment cycle slows down. Private consumption, which slumped by 9.4% in 2020, is projected to recover fast with 4% growth in 2021 and 5.8% in 2022. This means that private consumption will exceed pre-crisis levels already in the first half of 2022, before slowing down in 2023 (+1.8%). Consumption growth will be driven substantially by dissaving, as the saving ratio is forecast to drop from its peak of 14.4% in 2020 to below 8% in 2023. Amid the economic recovery, the unemployment rate is expected to fall to 4.6% in 2023, from 5.2% in 2021. HICP inflation is projected to rise to 2.0% in 2021, driven by rising commodity prices, and to decelerate to 1.8% in both 2022 and 2023. The general government deficit is projected to improve to 6.9% of GDP (following 8.9% in 2020) and to drop to around 2% of GDP by 2023. The debt ratio, which rose from 83.9% to 85.1% of GDP in 2021, is forecast to start shrinking from 2022 and to amount to close to 82% of GDP in 2023.

1 Summary

With pandemic broadly contained, economy starts reopening

Since COVID-19 infections peaked for the third time in Austria in late March 2021, the incidence of new infections and hence the level of COVID-19 bed occupancy in intensive care units have been declining substantially, as in almost all European countries. At the cutoff date for data for this report, close to 40% of the Austrian population had received at least one dose of a COVID-19 vaccine, and the vaccination rate was rising rapidly. In terms of underlying assumptions, the OeNB's projections are based on the expectation that none of the emerging COVID-19 variants will be resistant to the vaccines, and that the number of available vaccine doses will exceed the number of people willing to get vaccinated against COVID-19 by mid-2021. The broad-based lifting of containment measures in mid-May will be followed by a further easing of measures. Since herd immunity will probably not be achieved before 2022, some containment measures are here to stay in the medium term, but

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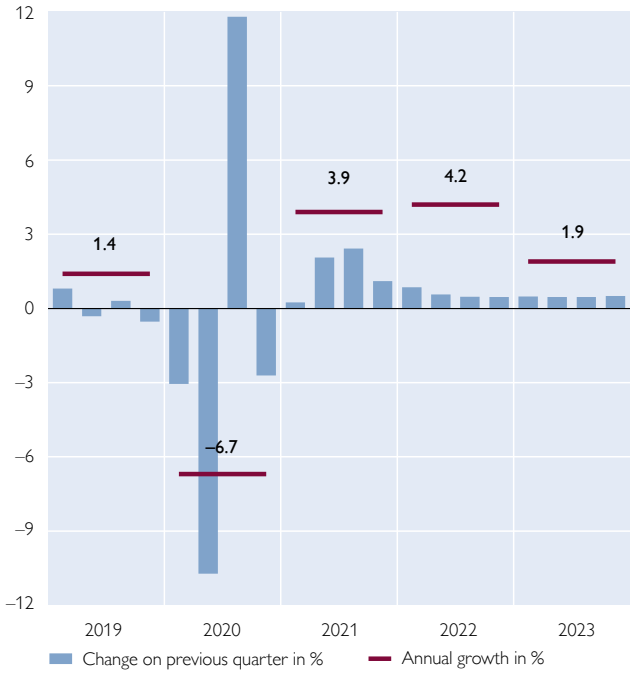
Chart 1

Main results of the June 2021 outlook

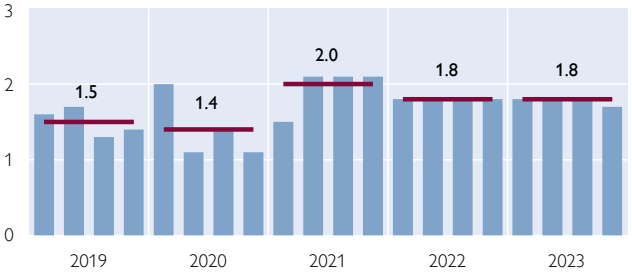
Real GDP growth

Change on previous period in % (seasonally and working day-adjusted)

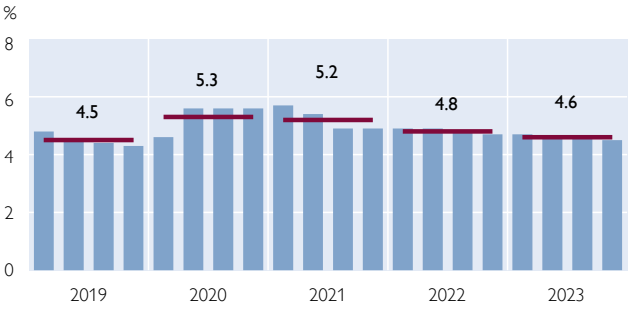


Harmonised Index of Consumer Prices (HICP)

Annual change in %



Unemployment rate



Source: WIFO, Statistics Austria; OeNB June 2021 projections.

the economic impact of those measures will remain limited. In 2022 and 2023, COVID-19 vaccines for all ages will be in plentiful supply, and so will drugs to treat the disease.

Heterogeneous recovery of the global economy

Over the forecast horizon, the development of the global economy will be characterized by a strong recovery from the pandemic, but the pace of the recovery will be mixed across regions. Advanced economies are expected to exceed their pre-crisis levels in the third quarter of 2021 and catch up with the growth path projected before the crisis at the end of 2022. In contrast, the economic output of emerging market economies is going to remain below pre-crisis trends even in the medium term given the slower vaccine rollout. On balance, global economic activity is going to accelerate at a particularly strong rate (6.0%) in 2021, and at a gradually lessening pace thereafter (4.3% in 2022 and 3.5% in 2023). Euro area growth is likewise expected to be robust, with growth rates of 4.6% in 2021, 4.7% in 2022, and 2.1% in 2023.

Goods exports on track for rapid recovery to pre-crisis levels – moderate recovery in tourism

In 2020, Austrian exports slumped by 10.9% on account of the pandemic-related containment measures. Meanwhile, leading indicators for the export industry point to a speedy recovery, driven above all by the strong global industrial production cycle and the robust performance of the US economy. Short-term downward risks

to the projections arise from high commodity prices, supply disruptions for semiconductors and transport delays. In the tourism sector, the number of total overnight stays in 2021 are bound to drop further, given the "loss" of the 2020/21 winter tourist season. The shutdown throughout the winter season will also be one of the main reasons why the 2021 GDP growth rate for Austria (3.9%) remains considerably below the projections for the euro area as a whole (4.6%). Based on these low levels and on the assumption that major pandemic-related restrictions will be a thing of the past, overnight stays are projected to recover substantially in 2022. In sum, exports are forecast to grow by 7.1% in 2021, by 6.4% in 2022 and by 3.4% in 2023.

Easing of containment measures unleashes pent-up consumer demand

The initial easing measures implemented in Austria in mid-May 2021 included the lifting of most supply-side restrictions on consumption. In the wake of these measures, we anticipate a sharp decline of the elevated saving ratio and a strong revival of private consumption on all services that were heavily constrained by the containment measures. Following a sizable contraction by 9.4% in 2020, private consumption is set to recover fast with 4% growth in 2021 and 5.8% in 2022. Once private consumption will have reached pre-crisis levels in the first half of 2022, consumption growth is going to broadly normalize in 2023 at a growth rate of 1.8%. The saving ratio, which peaked at 14.4% in 2020, is forecast to drop to below 8% in 2023. This development is based on the assumption of some post-COVID spending of excess savings. If consumers were to spend larger-than-expected amounts of excess savings accumulated during the pandemic, this might constitute upward risks to the projections for consumption.

Investment bouncing back strongly as well

In the run-up years to the pandemic outbreak, investment was a key pillar of Austria's economy. In 2020, gross fixed capital formation contracted by 4.8% owing to the high degree of uncertainty. As industrial activity and exports rebounded, capacity utilization has been increasing steadily as well. Apart from meeting pent-up demand following the setback in 2020, domestic companies will therefore also have to invest in expanding their production capacities in the longer run. Investment activity is forecast to grow by a solid 4.7% in 2021, followed by slower growth rates in the years ahead. Specifically, gross fixed capital formation is projected to grow by 3.3% in 2022 and by 1.8% in 2023.

Economic recovery to feed through to the labor market

While hours worked in payroll employment contracted by 9.4% in 2020, the rollout of short-time work was instrumental in preventing an even stronger decline of employment (−2%) and in limiting the rise in unemployment (Eurostat definition) to 5.3% (+0.8 percentage points). Given the broad-based lifting of lockdown measures in Austria in mid-May 2021, we expect the domestic economy to stage a visible recovery, and re-accelerating output to give a boost to employment. Reflecting the very weak first quarter, the number of payroll employment is forecast to rise by 1.2% in 2021. This should be followed by employment growth of 1.6% in 2022 and of 0.9% in 2023. The recovery will be even more pronounced in terms of hours worked, which are expected to rise by 4.7% in 2021, 4.1% in

2022 and 1.7% in 2023. The unemployment rate is forecast to decline from 5.2% in 2021 to 4.6% in 2023.

Temporary rise in inflation in 2021

Based on the OeNB's most recent inflation forecast, we expect HICP inflation to accelerate to 2.0% in 2021 and to amount to 1.8% in both 2022 and 2023. Thus, the current forecast for 2021 exceeds the December 2020 outlook, given above all accelerating commodity prices (for energy and nonenergy commodities). Core inflation, which excludes services and nonenergy industrial goods, is projected to reach 1.6% in 2021. As economic activity recovers, core inflation is expected to rise further to 1.9% in 2022 and to 2.1% in 2023. This development will be driven by both rising demand and the accelerated growth of unit labor costs, given the anticipated improvement of labor market conditions.

Gradual reduction of pandemic-related budget deficit

In 2021, the general government deficit is set to improve to 6.9% of GDP (from 8.9% in 2020), as both the scope of discretionary measures and the effect of automatic stabilizers is going to shrink somewhat compared with 2020. In the following two years, the unwinding of numerous discretionary measures (above all short-time work, fixed cost grants and compensation for forgone revenues) together with the business cycle recovery are going to facilitate a strong improvement of the deficit ratio to about 2% of GDP in 2023. The debt ratio, which stood at 83.9% in 2020, is forecast to rise to 85.1% of GDP in 2021 and to decline from 2022, reaching close to 82% of GDP in 2023.

2 Technical assumptions

2.1 General assumptions

This forecast for the Austrian economy is the OeNB's contribution to the June 2021 Eurosystem staff macroeconomic projections for the euro area. The forecast horizon ranges from the second quarter of 2021 to the fourth quarter of 2023. The cutoff date for all assumptions on the performance of the global economy, interest rates, exchange rates and crude oil prices was May 21, 2021. To prepare these projections, the OeNB used its macroeconomic quarterly model and national accounts data provided by the Austrian Institute of Economic Research (WIFO), as adjusted for seasonal and working-day effects in line with Eurostat requirements. The preliminary national accounts data published by WIFO on April 30 were available for the period ending with the first quarter of 2021.

Demand for Austrian exports is forecast to rebound by 9.3% in 2021, after having contracted by 9.2% in 2020. It is expected to grow by 6.2% in 2022 and by 3.5% in 2023. Short-term interest rates are based on market expectations for the three-month EURIBOR, namely −0.5% for 2021 and 2022, and −0.3% for 2023. Long-term interest rates, which reflect market expectations for ten-year government bonds, are expected to rise from −0.2% in the first quarter of 2021 to 0.6% in the fourth quarter of 2023. In other words, compared with the OeNB's December 2020 outlook, the long-term yield assumptions were revised upward by 0.4 percentage points for 2021, and by 0.6 percentage points each for 2022 and 2023. The exchange rate of the euro vis-à-vis the US dollar is assumed to remain constant

Table 1

OeNB June 2021 outlook for Austria – main results[1]

	2020	2021	2022	2023
Economic activity	*Annual change in % (real)*			
Gross domestic product (GDP)	–6.7	+3.9	+4.2	+1.9
Private consumption	–9.4	+4.0	+5.8	+1.8
Government consumption	+1.6	+2.1	+0.5	+0.8
Gross fixed capital formation	–4.8	+4.7	+3.3	+1.8
Exports of goods and services	–10.9	+7.1	+6.4	+3.4
Imports of goods and services	–10.0	+7.4	+6.3	+3.0
	% of nominal GDP			
Current account balance	2.5	2.1	2.2	2.4
Import-adjusted contributions to real GDP growth[2]	*Percentage points*			
Private consumption	–3.6	+1.4	+2.0	+0.6
Government consumption	+0.3	+0.4	+0.1	+0.1
Gross fixed capital formation	–0.5	+0.6	+0.4	+0.2
Domestic demand (excl. changes in inventories)	–3.8	+2.4	+2.6	+1.0
Exports	–3.5	+2.0	+1.8	+1.0
Changes in inventories (incl. statistical discrepancy)	+0.2	–0.2	+0.1	+0.0
Prices	*Annual change in %*			
Harmonised Index of Consumer Prices	+1.4	+2.0	+1.8	+1.8
Private consumption expenditure deflator	+1.1	+2.1	+1.8	+1.7
GDP deflator	+1.2	+2.3	+1.9	+1.6
Unit labor costs (whole economy)	+5.9	–0.6	+0.1	+1.4
Compensation per employee (nominal)	+0.4	+2.2	+2.9	+2.6
Compensation per hour worked (nominal)	+8.8	–1.4	+0.3	+1.8
Import prices	–1.6	+1.6	+1.9	+1.9
Export prices	–0.2	+1.7	+2.0	+1.5
Terms of trade	+1.4	+0.1	+0.1	–0.3
Income and savings				
Real disposable household income	–2.9	+0.6	+2.4	+1.4
	% of nominal disposable household income			
Saving ratio	14.4	11.0	8.1	7.8
Labor market	*Annual change in %*			
Payroll employment	–2.0	+1.2	+1.6	+0.9
Hours worked (payroll employment)	–9.4	+4.7	+4.1	+1.7
	% of labor supply			
Unemployment rate (Eurostat definition)	5.3	5.2	4.8	4.6
Unemployment rate (AMS definition)	10.0	9.0	8.0	7.7
Public finances	*% of nominal GDP*			
Budget balance	–8.9	–6.9	–2.8	–2.0
Government debt	83.9	85.1	82.8	81.9

Source: 2020: Statistics Austria; 2021 to 2023: OeNB June 2021 outlook.

[1] The outlook was drawn up on the basis of seasonally and working day-adjusted national accounts data (as available for Q1 21).
[2] The import-adjusted growth contributions were calculated by offsetting each final demand component with corresponding imports, which were obtained from input-output tables.

at USD/EUR 1.21. The projected path of crude oil prices is based on futures prices, which are trending upward strongly following a major demand-driven setback in 2020. The price of a barrel of Brent crude oil increased substantially from USD 44.5 in the fourth quarter of 2020 to USD 60.1 in the first quarter of 2021.

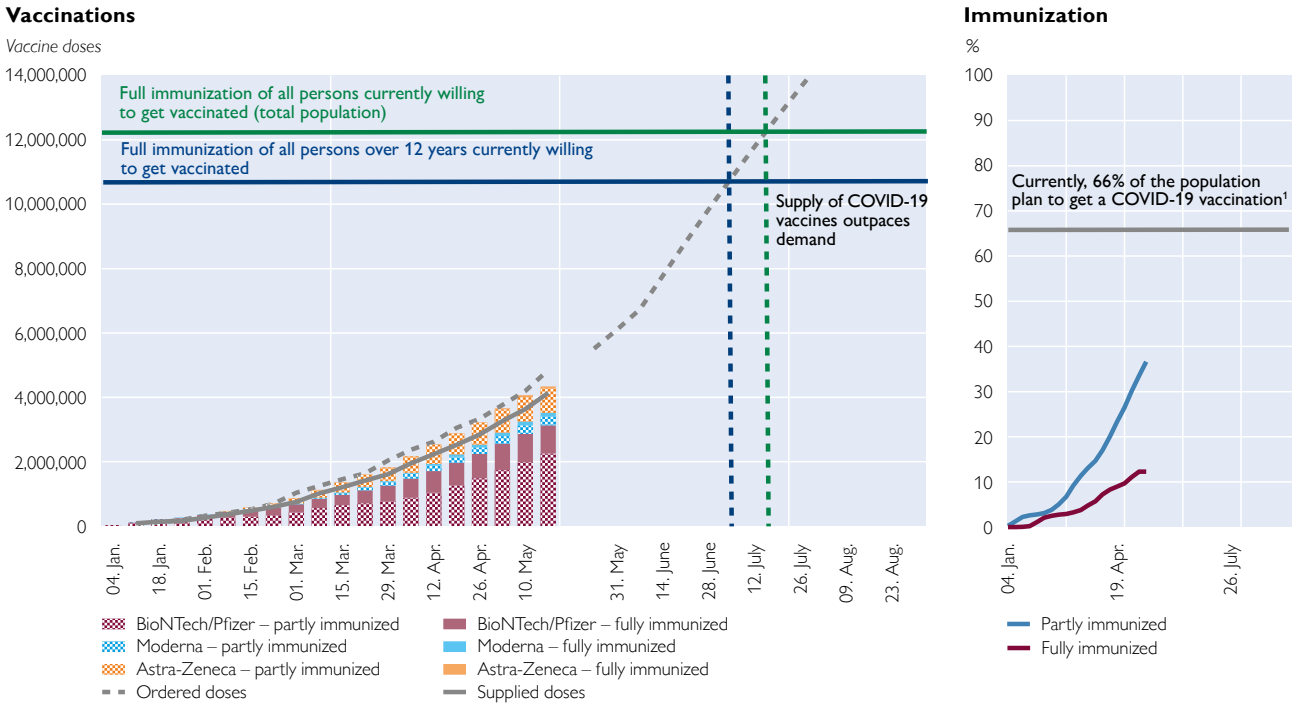
In line with crude oil futures prices, it is expected to keep rising until mid-2021 (USD 86.2 in the third quarter), before receding to USD 61.1 in the fourth quarter of 2023. The prices of nonenergy commodities are also assumed to move in line with futures prices.

2.2 Pandemic-related assumptions

Since COVID-19 infections peaked for the third time in Austria in late March 2021, the incidence of new infections and hence the level of COVID-19 bed occupancy in intensive care units have been declining substantially, as in almost all European countries. At the cutoff date for data for this report, Austria had a seven-day incidence of 41, and intensive care treatment was required for close to 200 individuals suffering from COVID-19. The rapid decline of COVID-19 infections in spring 2021 was supported by comprehensive containment measures and, ultimately, by the increasing rollout of the COVID-19 vaccination program. While at the start of the year the availability of vaccine doses was still highly limited, the supply of vaccine doses has since been rising continuously. At the cutoff date for data, close to 3.5 million individuals or 39% of the Austrian population had received at least one vaccine dose. Based on the supply of vaccine doses[2] and current surveys of vaccination preparedness,[3] the number of available vaccine doses will exceed the number of people willing to get vaccinated against COVID-19 by summer 2021 at the latest.

Chart 2

COVID-19 vaccine supply and vaccinations in Austria



Source: Federal Ministry for Social Affairs, Health, Care and Consumer Protection.

[1] *Based on the BioNTech/Pfizer vaccine.*

[2] *See data published by Austria's ministry of health, https://info.gesundheitsministerium.at/.*

[3] *See survey results from the University of Vienna, https://viecer.univie.ac.at/corona-blog/corona-blog-beitraege/corona-dynamiken30/.*

The OeNB's June 2021 outlook is based on the assumption that the number of people who will have been vaccinated against, or will have recovered from COVID-19 by fall 2021 will not suffice to fully rule out the possibility of another resurgence of infections. To keep the reproduction rate of the virus below the critical value of 1, some containment measures will therefore have to be retained also in the fall. This includes vaccine/test/recovery access requirements, travel warnings, potential restrictions for large-scale events (including conferences) and hygiene practices. Directly or indirectly, these measures will continue to affect economic sentiment, thus dampening the recovery in some economic sectors. However, the OeNB's projections are based on the assumption that potential future virus variants are not going to undermine the vaccination progress achieved so far.

For 2022 and 2023, we expect that COVID-19 vaccines will be available to immunize all children and that the overall preparedness of individuals to get the vaccine will continue to rise. This should bring the overall number of people who have been vaccinated or have recovered from COVID-19 to sufficiently high levels to prevent broad-based resurgences of the virus. Vaccine availability will not be an issue, and medication for treating COVID-19 will also have become available. To sum it up, economic activity in Austria is not expected to be affected by major immediate pandemic-related repercussions in 2022 and 2023.

2.3 World economy recovers strongly from the pandemic

Amid the COVID-19 pandemic, the world economy contracted heavily in 2020. Ultimately, however, the economic setback was somewhat lower in most major economies and economic areas than had been anticipated during the year. Excluding the euro area economies, global economic output shrank by 2.4% and thus by 0.6 percentage points less than the OeNB had expected in its December 2020 outlook. The United Kingdom suffered a GDP decline of 9.8%, intensified by Brexit, and the Latin American economies saw output shrink by 7.1%. In contrast, China achieved 2% output growth in 2020, after having succeeded in swiftly containing the novel coronavirus with stringent measures. In the United States, the impact of the pandemic remained relatively limited, as the economy contracted by "just" 3.5% on the back of a comparatively softer approach to containment and heavy fiscal stimulus.

In the first few months of 2021, global industrial production and the trade of goods continued to accelerate. Stronger-than-expected demand and some supply-side restrictions led to a sharp increase in prices for agricultural products, crude oil, industrial metals (above all copper) and construction material (above all wood and steel). China's strong export growth resulted in regional container bottlenecks and a substantial increase in freight traffic, from Chinese ports to European destinations in particular. Moreover, we witnessed extended disruptions in global supply chains following a Suez Canal traffic jam caused by a cargo ship and high coronavirus infection rates in India. The automotive industry in particular has been suffering from semiconductor supply shortages. With just-in-time inventory management and production having become widespread in the automotive supply chain, car manufacturers had drastically cut their orders from suppliers when the pandemic broke out. These supplies have since found new buyers in the electronics industry. While the supply of some commodities, including crude oil, can typically be adjusted rather swiftly, the production of sophisticated semiconductor plants is

comparatively more time and cost intensive. Major global manufacturers have already said they will expand their production capacities, but manufacturing supply bottlenecks are likely to persist until the end of 2021, and possibly even until the end of 2022.

Unlike industrial production, the recovery of the services industry and of tourism has remained subdued in most countries in 2021 given the prevailing restrictions on business and leisure travel. Depending on vaccination progress and the incidence of infections, some countries and regions moved ahead with a gradual easing of restrictions in the first half of 2021.

Until the end of the forecast horizon, the development of the global economy is characterized by a strong recovery from the pandemic, but the pace of recovery will be mixed across regions. See chart 3 for an overview of current projections (OeNB June 2021 forecast = blue line) for selected economic areas compared with the pre-crisis projections (OeNB December 2019 forecast = red line). Economic activity in the advanced economies[4] is expected to surpass pre-crisis levels (fourth quarter of 2019) in the third quarter of 2021 and catch up with the growth path projected before the crisis by the end of 2022. In contrast, the economic output of the emerging market economies is going to remain about 2 percentage points below the pre-crisis trends even in the medium term given the slower vaccine rollout.

Table 2

Underlying global economic conditions

	2020	2021	2022	2023
Gross domestic product	*Annual change in % (real)*			
World excluding the euro area	–2.4	+6.2	+4.2	+3.7
USA	–3.5	+6.6	+3.8	+2.3
Japan	–4.7	+2.4	+2.3	+1.2
Asia excluding Japan	–0.2	+7.9	+5.3	+5.3
Latin America	–7.1	+5.5	+3.0	+2.8
United Kingdom	–9.8	+6.5	+5.1	+1.8
CESEE EU Member States[1]	–3.9	+4.7	+4.3	+3.4
Switzerland	–3.0	+3.1	+2.2	+1.7
Euro area[2]	–6.8	+4.6	+4.7	+2.1
World trade (imports of goods and services)				
World	–8.7	+10.0	+5.5	+3.7
World excluding the euro area	–8.5	+10.8	+4.9	+3.7
Growth of euro area export markets (real)	–10.0	+8.6	+5.2	+3.4
Growth of Austrian export markets (real)	–9.2	+9.3	+6.2	+3.5
Prices	*absolute*			
Oil price in USD/barrel (Brent)	42.3	65.8	64.6	61.9
Three-month interest rate in %	–0.4	–0.5	–0.5	–0.3
Long-term interest rate in %	–0.2	0.1	0.3	0.5
USD/EUR exchange rate	1.1	1.2	1.2	1.2
Nominal effective exchange rate of the euro (euro area index)	119.3	122.0	122.2	122.2

Source: Eurosystem.

[1] *Bulgaria, Croatia, Czechia, Hungary, Poland and Romania.*
[2] *2020: Eurostat; 2021 to 2023: Results of the Eurosystem's June 2021 projections.*

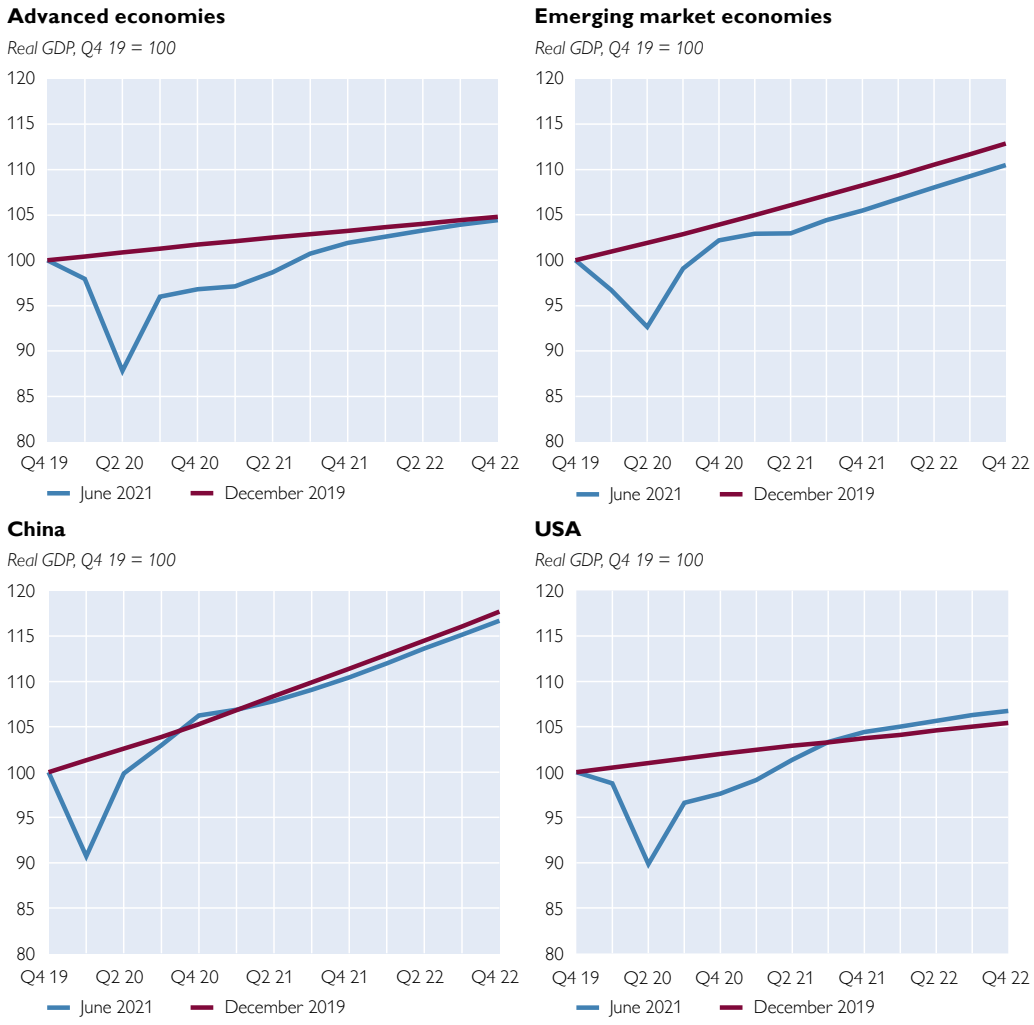
[4] *USA, Japan, EU, UK, Switzerland, Australia, New Zealand, Canada, Norway and Iceland.*

The pace of economic recovery differs even within the individual regions. While a number of Southeast Asian and Latin American economies are likely to recover slowly given the continued high incidence of infections in some parts and the slow vaccine rollout, *China* reverted to the growth path projected before the crisis struck already toward the end of 2020. China's fast recovery is attributable to the rapid containment of the pandemic in 2020 as well as to thriving exports and robust investment.

The *US* economy is expected to surpass pre-crisis levels already in the third quarter of 2021, aided by the decline in infection rates observed since early 2021 and the massive stimulus package adopted by the government. In this respect, the American Rescue Plan Act passed in March with a price tag of USD 1,900 billion is expected to have the largest impact.[5] Additional draft bills include the American

Chart 3

Heterogeneous recovery



Source: Eurosystem, OeNB.

[5] *Apart from additional funds for combating the pandemic, the American Rescue Plan Act provides for direct payments to individuals, extends and expands unemployment compensation, includes transfers to states and local governments, and appropriates funds for industry-specific support for businesses.*

Jobs Plan Act with a budget of USD 2,000 billion and the American Families Plan Act with a budget of USD 1,800 billion. The strong fiscal stimulus has lately given rise to concerns about a possible overheating of the economy. Recent months have seen a visible uptick in inflation, which, however, also reflects a base effect attributable to energy prices.

Like the other regions, the *euro area* economy is now also expected to recover at a faster rate than projected in the December 2020 round of projections. Following another contraction in early 2021, second-quarter growth should be robust. Real GDP is likely to surpass pre-crisis levels early next year and reach the pre-pandemic growth path at the end of 2022. Starting with the second half of 2021, the NextGenerationEU package is expected to add further stimulus. In *Germany*, the lockdown imposed in late December 2020 stopped the incipient recovery of private consumption and resulted in a quarter-on-quarter decline of economic output in the first quarter of 2021. The vaccination rate of the population accelerated visibly in the second quarter, and the incidence of infections dropped sharply in May. Current leading indicators imply a forthcoming boom of the construction and manufacturing industries, which will be cushioned by rising commodity prices and semiconductor supply shortages, but only in the short term. Private consumption should revive strongly in the third quarter, in line with a broad-based easing of containment measures. Exporters benefit from the global recovery, above all from strong US output growth. In *Italy*, economic output also contracted in the first quarter of 2021 during the third wave of COVID-19 infections. Following a gradual recovery in the second quarter, GDP growth is set to accelerate in the second half of the year. The recovery is driven by a massive fiscal stimulus package, to be largely financed with funds from the EU's Recovery and Resilience Facility (EUR 190 billion out of a total of EUR 250 billion). 2020 was a difficult year also for *France*, with an 8.2% decline of economic output. While economic output stagnated in the first quarter of 2021, the full-fledged lockdown imposed in April is likely to lead to a contraction in the second quarter. In the third quarter, the broad-based lifting of containment measures ought to cause a strong rebound in private consumption. The recovery of total exports is expected to lag somewhat behind, as tourism exports, which are a key pillar of the French economy, will probably continue to suffer from prevailing restrictions on international mobility.

In the *Central, Eastern and Southeastern European (CESEE) countries*, the recovery is set to be a homogeneous process. Re-accelerating external demand is going to support CESEE exports, and private consumption is going to revive from mid-2021 once the lockdown measures have been lifted.

3 Strong economic growth driven by all demand components of GDP

3.1 Exports benefit from robust demand for goods and reopening

Exports from Austria slumped by 10.9% in 2020 as a result of the COVID-19 pandemic. Goods exports were hit hard during the first lockdown given containment measures and disruptions in international supply chains. However, the export-oriented industry nimbly adjusted production processes to the new health policy constraints, thus managing to regain pre-crisis levels in late 2020. In contrast, the travel and tourism industry, above all the hospitality industry, was shut down for months on end. Driven by the sharp contraction of travel and

tourism services, the contraction of services exports (−18.9%) was more than twice as large as the decrease in goods exports (−7.3%).

In February 2021, nominal goods exports as published by Statistics Austria were already 3.1% above the measure for January. The latest leading indicators for the export industry signal further improvements. As implied by the OeNB's truck mileage-based export indicator, the recovery continued in March and April. The index of new orders from abroad computed by UniCredit Bank Austria exhibits the highest measure in the history of the index, and export expectations as captured by European Commission surveys signal an acceleration of exports. At the same time, stronger-than-expected global demand has been pushing industrial production to its limits. Apart from rising commodity prices and transport delays given regional container shortages, we have increasingly been witnessing delivery bottlenecks. Intermediary goods shortages were identified as the number one obstacle to growth in the most recent business surveys by both Austrian and German manufacturers.

The external sector of the Austrian economy is well on track for high growth over the forecast horizon given robust global demand. Austria's goods exports are going to benefit, above all, from the robust global industrial cycle and from the strong performance of the US economy. Exports of travel and tourism services, meanwhile, will take much longer to recover (see also box 1). In sum, real exports of goods and services as recorded for national accounts purposes will increase by 7.1% in 2021, by 6.4% in 2022 and by 3.4% in 2023.

Table 3

Austria's exports and imports and price competitiveness

	2020	2021	2022	2023
Exports	*Annual change in %*			
Competitor prices on Austria's export markets	–2.5	+2.8	+1.8	+1.4
Export deflator	–0.2	+1.7	+2.0	+1.5
Changes in price competitiveness[1]	–2.3	+1.1	–0.2	–0.1
Import demand on Austria's export markets (real)	–9.2	+9.3	+6.2	+3.5
Austrian exports of goods and services (real)	–10.9	+7.1	+6.4	+3.4
Austrian market share	–1.8	–2.2	+0.2	+0.0
Imports	*Annual change in %*			
International competitor prices on the Austrian market	–1.7	+2.5	+2.0	+1.5
Import deflator	–1.6	+1.6	+1.9	+1.9
Austrian imports of goods and services (real)	–10.0	+7.4	+6.3	+3.0
Terms of Trade	+1.4	+0.1	+0.1	–0.3
	Percentage points of real GDP			
Contribution of net exports to GDP growth	–0.9	+0.1	+0.3	+0.4
	% of nominal GDP			
Export ratio	52.4	53.7	54.8	55.6
Import ratio	49.0	50.2	51.2	51.9

Source: 2020: Statistics Austria, Eurosystem; 2021 to 2023: OeNB June 2021 outlook.

[1] *Changes in price competitiveness are defined as the difference between changes in competitor prices on Austria's export markets and changes in the export deflator.*

Box 1

Complete "loss" of 2020/21 winter season cuts into overnight stays in 2021

Resident and nonresident tourist overnight stays dropped by nearly 55 million or 36% in 2020 compared with 2019. The second and third infection waves sent the hospitality industry into a large-scale shutdown from early November 2020 to mid-May 2021. In 2020/21, the winter tourist season, which is a mainstay of the Austrian economy, was more or less canceled. According to OeNB estimates, tourism stays until the end of 2021 will not suffice to compensate for the earlier losses: the OeNB expects this year's total overnight stays to be 16.5% lower than in 2020, and 46.5% lower than in 2019 – even though Austria's hospitality sector reopened in mid-May and vaccine/test/recovery requirements have largely replaced travel warnings and quarantine-based entry requirements for key neighboring states and even though no further lockdowns will presumably have to be imposed in 2021. Annual tourist overnight stays are projected to decline despite the assumption that we are going to see a revival, starting in May and June, along the lines seen in 2020. Compared with the record summer of 2019, the "pandemic deficit" will amount to slightly more than 10%. The projected outcome reflects different development paths for all nine provinces (given that their tourism profiles differ) and for tourists' home countries. While the number of domestic tourists is expected to even surpass pre-crisis levels slightly from July onward, overnight stays by nonresident tourists will continue to fall short of pre-crisis levels; the expected declines are a function of the distance to the countries of origin. This means that, on balance, the share of domestic tourists in overnight stays is going to rise (2019: 26%, 2021: 34%).

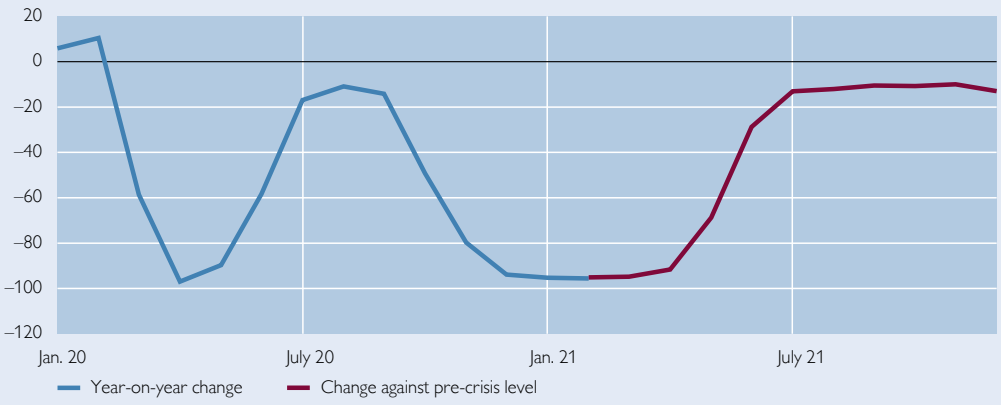
The results for Austria's provinces are mixed. Provinces focusing on winter tourism (Vorarlberg, Tyrol, Salzburg, but also Styria and Carinthia) show further substantial losses, starting from the already low levels of 2020, because of the "loss" of the 2020/21 winter season. The number of overnight stays is going to be more than 50% smaller in Vorarlberg (−55%), Tyrol (−54%) and Salzburg (−53%). In contrast, both Lower and Upper Austria and Burgenland are going to see a "pandemic deficit" of "only" about −20% compared with 2019, and even (small) gains compared with 2020. Vienna is an outlier in this respect. Given its strong focus on overseas markets as well as the high significance of conferences, events and business travel, Vienna is the province with the highest loss of overnight stays (−74%). Starting from these low levels, 2021 overnight stays are expected to go up by 70%; in sum, however, the figures translate into a 56% drop in the number of overnight stays compared with 2019.

Chart B1.1

Tourism

Monthly overnight stays

Change against pre-crisis level in %

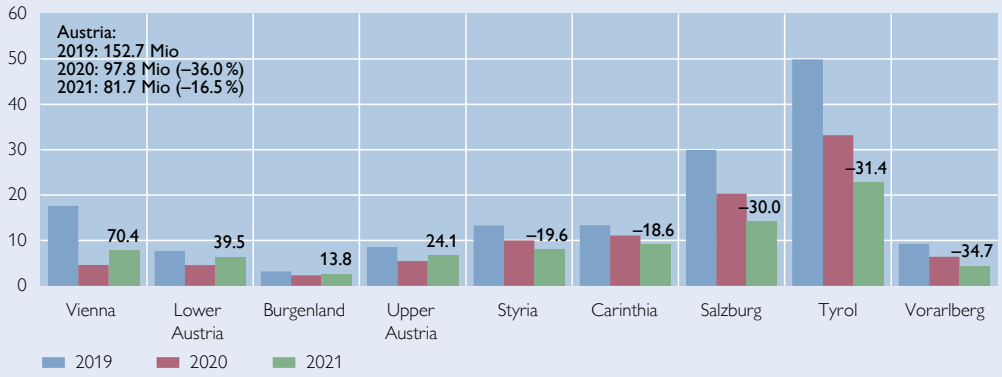


Source: OeNB, Statistics Austria.

Chart B1.2

Tourism

Forecast of 2021 overnight stays across Austria



Source: OeNB, Statistics Austria.

Note: 2021 figures reflect change on 2020 in %.

On balance, the OeNB expects 2021 to be characterized by another severe drop in overnight stays. In 2022, we expect to see a major recovery of overnight stays, based on the low levels of 2021 and the assumption that the pandemic will not entail any major restrictions in future.

Austrian export markets are forecast to grow by 9.3% in 2021, well above the growth rate of Austrian exports. Notwithstanding improved price competitiveness, Austria is expected to lose close to 2.2% in market shares. These losses are attributable to the tourist industry, which will recover only gradually, above all with regard to overseas visitors visiting urban destinations. In 2022 and 2023, Austria should be able to broadly retain its market shares.

Despite the huge setback in travel account receipts from nonresidents, Austria's services account surplus of 2.5% of GDP in 2019 only edged down to 2.1% in 2020. In line with the revival of tourism, the balance of services is expected to rebound to 2.7% until the end of the forecast horizon. Austria's surplus on goods amounted to 1.4% of GDP in 2020, reflecting the sharp reduction of the deficit arising from goods traded with other euro area countries (2019: 0.8%). As imports rise amid

Table 4

Austria's current account

	2020	2021	2022	2023
	% of nominal GDP			
Balance of trade	3,5	3,1	3,2	3,5
Balance of goods	*1,4*	*0,8*	*0,7*	*0,7*
Balance of services	*2,1*	*2,3*	*2,5*	*2,7*
Balance of primary income[1]	–0,1	–0,1	–0,1	–0,1
Balance of secondary income[2]	–0,9	–0,9	–0,9	–0,9
Current account balance	2,5	2,1	2,2	2,4

Source: 2020: OeNB, Statistics Austria; 2021 to 2023: OeNB June 2021 outlook.

[1] *Balance of income (e.g. compensation of labor, investment income).*
[2] *Balance of current transfers.*

the revival of private consumption and business investment, the surplus on goods is projected to shrink to 0.7% over the forecast horizon. The balances of primary and secondary income are forecast to remain unchanged until the end of the forecast horizon. On balance, Austria is expected to run a current account surplus in terms of nominal GDP of 2.1% in 2021, 2.2% in 2022 and 2.4% in 2023.

3.2 Private consumption to reach pre-crisis levels already in spring 2022

In 2020, private consumption contracted by more than 9% given the government-mandated shutdown of retail trade and the hospitality industry. As private consumption accounts for more than 50% of economic output in Austria, their shutdown was instrumental in throwing Austria into the deepest recession since the beginning of the "Second Republic." Real disposable household income was supported by major fiscal stimulus measures (above all the short-time work scheme) and declined by about 3% in 2020 compared with 2019. This decline in real disposable income, which was moderate all things considered, in turn caused the saving ratio to increase considerably. However, such saving was largely the result of limited consumption opportunities ("forced saving").

In the first quarter of 2021, private consumption stagnated according to WIFO's GDP flash estimate compared with the previous quarter (−0.2%); in this quarter, and in the fourth quarter of 2020, retail trade was shut down for several weeks, and the hospitality industry basically most of the time. With the lifting of the lockdowns in Vienna, Lower Austria and Burgenland in early May 2021, the decline in private consumption slowed visibly, as is evident from the OeNB's weekly GDP indicator.[6] The broad lifting of anti-pandemic measures on May 19 is further accelerating private consumption in the second quarter of 2021. Any remaining containment measures are going to be eased further in line with progress made with the vaccination program. Once the supply-side restrictions on private consumption have been lifted, private consumption should expand by more than 4% in the second and third quarters (compared with the first and second quarters). Thereafter, pent-up demand will have been largely met, but the quarterly growth rates are going to remain above the long-term average. In this process, the saving ratio will go down markedly already in 2021. At the end of 2023, the saving ratio is projected to lie slightly below pre-crisis levels (see box 2).

Box 2

Post-COVID-19 spending of excess savings in Austria

Over the forecast horizon, the saving ratio is expected to drop considerably, in line with the following two assumptions: (1) rapid dissaving of amounts individuals saved as a percentage of their real gross disposable income, causing the saving ratio to return to pre-crisis levels (flows) and (2) only limited spending of excess savings accumulated during the pandemic (stocks).

The rapid return of the saving ratio to pre-crisis levels can be explained with the high contribution of forced saving to excess savings. According to current estimates,[7] some 80% of the amounts saved in excess of the normal saving rate in the second and third quarters of 2020 were accumulated because the usual spending avenues were shut off. Amid the

[6] *See: https://www.oenb.at/Publikationen/corona/bip-indikator-der-oenb.html.*

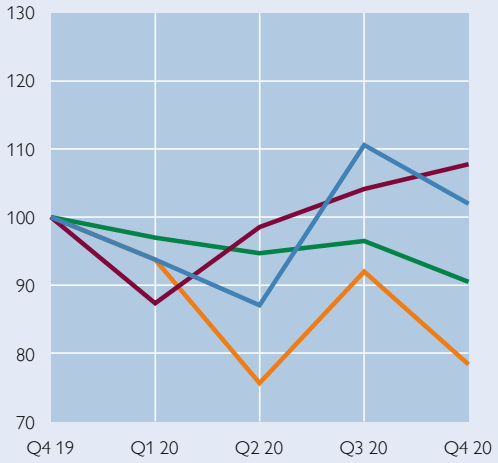
[7] *See Fenz et al. (2021). Forced saving has also been widespread as a motive internationally (see Dossche and Zlatanos, 2020).*

Chart B2

Saving behavior determinants

Private consumption of goods in Austria by durability

Real seasonally and calendar day-adjusted figures, Q4 19 = 100

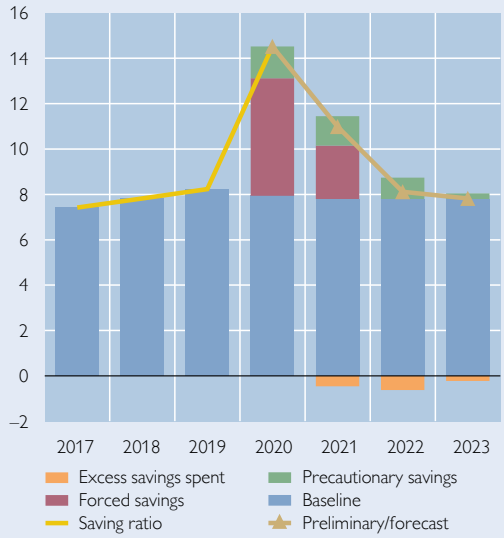


Source: Eurostat, OeNB.

Note: The line for Q4 19 to Q1 20 starts for Services at the same level as for Durable goods.

Breakdown of saving ratio

% of disposable income



Source: Statistics Austria, OeNB.

broad-based lifting of containment measures in mid-May 2021, this motive for saving is going to vanish rapidly. The remaining 20% of the elevated saving ratio may be traced back to precautionary saving, motivated by heightened uncertainty and fear of job loss. As the economy recovers, these uncertainties are going to decrease, and the job situation is going to ease. This motive for excess saving is therefore going to gradually decrease over time.

The plausibility of the assumption that private consumption spending out of excess savings will remain limited over the forecast horizon is supported by the composition of forgone consumption and the socio-economic characteristics of the households that accumulated the highest amounts of excess savings. Last year's pandemic-related containment measures affected above all services, which is why the decline in private consumption was highest for services. As is evident from chart B2 (left panel), the decline in private consumption on durable goods pent up in the second quarter of 2020 was offset already in the third quarter of 2020. In other words, services and nondurable consumer goods are likely to account for a high share of pent-up consumer demand. The consumption of services tends to be characterized by a high degree of regularity; after all, one can get one's hair cut or visit a restaurant only every so often; ex post compensation will not really work here.[8]

Consumer sentiment subindicators[9] *imply that higher-income households account for a high share of excess savings. For such households, any assets accumulated through forced saving are likely to be considered as a windfall gain of wealth. Households' marginal propensity to spend out of their wealth lies well below their income-related propensity to spend*[10] *and*

[8] *Beraja and Wolf (2021) show that demand-driven recoveries from recessions characterized by lower spending on services tend to be weaker than recoveries following a setback in the consumption of durable goods.*

[9] *See European Commission (2021). Moreover, data analyzed by the Federal Reserve Bank of New York (see Dam et al., 2021) imply that COVID-19-related measures affected above all higher-income households.*

[10] *For an overview and recent estimates of marginal propensity to consume from income and wealth, see e.g. de Bondt et al. (2019).*

decreases in line with rising household wealth.[11] This is why we expect a large share of the accumulated excess savings to be retained as wealth.

Chart B2 (right panel) visualizes the decomposition of the saving ratio into the contributions from forced saving, precautionary saving and spent excess savings for the forecast horizon. Excess savings were estimated as the difference between observed saving and the counterfactual scenario without a pandemic for the period from Q2/2020 to Q2/2021. For the counterfactual scenario, we extrapolated nominal disposable income (based on a long-term growth rate of 3% per year) and assumed the saving ratio to amount to 7.8% (broadly corresponding to the five-year pre-pandemic average). This calculation yields total excess savings of about EUR 20.4 billion, of which 80% or EUR 16.3 billion are attributable to forced saving. Assuming that about one-fifth of such forced saving will go into consumption over the forecast horizon, we arrive at about EUR 3.0 billion. As a result, the saving ratio should go down by 0.5 percentage points in 2021, by 0.6 percentage points in 2022 and by 0.2 percentage points in 2023. This compares with a positive contribution from pandemic-related precautionary saving, which should go down gradually, from 1.3 percentage points in 2021 to 0.2 percentage points at the end of the forecast horizon.

Table 5

Determinants of nominal household income and private consumption growth in Austria

	2020	2021	2022	2023
	Annual change in %			
Payroll employment	–2.0	+1.2	+1.6	+0.9
Wages and salaries per employee	+0.4	+2.2	+2.9	+2.6
Compensation of employees	–1.6	+3.4	+4.5	+3.5
Investment income	–42.6	+15.1	+2.2	+2.9
Self-employment income and operating surpluses (net)	–2.0	+3.0	+3.5	+3.8
Contribution to household disposable income growth	*Percentage points*			
Compensation of employees	–1.4	+2.9	+3.9	+3.1
Investment income	–4.9	+1.0	+0.2	+0.2
Self-employment income and operating surpluses (net)	–0.3	+0.5	+0.6	+0.6
Net transfers less direct taxes[1]	+4.9	–0.6	–1.7	–0.7
	Annual change in %			
Disposable household income (nominal)	–1.9	+2.7	+4.3	+3.2
Consumption deflator	+1.1	+2.1	+1.8	+1.7
Disposable household income (real)	–2.9	+0.6	+2.4	+1.4
Private consumption (real)	–9.4	+4.0	+5.8	+1.8
	% of household disposable income growth			
Saving ratio	14.4	11.0	8.1	7.8

Source: 2020: Statistics Austria; 2021 to 2023: OeNB June 2021 outlook.

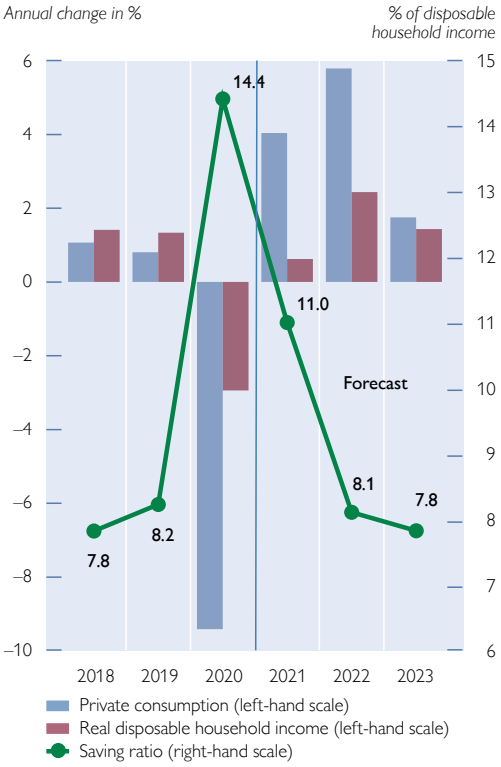
[1] Negative values indicate an increase in (negative) net transfers less direct taxes; positive values indicate a decrease.

[11] According to estimates for Austria (see Albacete and Lindner, 2017), the following shares of one additional euro of net wealth will go into consumption: 8.5 cent in the second wealth quintile, 2.7 cent in the third wealth quintile, 1.2 cent in the fourth wealth quintile, and 0.5 cent in the fifth, and uppermost quintile. See OeNB (2021), p. 32, on household financial investment in Austria.

Chart 4

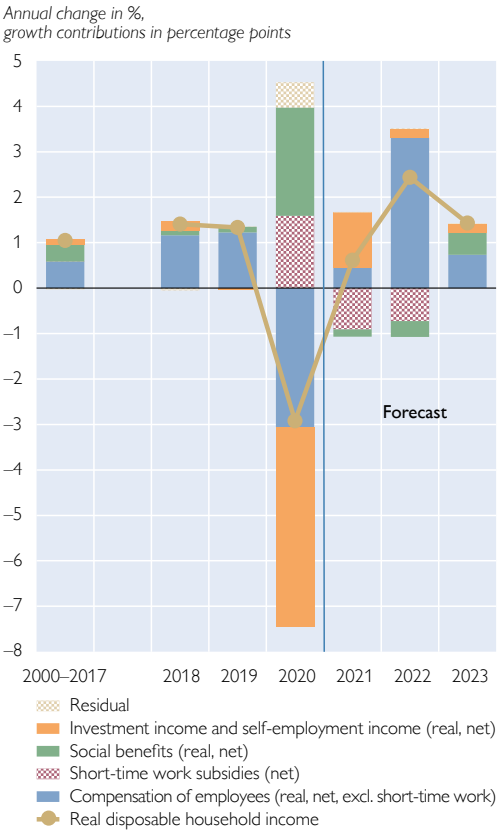
Income, saving and spending

Disposable household income, private consumption and saving ratio



Source: WIFO, OeNB.

Contributions to growth of real disposable net household income



Source: Statistics Austria, OeNB.

Over the forecasting horizon, disposable household income is influenced largely by the compensation of employees. In 2020, the compensation of employees dropped somewhat but was cushioned from dropping any further by the short-time work scheme. In the period from 2021 to 2023, the annual contribution of employee compensation to the nominal growth of disposable household income will again amount to about 3.5 percentage points on average. Following a drastic drop in profit distributions, which was among other things due to the conditionality for support measures for firms, we expect to see offsetting changes in 2021. In 2022 and 2023, the contribution to GDP growth from investment income should be visibly lower again.

Real disposable household income is going to be dampened by the rise in inflation in 2021; the private consumption expenditure deflator will be 1 percentage point higher in 2021 than in 2020. In 2022 and 2023, inflation is expected to recede somewhat, thus exerting a lower dampening effect.

Following 0.6% growth in 2021, real disposable household income is projected to re-increase in 2022 (+2.4%) and at a somewhat lesser rate also in 2023 (+1.4%). Private consumption is expected to revive strongly in 2021 (+4%) and 2022 (+5.8%) and thus surpass pre-crisis levels in the first half of 2022, before leveling off in 2023 (+1.8%). Consumption growth will be boosted by dissaving, with the saving ratio dropping from its peak of 14.4% in 2020 to below 8% in 2023. As

outlined in box 2, this includes some spending of excess savings. If consumers were to spend larger-than-expected amounts of excess savings accumulated during the pandemic, this might constitute upward risks to the projections for consumption.

3.3 Crisis impact on investment comparatively low

Real gross capital formation was a key pillar of the Austrian economy from 2016 to 2019, having grown by 4.0% on average during those years. The investment cycle was driven above all by investment in equipment (6%), but R&D investment (4.2%) and investment in residential construction (3.4%) and in nonresidential construction (1.9%) witnessed boom years as well. In 2020, the high degree of uncertainty related to the pandemic, plus the relating containment measures prompted numerous firms to shrink their production in the first half of the year and postpone investment projects. Gross fixed capital formation thus contracted by 4.8%. Capacity utilization dropped from 84.8% in January 2020 to 73.9% in April 2020. As industrial production gained momentum again, gross fixed capital consumption bounced back strongly and steadily until mid-2021 (Q3/2020: 77.2%, Q2/2021: 87.1%), thus exceeding the long-term average of 85.1% by now. The robust export cycle, healthy order books and the high order intake would imply a further expansion of production and thus the need for production capacity increases. The funding situation of Austrian firms continues to be very good. Last but not least, steady vaccination progress has been key in reducing uncertainty about what the economy may look like in future.

At present, the investment cycle is characterized not only by pent-up demand following the setback in 2020 but also by the need for longer-term expansions of production capacity. This includes above all cyclically sensitive investment in equipment, which contracted by about 11% in 2020 and which is expected to grow by 7.6% in 2021 and by 5.0% in 2022. Construction investment (−3.9%) did not shrink as much as gross fixed capital formation (−4.8%) in 2020. The continued rise in real estate prices signals continued high demand. In 2021, residential construction investment is projected to grow by 3.7%. In 2020, there was a single positive growth outlier, namely investment in intellectual property (1.6%). R&D and software investment tends to be less responsive to the cycle and was boosted in addition by the crisis-related need to invest in this area. In 2021, investment growth is expected to accelerate somewhat to 2%. 2022 and 2023 are forecast to see further growth, albeit at a gradually lessening pace. On balance, the OeNB projects real gross fixed capital formation to grow by 4.7% in 2021, by 3.3% in 2022 and by 1.8% in 2023.

The pronounced investment cycle before the COVID-19 crisis struck was accompanied by a rise in the investment-to-GDP ratio from 22.7% in 2015 to 24.6% in 2019. In view of the pandemic, real gross fixed capital formation contracted by as much as 4.8% in 2020. Yet, unlike during the financial and economic crisis of 2009, the deterioration of the investment ratio was not nearly as bad as the contraction of real GDP. At the time, the investment ratio dropped from

Table 6

Investment activity in Austria

	2020	2021	2022	2023
	Annual change in %			
Total gross fixed capital formation (real)	–4.8	+4.7	+3.3	+1.8
of which:				
investment in plant and equipment	*–11.1*	*+7.6*	*+5.0*	*+2.5*
residential construction investment	*–3.9*	*+3.7*	*+2.8*	*+1.7*
nonresidential construction investment and other investment	*–2.6*	*+4.5*	*+2.5*	*+0.9*
investment in research and development	*+1.6*	*+2.0*	*+2.3*	*+1.9*
public sector investment	*+1.0*	*+2.0*	*+2.4*	*+1.4*
private investment	*–5.6*	*+5.1*	*+3.5*	*+1.9*
Contribution to the growth of real gross fixed capital formation	*Percentage points*			
Investment in plant and equipment	–3.8	+2.5	+1.7	+0.8
Residential construction investment	–0.7	+0.7	+0.5	+0.3
Nonresidential construction investment and other investment	–0.7	+1.2	+0.7	+0.2
Investment in research and development	+0.3	+0.4	+0.5	+0.4
Public sector investment	+0.1	+0.3	+0.3	+0.2
Private investment	–4.9	+4.4	+3.0	+1.6
Contribution to real GDP growth				
Total gross fixed capital formation	–1.2	+1.2	+0.8	+0.5
Changes in inventories	–0.4	+0.6	+0.1	+0.1
	% of nominal GDP			
Investment ratio	25.3	25.3	25.1	25.1

Source: 2020: Statistics Austria; 2021 to 2023: OeNB June 2021 outlook.

23.1% in 2008 to 22.4% in 2009. In 2020, the investment ratio even rose slightly against 2019, from 24.6% to 25.3% because the growth setback of private consumption and exports was even more pronounced. 2022 and 2023 should see only a slight decline to 25.1% each.

Box 3

Budget deficit to gradually fall below 2% of GDP by 2023

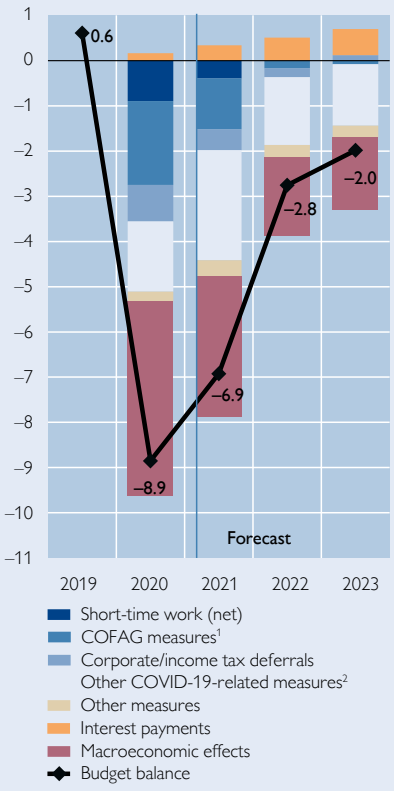
In 2020, the budget balance deteriorated by about 9½ percentage points to 8.9% of GDP (black line in chart B3). This decline was essentially driven by automatic stabilizers kicking in as the economy weakened (red bars) and by comprehensive fiscal support measures adopted in response to the COVID-19 pandemic (bars in different shades of blue).

In 2021, the budget deficit is expected to remain at historically high levels, yet improve to 6.9% of GDP as the economy recovers and as fewer subsidies need to be provided for short-time work, lost sales and fixed costs. The impact of reductions for corporate and personal income tax prepayments will also be lower than in 2020. At the same time, the volume of other pandemic-related expansionary fiscal measures (light blue bars) is going up comparatively sharply. Most of the funding will be made available to provide investment incentives for the private sector to stimulate the economy. Compared to that, additional spending for medical

Chart B3

Change in budget balance since 2019

Percentage points



Source: OeNB.

Note: COFAG = Austrian COVID-19 funding agency.

[1] Fixed cost grants, compensation for forgone revenues, guarantees.
[2] Including economic stimulus packages.

equipment, tests and vaccines will have relatively limited fiscal effects. Likewise, additional revenues from the enhanced EU budget (above all from the Recovery and Resilience Facility) are going to play a comparatively limited role for the development of the fiscal balance, as these revenues will probably be spread over six years, and as they may also be used, to some extent, to cover additional expenditure.

In the years ahead, the budget deficits are expected to be considerably lower. The lower deficits will be facilitated by the continued cyclical upswing and above all by the much smaller contribution of discretionary measures. The fiscal net effect of corporate and personal income tax prepayments will be positive by 2023, if not earlier. Plus, hardly any subsidies will be required by then for short-time work, lost sales and fixed costs. Moreover, some other minor COVID-19-related fiscal measures will no longer be required by then, either. This includes the hardship fund for micro-enterprises and single proprietorships, the NPO relief fund or the temporary VAT reduction for hotels and restaurants. Thanks to the accommodative monetary policy and ultralow interest rates over the forecast horizon, the amount of interest to be paid on government debt is going down year after year (orange bars). Given the continued high budget deficit, the public debt ratio will continue to rise in 2021, to slightly above 85% of GDP. Thereafter, the debt ratio will, however, go back to below 82% in 2023.

3.4 Employment levels stabilized by short-time work – labor market recovering fast

During Austria's first lockdown in March 2020, the number of unemployed people jumped by more than 200,000 to 534,000 individuals. As containment measures were eased, labor market conditions gradually improved until November 2020, before deteriorating again during the second and third lockdowns in late 2020 and early 2021 (see left panel in chart 5[12]). The same holds true, with a time lag, for the average duration of unemployment. The measures adopted to contain the successive waves of the COVID-19 pandemic related above all to the provision of personal services, temporary work (which is typically highly procyclical) and the hospitality industry; in contrast, the construction sector and the production of goods were comparatively less affected (for details, see Ragacs und Reiss, 2021). While the ebb

[12] *Chart 5 based on Ragacs and Reiss (2021).*

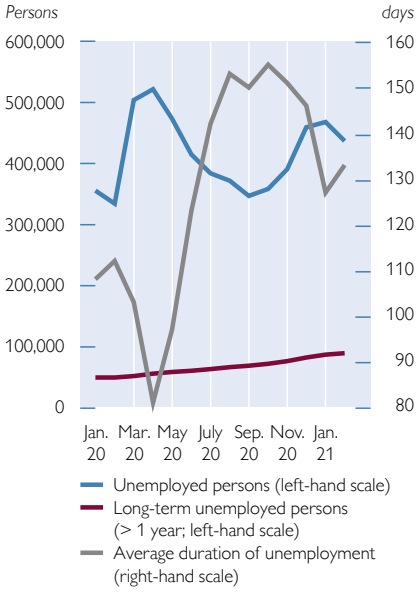
and flow of unemployment essentially mirrored the pandemic-related containment measures, the number of long-term unemployed individuals has been trending upward steadily, rising from 48,400 in February 2020 to 88,400 in February 2021 (left panel of chart 5).

The number of hours worked is typically more sensitive to the business cycle than the number of people in payroll employment. In a cyclical downturn, firms will generally cut overtime and not require extra hours to be offset before laying off people.[13] In 2020, the number of hours worked dropped off by 8.7%, while the number of employees went down by just 1.7% (based on national accounts data). A reform of the existing short-time scheme, agreed upon in March 2020 between the government and the social partners, gave Austria one of the most generous schemes of the EU (Huemer et al., 2021).[14] The share of short-time work scheme participants in total employment and the changes over time are evident from the middle panel of chart 5. The take-up of short-time work peaked in April 2020, with about 30% of all employees receiving short-time pay. Since then, this number has been going down steadily, except for short interruptions in late 2020. See chart 5 (right panel) for a quarterly year-on-year comparison of hours worked and paid.[15] The short-time work scheme was instrumental in stabilizing the number of hours paid

Chart 5

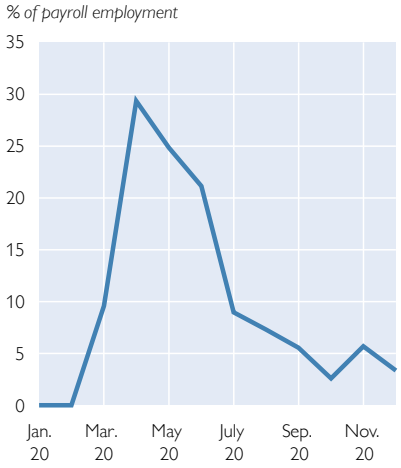
Unemployment, short-time work and hours worked in Austria

Unemployment, long-term unemployment and duration of unemployment



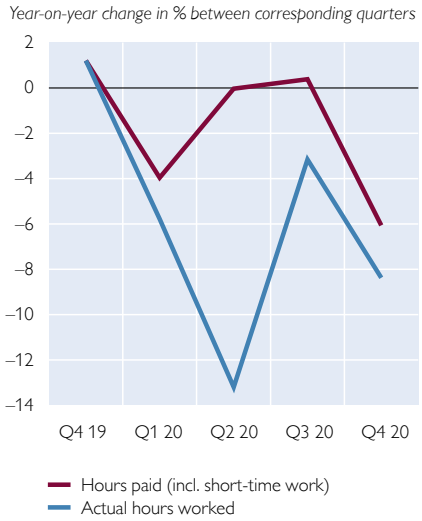
Source: Public Employment Service Austria (AMS).

Short-time work



Source: Public Employment Service Austria (AMS).

Hours worked per employee



Source: Eurostat, OeNB.

[13] *Especially in industries where labor shortages are a recurring issue, firms seek to retain employees so as not to be confronted with labor shortages in an expected future upswing.*

[14] *For details of these effects, see Ragacs and Reiss (2021).*

[15] *Data on hours worked are national accounts data as a rule. These data are available seasonally and working day-adjusted and unadjusted, and were available until the fourth quarter of 2020 at the time of writing. Since seasonally adjusting the data on short-time work is methodologically infeasible, we discuss the quarterly year-on-year changes based on unadjusted data.*

especially during the lockdown-driven economic setbacks in the second and fourth quarters of 2020. After all, the growth differential between hours paid and worked exceeded 13 percentage points in the second quarter. The current short-time work scheme runs until the end of June 2021 and will be prolonged in June 2021, following a review and a reform. For the forecast, we assume that the number of individuals benefiting from the short-time work scheme is going to drop off fast and steadily (from about 350,000 in the first quarter of 2021 to about 50,000 in the fourth quarter of 2021) and that the recipients of short-time pay will keep their jobs once the short-time work scheme ends, as intended by policymakers. As people leave the short-time work scheme and resume normal hours, the number of hours worked will go up considerably, while the compensation of employees per hour worked will go down.

The lifting of major containment measures in May 2021 is expected to feed through to a visible economic expansion and hence to a considerable uptick of employment. Reflecting the very weak first quarter, payroll employment is forecast to rise only by 1.2% in 2021, though, which is barely above the long-term average (following a contraction by 2% in 2020). This should be followed by 1.6% growth in 2022 and 0.9% growth in 2023. The development of hours worked is much more mixed, given the impact of the short-time work scheme. In 2020, the number of hours worked in payroll employment declined by an unprecedented 9.4%. For 2021 and 2022, we project considerable catch-up effects with increases of 4.7% and 4.1%, respectively. The outlook for 2023 is 1.7%, which surpasses the long-term average. The supply of labor, which also decreased in 2020, will rise gradually as well.[16]

Following 4.5% in 2019, the unemployment rate (Eurostat definition)[17] peaked in 2020 (5.3%) and again in the first quarter of 2021 (5.7%). Thus, in 2020 on average, unemployment did not exceed the rate measured during the financial and economic crisis of 2009 (5.3%). In the years ahead, the unemployment rate is expected to gradually decline, to 5.2% (2021), 4.8% (2022) and 4.6% (2023). This means that even in 2023, the rate will continue to lie above the pre-crisis level of 2019 (4.5%). At the same time, it will be below the annual rates measured for the period from 2012 to 2018.

Social partner agreements on collective wage increases typically take effect with a time lag. Therefore, the 2.4% increase negotiated for 2020 on average was comparatively high for a crisis year. This figure was in line with the long-term average of the wage deals made for the period from 2000 and 2019 and broadly contributed to wage stability in 2020. Nonetheless, gross wages and salaries did decline by 1.6% in 2020 on account of the crisis. Based on the results of the fall 2020 bargaining round, collective wages are expected to be raised by 1.7% in 2021. The outlook is brighter for 2022 and 2023. For 2022, we expect an above-average increase of collectively agreed wages by about 2.6%, given the prospect of

[16] *The supply of labor is defined as the number of employed and unemployed individuals; the figures discussed here are based on the Eurostat definition of the unemployment rate. When calculated based on the national definition of unemployment, the supply of labor actually increased somewhat in Austria in 2020 (Ragacs and Reiss, 2021).*

[17] *The national definition of unemployment (2020: 10%, 2019: 7.4%) and the Eurostat definition (2020: 5.3%, 2019: 4.5%) became even more divergent amid the COVID-19 crisis than before. Austria's national definition of the unemployment rate is based on the number of people registered as unemployed with the Public Employment Service Austria (AMS). Eurostat's definition of unemployment is based on the EU-wide labor force survey. For the purpose of this survey, only people actively looking for a job are defined as unemployed. However, during the lockdowns, many unemployed persons may not have been actively looking for a job because they considered such efforts to be pointless, or because they could rely on being rehired by their former employers.*

Table 7

Labor market growth in Austria

	2020	2021	2022	2023
	Annual change in %			
Total employment (heads)	–1.7	+1.1	+1.4	+0.7
Payroll employment	*–2.0*	*+1.2*	*+1.6*	*+0.9*
of which: public sector employees	*+0.2*	*+0.1*	*+0.1*	*+0.1*
Self-employment	*+0.6*	*+0.8*	*+0.2*	*–0.2*
Total hours worked	–8.7	+4.4	+3.8	+1.4
Payroll employment	*–9.4*	*+4.7*	*+4.1*	*+1.7*
Self-employment	*–5.6*	*+3.2*	*+2.4*	*+0.2*
Labor supply	–0.8	+0.9	+0.9	+0.5
Registered unemployment	+18.9	–2.2	–8.0	–4.1
Unemployment rate	*% of labor supply*			
Eurostat definition	5.3	5.2	4.8	4.6
AMS definition	10.0	9.0	8.0	7.7

Source: 2020: Statistics Austria; 2021 to 2023: OeNB June 2021 outlook.

Table 8

Compensation of employees

	2020	2021	2022	2023
Gross wages and salaries[1]	*Annual change in %*			
In nominal terms	*–1.6*	*+3.4*	*+4.5*	*+3.5*
Consumption deflator	*+1.1*	*+2.1*	*+1.8*	*+1.7*
In real terms	*–2.7*	*+1.3*	*+2.7*	*+1.8*
Collectively agreed wages and salaries[1]	+2.4	+1.7	+2.6	+2.4
Wage drift	–1.9	+0.5	+0.3	+0.2
Compensation per employee				
Gross[2] compensation (nominal)	+0.4	+2.2	+2.9	+2.6
Gross compensation (real)	–0.7	+0.1	+1.1	+0.9
Net[3] compensation (real)	–0.7	–0.2	+0.6	+0.5
Compensation per hour worked				
Gross compensation (nominal)	+8.8	–1.4	+0.3	+1.8
Gross compensation (real)	+7.7	–3.4	–1.5	+0.1
	% of nominal GDP			
Wage share	50.6	49.2	48.4	48.4

Source: 2020: Statistics Austria; 2021 to 2023: OeNB June 2021 outlook.

[1] *Overall economy.*
[2] *Including employers' social security contributions.*
[3] *After tax and social security contributions.*

a strong economic recovery. 2023 should see average growth of 2.4%. Wage drift is expected to remain positive over the entire forecast horizon; thus, the nominal wage bill should rise by 3.4% in 2021, by 4.5% in 2022, and by 3.5% in 2023. Starting in 2022, employees are thus going to see rising net wages (per employee) again. The growth outlook for 2021 remains negative for the net compensation of employees per employee (−0.2%) and for net wages per hour worked (−3.4%). These figures essentially reflect the unwinding of the short-time work scheme, which will drive up the number of hours worked per employee.[18]

[18] *Given the wide variety of support measures across countries, international comparisons of many indicators remain challenging, or their informative value remains limited. This includes comparisons of hourly wages and unit labor costs.*

3.5 HICP inflation temporarily increases to 2.0% in 2021[19]

Based on the OeNB's most recent inflation forecast, we expect HICP inflation to run up to 2.0% in 2021, before dropping to 1.8% in both 2022 and 2023. Core inflation, which excludes energy and food prices, is projected to stand at 1.6% in 2021. As the economy recovers, core inflation will increase to 1.9% in 2022 and edge up to 2.1% in 2023. The driving factors behind this development are rising demand and accelerated growth of unit labor costs, given the anticipated improvement of labor market conditions.

Compared with the OeNB's December 2020 outlook, the most recent inflation forecast was revised upward by 0.6 percentage points for 2021, and remained broadly unchanged for 2022 and 2023 (+0.1 percentage points in each year). The upward revision for 2021 is primarily attributable to accelerating commodity prices (for energy and nonenergy commodities).

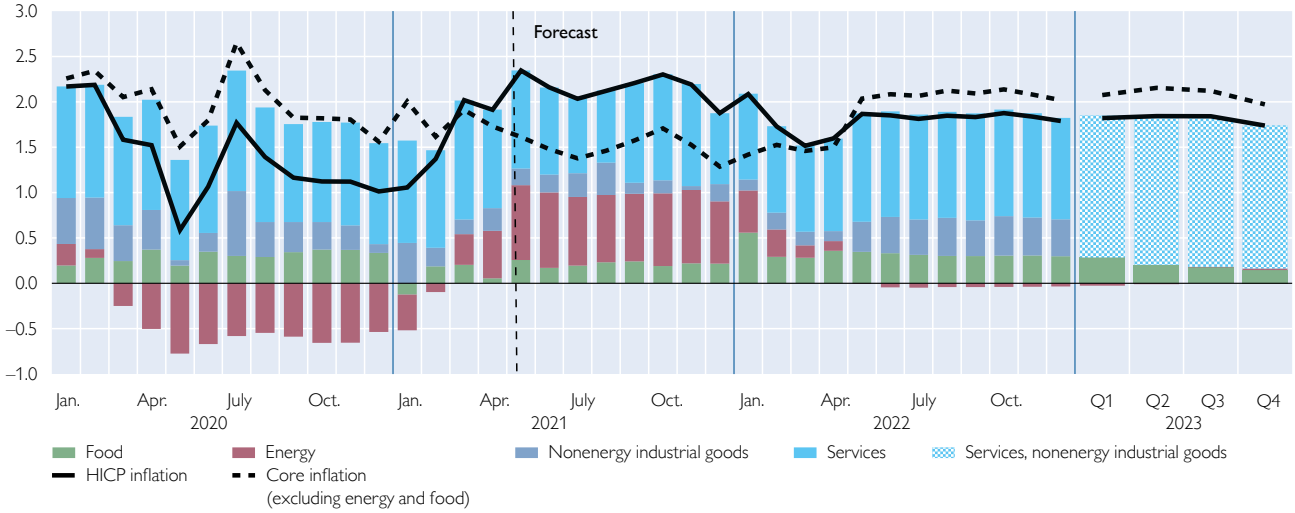
Energy price-related pickup in inflation set to peter out in 2022

Reflecting the path of crude oil prices, which are informed by futures prices, oil prices in euro terms were 47% higher on average in 2021 compared with 2020 figures. In addition to rising crude oil prices in recent months, this development is also due to the slump in crude oil prices seen in the first four months of 2020. As a result, annual energy price inflation will climb to 7.1% in 2021 (up from –5.9% in 2020). For 2022 and 2023, we expect energy prices to remain broadly constant year on year, as oil prices are projected to edge down over the forecast horizon in line with futures quotations.

Chart 6

Contributions to Austrian HICP inflation and core inflation

Inflation in %; inflation contributions in percentage points



Source: OeNB, Statistics Austria.

[19] *Authors: Friedrich Fritzer and Mirjam Salish, Oesterreichische Nationalbank, Economic Analysis Division, corresponding author: friedrich.fritzer@oenb.at.*

Inflation developments for *nonenergy industrial goods* will remain subdued, particularly on account of containment measures still in place in the first half of 2021 and the resulting weaker demand. Apparel retail sales have fallen visibly in the year to date and are not yet likely to return to their pre-pandemic levels in the coming months. Due to heightened uncertainty and recent high unemployment, demand for durable consumer goods, such as vehicles and furniture, is expected to remain weak for a while. In light of the anticipated gradual improvement of economic conditions in the second half of 2021, we expect the inflation rate for industrial goods excluding energy to rise from 0.7% in 2021 to 1.1% in the following year (2020: 1.2%).

Services inflation is expected to decline to 2.2% in 2021 (from 2.5% in 2020), partly due to rental prices, whose inflation rate is projected to decline over the forecast horizon owing to inflation-dampening base effects. Moreover, prices of tourism-related services will only accelerate at the beginning of next year once containment measures have been phased out. According to the European Commission's Business and Consumer Survey, Austrian service providers in the hospitality industry currently expect demand levels to remain well below the long-term average for the next three months. To provide financial support to the hospitality industry, the VAT rate for food and accommodation services was cut to 5% for the period from July 2020 to December 2021. The lower VAT rate is unlikely to be passed on to consumers, which is in line with government intentions. After all, the hospitality industry has been facing both higher costs and lower incomes resulting from capacity constraints imposed with a view to containing the COVID-19 pandemic (hygiene rules, physical distancing). Besides, numerous businesses are struggling with liquidity problems. We therefore do not expect the VAT rate cut to feed through to consumer prices.

Inflation of *food prices*, including alcohol and tobacco, recorded a substantial decrease at the beginning of the year, which had partly reversed by April 2021. For the full year 2021, we expect food price inflation to come to 1.0% and to accelerate thereafter to 1.9% in 2022. This increase is mainly attributable to rising price expectations for global agricultural commodities, which are putting pressure on imported food prices. In addition, the tobacco tax hike, which entered into force in April 2021, will cause food price inflation including tobacco to edge up by 0.2 percentage points in 2021. In 2023, food price inflation is projected to drop to 1.2%, as effects on inflation brought about by the tobacco tax hike will bottom out. Downward pressures on food prices will also come from a decline in global agricultural commodity prices anticipated for 2023.

Table 9

Price, cost, productivity and profit indicators for Austria

	2020	2021	2022	2023
	Annual change in %			
Harmonised Index of Consumer Prices (HICP)	+1.4	+2.0	+1.8	+1.8
HICP energy	–5.9	+7.1	+0.7	+0.0
HICP excluding energy	+2.0	+1.6	+1.9	+2.1
Private consumption expenditure (PCE) deflator	+1.1	+2.1	+1.8	+1.7
Investment deflator	+1.7	+1.8	+1.9	+1.8
Import deflator	–1.6	+1.6	+1.9	+1.9
Export deflator	–0.2	+1.7	+2.0	+1.5
Terms of trade	+1.4	+0.1	+0.1	–0.3
GDP deflator at factor cost	+1.0	+1.6	+2.0	+1.8
Collective wage and salary settlements	+2.4	+1.7	+2.6	+2.4
Compensation per employee	+0.4	+2.2	+2.9	+2.6
Compensation per hour worked	+8.8	–1.4	+0.3	+1.8
Labor productivity per employee	–5.2	+2.8	+2.8	+1.2
Labor productivity per hour worked	+2.3	–0.5	+0.4	+0.5
Unit labor costs	+5.9	–0.6	+0.1	+1.4
Profit margins[1]	–4.9	+2.2	+1.9	+0.4

Source: 2020: Statistics Austria; 2021 to 2023: OeNB June 2021 outlook.

[1] *GDP deflator divided by unit labor costs.*

4 Assessing the risks to the OeNB's outlook and lockdown scenario

While the risks surrounding the economic outlook for 2021 are balanced, the international and domestic risks over the entire forecast horizon are predominantly tilted toward the upside. These upside risks are counteracted by downside risks stemming from the downward revision of the historical growth rates for Austria seen after the cutoff date for data for this report. The projections for both 2022 and 2023 are subject to upside risks.

4.1 General risks to the outlook

The past 15 months have been fraught with a high degree of uncertainty over the trajectory of the pandemic, with health policy measures playing a critical role for economic developments. Since the end of May 2021, uncertainty has been receding perceptibly. In recent weeks, infection numbers have seen a notable drop, causing the risk of a renewed flare-up of infections resulting from the current unwinding of containment measures to decrease as well. Similarly, in fall, we are less likely to see another wave of infections necessitating the reintroduction of containment measures, as the vaccination rate keeps rising. Compared with the OeNB's December 2020 outlook, framework conditions have improved noticeably thanks to vaccination progress as well as expected further developments based on the amount of vaccine doses ordered.

As a result, economic aspects have again started to take center stage in risk assessments. Factoring out pandemic developments, risks to the international environment are primarily tilted to the downside in the short run. Prices for a broad range of commodities are rising markedly amid the swift global recovery, which is primarily led by advanced economies, most notably the USA, as well as strong economic growth in China. Furthermore, essential industries have reported increasing bottlenecks for various intermediate goods, hampering further output

expansion. While these supply-side shortages have been recorded in many countries, they seem to have become particularly acute in Germany, where new orders are exceeding actual industry output by a large margin. Surveys show that bottlenecks in the supply of materials have also prevented Austrian manufacturers from increasing their output swiftly. Supply disruptions thus have a direct dampening impact on output; in addition, they may also bring about indirect negative effects via price increases. Since Austria's industry was the main driver of growth at the start of the year, recent supply disruptions may weigh on growth developments in the second and third quarters of 2021. Over the medium term, however, these constraints – and with them the downside risks – are expected to ease.

4.2 Domestic risks to the outlook

Over the forecast horizon, the balance of domestic risks is clearly on the upside. This is essentially due to three factors: (1) The economic recovery projected for the second quarter of 2021 may turn out to be much stronger than previously expected. While the nationwide lockdown at the beginning of 2021 adversly affected private consumption, the three-week lockdown imposed in the second quarter in eastern Austria, which accounts for some 43% of domestic economic output, put less pressure on consumption growth. In light of mid-May unlocking in Austria, we expect additional positive effects from the hospitality industry, which was completely shut down in the first quarter. In sum, economic activity could thus accelerate markedly in the second quarter of 2021. (2) The present economic outlook anticipates a sharp decline of the saving ratio; yet – as described in box 2 – we expect only a small fraction of excess savings accumulated during the pandemic to be spent on consumption. If consumers were to spend larger-than-expected amounts, this might constitute an upward risk to the projections for consumption. (3) As noted in greater detail in box 1, we forecast the numbers of domestic visitors and guests from neighboring countries to rebound swiftly, whereas tourists from oversees will be more hesitant to return to travel. Moreover, we project catch-up effects to materialize only for domestic tourism in 2021, fueled further by more people spending their vacation in Austria this year, which will cause the number of overnight stays to exceed 2019 figures. Should the confidence and the desire to travel be more pronounced than expected, we might see higher numbers of foreign visitors traveling to Austria than anticipated in our baseline scenario.

4.3 Risks arising from revisions to historical data after the cutoff date

The present economic outlook is the OeNB's contribution to the Eurosystem staff macroeconomic projections. The cutoff date for data was May 26, 2021; the key data source for this exercise are the national accounts data, as adjusted for seasonal and working-day effects. Shortly after the cutoff date for this report, i.e. on May 31, 2021, Statistics Austria published an update of the national accounts data, which saw real GDP growth being revised significantly downward for the first quarter of 2021, from +0.2% to –1.1% (seasonally and working-day adjusted; compared to the previous quarter). If we took into account the revised data and carried forward our projections from the second quarter of 2021 onward (technical update), this would imply a marked downward revision of the present outlook for the full year 2021. From the second quarter of 2021 onward, however, we would see a substantial upward revision of growth estimates if we were to

recalculate the outlook based on the revised data. This is due to particularly strong improvements in a number of leading indicators and assessments derived from the OeNB's weekly GDP indicator. On balance, the downside risks to the projections still prevail for 2021, owing to the updated national accounts data. For 2022, however, the changes to the quarterly profiles of 2021 due to the revision would constitute a positive impact (upside risk) on aggregate economic growth.

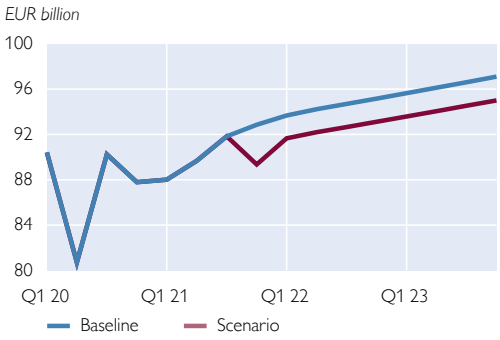
4.4 Lockdown scenario

The OeNB's June 2021 outlook is based on the assumption that more than 60% of the Austrian population aged over 12 years will have been vaccinated against COVID-19 by fall 2021, which corresponds to more than 5.3 million individuals. Furthermore, some 700,000 individuals will have tested positive for coronavirus by fall. It should be noted, however, that there may be some overlap of the shares of vaccinated and recovered persons and that not all COVID-19 cases have been reported. Come fall, roughly 3 million individuals in Austria are estimated to still face an increased risk of infection, as they will not have been vaccinated against or will not have recovered from the coronavirus disease. Expert reports moreover suggest that a small share of the population might be reinfected despite having been immunized or having had COVID-19, with patients possibly experiencing more severe symptoms the second time they are infected. Even if the majority of vulnerable individuals will have been vaccinated and not-at-risk groups are less likely to develop a severe case after being infected, the overall number of 3 million people who are not immunized remains sufficiently high, which is why another wave of infections in fall cannot be ruled out completely.

The scenario described here illustrates the potential implications of another major wave of infections requiring renewed containment measures in fall 2021. Our projections are based on a progression similar to that observed for the second infection wave in fall 2020; moreover, we assume that the same containment measures will be put in place to prevent intensive care units from being overwhelmed as COVID-19 cases rise.[20] At the same time, industrial activity is expected to remain robust, which is why we mirror GDP developments recorded in the fourth quarter of 2020 (change on previous quarter: –2.7%). We assume that the negative impacts on economic activity triggered by the lockdown periods are not cushioned by additional learning effects. Furthermore, we expect the resurgence of infections to significantly enhance incentives boosting people's willingness to get vaccinated. As a result, the infection curve is set to flatten more swiftly and, ultimately, in a sustained manner. The ensuing negative effects should

Chart 7

GDP: June 2021 outlook and risk scenario



Source: Statistics Austria, OeNB.

[20] *In fall 2020 (October to December), 315,000 individuals fell ill with COVID-19. Based on the considerations set out above, this corresponds to 10% of individuals who have no immunity protection against the disease.*

thus be limited to one quarter only. The rebound anticipated for the first quarter of 2022 reflects the developments seen from the first quarter of 2020 to the third quarter of 2020, i.e. losses will not be fully recovered and catch-up effects will fail to materialize. In line with these assumptions, we project GDP to permanently hover at lower levels and annual growth to drop by about 1 percentage point to 2.8% (2021) and 3.0% (2022).

5 Revisions remain limited despite varying quarterly growth dynamics

The OeNB's December 2020 outlook was based on the assumption that the pandemic situation would gradually improve from December 2020 onward. Yet, after a light lockdown in the run-up to Christmas, Austria went into a nationwide lockdown from December 26 onward, which saw retail trade shut down until February 7, 2021. As a result, GDP growth stagnated in the first quarter of 2021 and did not expand, as the OeNB had anticipated in its December 2020 forecast. Contrary to what had been expected in December, Austria's economy is set to recover at a visibly faster pace in mid-2021, following the recent easing of containment measures, which essentially reflects improved pandemic conditions and a faster-than-expected COVID-19 vaccine rollout. In sum, the two effects described above mostly cancel each other out (forecast error: –0.7 percentage points; more pronounced recovery (see table 10, item "Other reasons"): +1.1 percentage points), leaving the projections for the full year 2021 virtually unchanged. Compared with the OeNB's December 2020 outlook, the predicted growth rate for 2022 is slightly higher, driven by improved external assumptions, while changes in external economic conditions are expected to have a somewhat dampening effect on growth in 2023.

The OeNB's inflation forecast was revised upward for the entire forecast horizon. At +0.6 percentage points, the upward revision is particularly pronounced

Table 10

Breakdown of revisions to the outlook

	GDP			HICP		
	2021	2022	2023	2021	2022	2023
	Annual change in %					
June 2021 outlook	+3.9	+4.2	+1.9	+2.0	+1.8	+1.8
December 2020 outlook	+3.6	+4.0	+2.2	+1.4	+1.7	+1.7
Difference	+0.3	+0.2	–0.3	+0.6	+0.1	+0.1
	Percentage points					
Caused by:						
External assumptions	–0.1	+0.2	–0.2	+0.5	+0.0	+0.0
New data[1]	–0.6	+0.0	+0.0	+0.0	+0.0	+0.0
of which: revisions to historical data up to Q3 20	*+0.2*	*+0.0*	*+0.0*	*+0.0*	*+0.0*	*+0.0*
projection errors for Q4 20 and Q1 21	*–0.7*	*+0.0*	*+0.0*	*+0.0*	*+0.0*	*+0.0*
Other reasons[2]	+1.1	+0.0	+0.0	+0.1	+0.1	+0.1

Source: OeNB June 2021 and December 2020 outlooks.

Note: Due to rounding, the sum of growth contributions subject to individual revisions may differ from the total revision.

[1] *"New data" refer to data on GDP and/or inflation that have become available since the publication of the preceding OeNB outlook.*

[2] *Different assumptions about trends in domestic variables such as wages, government consumption, effects of tax measures, other changes in assessments and model changes.*

for 2021, mainly on account of considerably higher oil prices (+USD 22 or +49.5% compared with December 2020). The latter also becomes evident when assessing the factors behind the revision, which can almost exclusively be traced back to external assumptions. The inflation forecast for the years 2022 and 2023 remains virtually unchanged.

Table 11

Comparison of the OeNB June 2021 outlook and the December 2020 outlook

	June 2021				Revisions since December 2020 outlook		
	2020	2021	2022	2023	2021	2022	2023
Economic activity	*Annual change in %*						
Gross domestic product (GDP)	–6.7	+3.9	+4.2	+1.9	+0.3	+0.2	–0.3
Private consumption	–9.4	+4.0	+5.8	+1.8	+0.1	+1.1	–0.2
Government consumption	+1.6	+2.1	+0.5	+0.8	+0.9	–0.3	–0.1
Gross fixed capital formation	–4.8	+4.7	+3.3	+1.8	+0.7	–1.4	–0.9
Exports of goods and services	–10.9	+7.1	+6.4	+3.4	+1.7	+0.9	–0.3
Imports of goods and services	–10.0	+7.4	+6.3	+3.0	+3.3	+0.5	–0.8
Current account balance	+2.5	+2.1	+2.2	+2.4	–0.3	–0.1	+0.0
Import-adjusted contribution to real GDP growth[1]	*Percentage Points*						
Private consumption	–3.6	+1.4	+2.0	+0.6	+0.0	+0.3	–0.1
Government consumption	+0.3	+0.4	+0.1	+0.1	+0.2	+0.0	+0.0
Gross fixed capital formation	–0.5	+0.6	+0.4	+0.2	+0.0	–0.2	–0.2
Domestic demand (excluding changes in inventories)	–3.8	+2.4	+2.6	+1.0	+0.3	+0.2	–0.3
Exports	–3.5	+2.0	+1.8	+1.0	+2.0	+1.8	–0.1
Changes in inventories (including statistical discrepancy)	+0.2	–0.2	+0.1	+0.0	+0.1	+0.0	–0.1
Prices	*Annual change in %*						
Harmonised Index of Consumer Prices (HICP)	+1.4	+2.0	+1.8	+1.8	+0.6	+0.1	+0.1
Private consumption expenditure (PCE) deflator	+1.1	+2.1	+1.8	+1.7	+1.1	+0.1	–0.1
GDP deflator	+1.2	+2.3	+1.9	+1.6	+2.1	+0.4	–0.1
Unit labor costs (whole economy)	+5.9	–0.6	+0.1	+1.4	+0.1	–0.1	–0.5
Compensation per employee (nominal)	+0.4	+2.2	+2.9	+2.6	+0.1	+0.6	+0.0
Compensation per hour worked (nominal)	+8.8	–1.4	+0.3	+1.8	–0.6	–0.5	–0.8
Import prices	–1.6	+1.6	+1.9	+1.9	+0.2	+0.0	+0.2
Export prices	–0.2	+1.7	+2.0	+1.5	+0.2	+0.3	–0.3
Terms of trade	+1.4	+0.1	+0.1	–0.3	+0.1	+0.2	–0.3
Income and savings							
Real disposable household income	–2.9	+0.6	+2.4	+1.4	+0.4	+0.1	–0.4
	% of nominal disposable household income						
Saving ratio	+14.4	+11.0	+8.1	+7.8	+1.0	+0.2	+0.1
Labor market	*Annual change in %*						
Payroll employment	–2.0	+1.2	+1.6	+0.9	+0.5	–0.5	–0.7
Hours worked (payroll employment)	–9.4	+4.7	+4.1	+1.7	+1.2	+0.6	+0.1
	% of labor supply						
Unemployment rate (Eurostat definition)	5.3	5.2	4.8	4.6	–0.4	–0.3	–0.2
Public finances	*% of nominal GDP*						
Budget balance (Maastricht definition)	–8.9	–6.9	–2.8	–2.0	–0.6	+0.1	–0.6
Government debt	83.9	85.1	82.8	81.9	–1.3	–1.6	–0.6

Source: 2020 (actual figures): WIFO, Statistics Austria, OeNB; OeNB June 2021 and December 2020 outlooks.

[1] *The import-adjusted growth contributions were calculated by offsetting each final demand component with corresponding imports, which were obtained from input-output tables.*

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Annex

Table 12

Demand components (real)

Chained volume data (reference year = 2015)

	2020	2021	2022	2023	2020	2021	2022	2023
	EUR million				*Annual change in %*			
Private consumption	173,267	180,270	190,713	194,052	–9.4	+4.0	+5.8	+1.8
Government consumption	72,964	74,468	74,818	75,413	+1.6	+2.1	+0.5	+0.8
Gross fixed capital formation	87,196	91,297	94,338	96,041	–4.8	+4.7	+3.3	+1.8
of which: investment in plant and equipment	*28,156*	*30,301*	*31,817*	*32,613*	*–11.1*	*+7.6*	*+5.0*	*+2.5*
residential construction investment	*16,131*	*16,730*	*17,201*	*17,496*	*–3.9*	*+3.7*	*+2.8*	*+1.7*
nonresidential construction investment and other investment	*22,940*	*23,966*	*24,563*	*24,777*	*–2.6*	*+4.5*	*+2.5*	*+0.9*
Changes in inventories (including statistical discrepancy)	4,127	4,907	5,430	5,707	x	x	x	x
Domestic demand	337,553	350,942	365,300	371,213	–6.0	+4.0	+4.1	+1.6
Exports of goods and services	191,356	204,928	218,027	225,527	–10.9	+7.1	+6.4	+3.4
Imports of goods and services	179,786	193,060	205,160	211,291	–10.0	+7.4	+6.3	+3.0
Net exports	11,570	11,867	12,867	14,236	x	x	x	x
Gross domestic product	349,123	362,809	378,168	385,449	–6.7	+3.9	+4.2	+1.9

Source: 2020: Statistics Austria; 2021 to 2023: OeNB June 2021 outlook.

Note: x = no data available.

Table 13

Demand components (current prices)

	2020	2021	2022	2023	2020	2021	2022	2023
	EUR million				*Annual change in %*			
Private consumption	188,024	199,735	215,116	222,702	–8.4	+6.2	+7.7	+3.5
Government consumption	80,316	83,009	84,349	86,472	+4.0	+3.4	+1.6	+2.5
Gross fixed capital formation	94,785	100,999	106,374	110,286	–3.2	+6.6	+5.3	+3.7
Changes in inventories (including statistical discrepancy)	–791	1,702	2,784	3,294	x	x	x	x
Domestic demand	362,334	385,445	408,623	422,755	–5.5	+6.4	+6.0	+3.5
Exports of goods and services	196,699	214,201	232,370	243,974	–11.1	+8.9	+8.5	+5.0
Imports of goods and services	183,875	200,509	217,166	227,795	–11.4	+9.0	+8.3	+4.9
Net exports	12,824	13,693	15,203	16,178	x	x	x	x
Gross domestic product	375,158	399,137	423,826	438,934	–5.6	+6.4	+6.2	+3.6

Source: 2020: Statistics Austria; 2021 to 2023: OeNB June 2021 outlook.

Note: x = no data available.

Table 14

Demand components (deflators)

	2020	2021	2022	2023	2020	2021	2022	2023
	2010 = 100				*Annual change in %*			
Private consumption	108.5	110.8	112.8	114.8	+1.1	+2.1	+1.8	+1.7
Government consumption	110.1	111.5	112.7	114.7	+2.4	+1.3	+1.1	+1.7
Gross fixed capital formation	108.7	110.6	112.8	114.8	+1.7	+1.8	+1.9	+1.8
Domestic demand (excluding changes in inventories)	108.9	110.9	112.8	114.8	+1.5	+1.8	+1.7	+1.8
Exports of goods and services	102.8	104.5	106.6	108.2	–0.2	+1.7	+2.0	+1.5
Imports of goods and services	102.2	103.8	105.8	107.8	–1.6	+1.6	+1.9	+1.9
Terms of trade	100.5	100.6	100.7	100.3	+1.4	+0.1	+0.1	–0.3
Gross domestic product	107.5	110.0	112.1	113.9	+1.2	+2.3	+1.9	+1.6

Source: 2020: Statistics Austria; 2021 to 2023: OeNB June 2021 outlook.

Table 15

Labor market

	2020	2021	2022	2023	2020	2021	2022	2023
	Thousands				*Annual change in %*			
Total employment	4,463.4	4,513.2	4,576.2	4,610.3	–1.7	+1.1	+1.4	+0.7
of which: private sector	*3,704.9*	*3,753.9*	*3,816.2*	*3,849.5*	*–2.1*	*+1.3*	*+1.7*	*+0.9*
Payroll employment (national accounts definition)	3,919.9	3,965.6	4,027.4	4,062.8	–2.0	+1.2	+1.6	+0.9
	% of labor supply							
Unemployment rate (Eurostat definition)	5.3	5.2	4.8	4.6	x	x	x	x
	EUR per real unit of output x 100							
Unit labor costs (whole economy)[1]	61.9	61.6	61.6	62.5	+5.9	–0.6	+0.1	+1.4
	EUR thousand per employee							
Labor productivity (whole economy)[2]	78.2	80.4	82.6	83.6	–5.2	+2.8	+2.8	+1.2
	EUR thousand							
Compensation per employee (real)[3]	44.6	44.7	45.1	45.5	–0.7	+0.1	+1.0	+0.9
	At current prices in EUR thousand							
Compensation per employee (gross)	48.4	49.5	50.9	52.2	+0.4	+2.2	+2.9	+2.6
	At current prices in EUR million							
Total compensation of employees (gross)	189,751	196,182	205,006	212,243	–1.6	+3.4	+4.5	+3.5

Source: 2020: Statistics Austria; 2021 to 2023: OeNB June 2021 outlook.

Note: x = no data available.

[1] *Gross wages and salaries divided by real GDP.*
[2] *Real GDP divided by total employment.*
[3] *Gross wages and salaries per employee divided by private consumption expenditure deflator.*

Table 16

Current account balance

	2020	2021	2022	2023	2020	2021	2022	2023
	EUR million				*% of nominal GDP*			
Balance of trade	13,133.0	12,533.6	13,604.3	15,224.1	3.5	3.1	3.2	3.5
Balance of goods	*5,271.0*	*3,359.3*	*3,010.2*	*3,277.3*	*1.4*	*0.8*	*0.7*	*0.7*
Balance of services	*7,862.0*	*9,174.3*	*10,594.1*	*11,946.8*	*2.1*	*2.3*	*2.5*	*2.7*
Balance of primary income	–332.0	–400.0	–400.0	–600.0	–0.1	–0.1	–0.1	–0.1
Balance of secondary income	–3,333.0	–3,700.0	–4,000.0	–4,148.0	–0.9	–0.9	–0.9	–0.9
Current account balance	9,468.0	8,433.6	9,204.3	10,476.1	2.5	2.1	2.2	2.4

Source: 2020: OeNB; 2021 to 2023: OeNB June 2021 outlook.

Table 17

Quarterly outlook results

	2021	2022	2023	2021				2022				2023			
				Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Prices, wages, costs	*Annual change in %*														
HICP	+2.0	+1.8	+1.8	+1.5	+2.1	+2.1	+2.1	+1.8	+1.8	+1.8	+1.8	+1.8	+1.8	+1.8	+1.7
HICP excluding energy	+1.6	+1.9	+2.1	+1.8	+1.6	+1.5	+1.5	+1.5	+1.9	+2.1	+2.1	+2.1	+2.2	+2.1	+2.0
Private consumption expenditure deflator	+2.1	+1.8	+1.7	+1.7	+2.5	+2.0	+2.2	+1.9	+1.8	+1.8	+1.7	+1.7	+1.7	+1.8	+1.9
Gross fixed capital formation deflator	+1.8	+1.9	+1.8	+1.5	+1.7	+1.7	+2.1	+2.0	+1.9	+1.9	+1.9	+1.8	+1.8	+1.8	+1.8
GDP deflator	+2.3	+1.9	+1.6	+1.1	+2.2	+3.0	+3.1	+3.1	+1.6	+1.3	+1.6	+1.7	+1.7	+1.6	+1.4
Unit labor costs	–0.6	+0.1	+1.4	+2.8	–2.4	+0.9	–3.6	–2.9	–1.3	+2.2	+2.4	+2.1	+1.6	+1.1	+1.0
Compensation per employee (nominal)	+2.2	+2.9	+2.6	+1.9	+5.4	+1.3	+0.3	+1.1	+1.7	+4.6	+4.3	+3.7	+2.9	+2.2	+1.8
Productivity	+2.8	+2.8	+1.2	–0.9	+7.9	+0.4	+4.1	+4.1	+3.0	+2.3	+1.8	+1.5	+1.2	+1.1	+0.8
Compensation per employee (real)	+0.1	+1.0	+0.9	+0.2	+2.8	–0.6	–1.8	–0.8	–0.2	+2.7	+2.5	+2.0	+1.2	+0.3	–0.1
Import deflator	+1.6	+1.9	+1.9	+0.6	+1.7	+1.4	+2.5	+1.3	+2.2	+2.2	+2.0	+1.9	+1.8	+1.8	+1.8
Export deflator	+1.7	+2.0	+1.5	+0.0	+1.8	+2.3	+2.6	+2.8	+1.9	+1.6	+1.7	+1.6	+1.5	+1.5	+1.4
Terms of trade	+0.1	+0.1	–0.3	–0.6	+0.0	+0.8	+0.1	+1.4	–0.3	–0.6	–0.3	–0.2	–0.3	–0.4	–0.5
Economic activity	*Annual and/or quarterly changes in % (real)*														
GDP	+3.9	+4.2	+1.9	+0.2	+2.1	+2.4	+1.1	+0.9	+0.6	+0.5	+0.5	+0.5	+0.5	+0.5	+0.5
Private consumption	+4.0	+5.8	+1.8	–0.2	+4.0	+4.7	+1.2	+0.8	+0.6	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4
Government consumption	+2.1	+0.5	+0.8	–0.3	+1.0	+0.0	–0.1	+0.1	+0.2	+0.0	+0.1	+0.3	+0.3	+0.2	+0.3
Gross fixed capital formation	+4.7	+3.3	+1.8	+1.7	+0.6	+1.3	+1.0	+0.8	+0.7	+0.6	+0.5	+0.4	+0.4	+0.3	+0.4
Exports	+7.1	+6.4	+3.4	–1.0	+4.1	+3.1	+1.9	+1.1	+0.7	+0.7	+0.9	+0.9	+0.9	+0.9	+0.9
Imports	+7.4	+6.3	+3.0	–1.5	+4.4	+3.8	+1.6	+1.0	+0.7	+0.6	+0.7	+0.9	+0.7	+0.7	+0.7
	Contribution to real GDP growth in percentage points														
Domestic demand	+3.6	+3.8	+1.5	+0.3	+2.3	+2.6	+0.8	+0.6	+0.5	+0.4	+0.3	+0.4	+0.4	+0.3	+0.4
Net exports	+0.1	+0.3	+0.4	+0.2	+0.0	–0.3	+0.2	+0.1	+0.0	+0.1	+0.1	+0.0	+0.1	+0.1	+0.1
Changes in inventories	+0.2	+0.1	+0.1	–0.2	–0.2	+0.0	+0.0	+0.1	+0.0	+0.0	+0.0	+0.1	+0.0	+0.0	+0.0
Labor market	*% of labor supply*														
Unemployment rate (Eurostat definition)	5.2	4.8	4.6	5.7	5.4	4.9	4.9	4.9	4.9	4.8	4.7	4.7	4.6	4.6	4.5
	Annual and/or quarterly changes in %														
Total employment	+1.1	+1.4	+0.7	–0.4	+0.5	+1.4	+0.2	+0.2	+0.1	+0.1	+0.1	+0.1	+0.3	+0.3	+0.4
of which: private sector	*+1.3*	*+1.7*	*+0.9*	*–0.5*	*+0.7*	*+1.7*	*+0.3*	*+0.3*	*+0.1*	*+0.2*	*+0.1*	*+0.1*	*+0.3*	*+0.4*	*+0.4*
Payroll employment	+1.2	+1.6	+0.9	–0.5	+0.7	+1.4	+0.3	+0.3	+0.1	+0.2	+0.2	+0.1	+0.3	+0.3	+0.4
Additional variables	*Annual and/or quarterly changes in % (real)*														
Disposable household income	+0.6	+2.4	+1.4	–6.6	+5.1	–1.8	+0.2	+0.7	+0.8	+0.9	+0.6	+0.2	+0.1	+0.0	+0.0
	% of real GDP														
Output gap	–3.3	–0.7	–0.4	–5.7	–4.1	–2.1	–1.4	–0.9	–0.8	–0.7	–0.6	–0.5	–0.4	–0.4	–0.2

Source: OeNB June 2021 outlook.

Note: Quarterly values based on seasonally and working day-adjusted data.

Table 18

Comparison of current economic forecasts for Austria

	OeNB			WIFO opening scenario		WIFO lockdown scenario		IHS		OECD		IMF		European Commission	
	June 2021			March 2021		March 2021		March 2021		May 2021		April 2021		May 2021	
	2021	2022	2023	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Main results	*Annual change in %*														
GDP (real)	+3.9	+4.2	+1.9	+2.3	+4.3	+1.5	+4.7	+2.6	+4.3	+3.4	+4.2	+3.5	+4.0	+3.4	+4.3
Private consumption (real)	+4.0	+5.8	+1.8	+2.4	+4.0	+1.1	+4.6	+4.4	+4.4	+3.0	+4.9	×	×	+3.0	+5.3
Governmet consumption (real)	+2.1	+0.5	+0.8	+1.4	+1.2	+1.4	+1.2	+1.5	+0.5	+1.3	+1.1	×	×	+3.3	+1.1
Gross fixed capital formation (real)	+4.7	+3.3	+1.8	+4.0	+4.0	+3.5	+4.4	+2.7	+4.9	+4.6	+4.1	×	×	+4.8	+3.3
Exports (real)	+7.1	+6.4	+3.4	+2.8	+7.2	+2.3	+7.8	+6.8	+7.2	+7.2	+7.8	+5.1	+7.2	+7.5	+7.2
Imports (real)	+7.4	+6.3	+3.0	+3.9	+6.0	+3.5	+6.5	+8.4	+6.6	+7.9	+7.3	+5.9	+6.9	+8.2	+6.6
Labor productivity[1]	+2.8	+2.8	+1.2	–1.8	+0.9	–1.7	+0.7	+1.3	+2.7	+2.4	+3.0	×	×	+2.6	+1.4
GDP deflator	+2.3	+1.9	+1.6	+1.2	+1.7	+1.2	+1.7	+1.5	+1.7	+1.1	+1.5	+1.7	+1.4	+1.3	+1.7
CPI	×	×	×	+1.8	+1.8	+1.8	+1.8	+2.0	+1.9	×	×	×	×	×	×
HICP	+2.0	+1.8	+1.8	+1.9	+1.9	+1.9	+1.9	+2.1	+1.9	+2.0	+1.9	+1.6	+1.8	+1.8	+1.6
Unit labor costs	–0.6	+0.1	+1.4	–0.8	–1.0	–0.3	–1.6	–0.3	–1.2	–0.3	–0.8	×	×	–1.5	–1.1
Payroll employment[2]	+1.1	+1.4	+0.7	+1.1	+2.2	+0.9	+2.3	+1.3	+1.5	+1.1	+1.3	+0.8	+0.8	+1.2	+1.3
	% of labor supply														
Unemployment rate (Eurostat definition)	5.2	4.8	4.6	+5.0	+4.8	+5.1	+4.8	+5.3	+5.0	+5.1	+4.8	+5.5	+5.3	+5.0	+4.8
	% of nominal GDP														
Current account balance	2.1	2.2	2.4	+1.4	+2.1	+1.3	+2.1	×	×	+1.6	+2.3	+2.4	+2.5	+2.2	+2.7
Budget balance (Maastricht definition)	–6.9	–2.8	–2.0	–7.1	–3.7	–7.7	–4.0	–6.6	–3.5	–7.3	–3.1	–6.5	–3.6	–7.6	–3.0
External assumptions															
Oil price in USD/barrel (Brent)	65.8	64.6	61.9	63.0	59.0	63.0	59.0	65.0	65.0	64.0	65.0	58.5	54.8	63.9	61.6
Short-term interest rate in %	–0.5	–0.5	–0.3	–0.5	–0.3	–0.5	–0.3	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5
USD/EUR exchange rate	1.21	1.21	1.21	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.22	1.24	1.20	1.20
	Annual change in %														
Euro area GDP (real)	+4.6	+4.7	+2.1	+3.9	+4.3	+3.9	+4.3	+4.3	+3.6	+4.3	+4.4	+4.4	+3.8	+4.3	+4.4
US GDP (real)	+6.6	+3.8	+2.3	+6.0	+3.0	+6.0	+3.0	+5.8	+3.5	+6.9	+3.6	+6.4	+3.5	+6.3	+3.8
World GDP (real)	+6.0	+4.3	+3.5	×	×	×	×	+5.3	+4.0	+5.8	+4.4	+6.0	+4.4	+5.6	+4.3
World trade[3]	+10.0	+5.5	+3.7	×	×	×	×	+7.0	+3.5	+8.2	+5.8	+8.4	+6.5	+8.7	+6.1

Source: OeNB, WIFO, IHS, OECD, IMF, European Commission.

Note: x = no data available.

[1] OeNB, WIFO: productivity per hour worked; IHS, OECD, European Commission: productivity per employee.
[2] WIFO and IHS: payroll employment.
[3] IHS: goods according to CPB; European Commission: world imports.