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Studies

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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 2022. Applicants will be notified of the jury's decision by end-November 2022.

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 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.*

Studies

The role of public services quality in shaping migration intentions in Central, Eastern and Southeastern Europe

Anna Katharina Raggl[1]

What role does the quality of public services play in shaping migration intentions? Using OeNB Euro Survey data collected in 2018, we study the impact of individual perceptions of public services quality on individuals' migration intentions in ten Central, Eastern and Southeastern European (CESEE) countries. We apply ordinary least squares (OLS) as well as instrumental variable (IV) estimations, using externally merged infrastructure-related variables and individuals' opinions on the adequacy of public spending on services as instrumental variables. Our findings suggest that dissatisfaction with the quality of public services in the home countries increases the likelihood of individuals having migration intentions. Broken down by the type of public service, we find that dissatisfaction with social security, health, public infrastructure and with services that target businesses and regional development is associated with higher migration aspirations. Furthermore, for people with young children, we see a higher effect on migration intentions resulting from dissatisfaction with education, health and public safety. For self-employed individuals, the effect of dissatisfaction with public services that address companies and regional development is particularly important. The results further confirm that sociodemographic characteristics, economic factors and network effects are closely associated with the aspiration to move abroad.

JEL classification: J61, F22, O52
Keywords: migration intentions, quality of public services, Central, Eastern and Southeastern Europe

In Europe, long-term demographic trends continue to follow different patterns reflecting past geopolitical divisions: we see population growth in Western, Southern and Northern Europe and population decline in Central, Eastern and Southeastern Europe (CESEE). The decrease in population in CESEE since 1990 results from a combined effect of natural population decrease (i.e. deaths exceeding births) and emigration. While some countries recently experienced moderate population growth (Hungary, Czechia), projections suggest that the observed declining population trends will continue over the next decades due to both natural change and net migration (VID and IIASA, 2020).

In a recent IMF report, Batog et al. (2019) comprehensively assess the implications of demographic developments in CESEE on labor supply, age-related fiscal spending and on productivity and the prospects for economic growth in the region. They conclude that without mitigating policies, growth and convergence toward Western European living standards would slow down considerably. Implementing

[1] *Oesterreichische Nationalbank, International Economics Section, anna.raggl@oenb.at.* *Opinions expressed by the authors of studies do not necessarily reflect the official viewpoint of the OeNB or the Eurosystem. The author would like to thank Doris Ritzberger-Grünwald (OeNB) for initiating this research and providing useful inputs, two anonymous referees, the participants of the Women in Economics (WinE) Networking & Mentoring Retreat 2019 in Manchester, the participants of the Wittgenstein Centre (WIC) Colloquium in February 2020 as well as colleagues in the OeNB's Economic Analysis and Research Department for helpful comments and valuable suggestions.*

policies that increase labor supply is one way to counteract demographic developments. But as it is unlikely that this is sufficient, a more comprehensive approach that also addresses emigration, immigration and return migration is needed.

This study attempts to contribute to a better understanding of why individuals intend to emigrate from their home country and to provide insights for designing policies that increase people's willingness to stay in their home countries (and/or to return or move to CESEE from abroad). Such policies can be important tools to counteract labor force declines, human capital deterioration and challenged public finances, and, as a consequence, to remove obstacles to continued and sustainable convergence to Western Europe. Following up on previous research dedicated to understanding why people in CESEE want to emigrate, we address the link between the perceived quality of public services – social security, public infrastructure, education, health, defense and public safety, regional development measures – and individuals' migration intentions.

We use individual-level data from the 2018 wave of the OeNB Euro Survey, which covers ten CESEE countries. Making use of a series of questions on public debt, we investigate the relationship between the perceived quality of public services and individual migration intentions. Our data allow us to control for a rich set of covariates that have previously been identified as relevant for the emergence of migration intentions and that range from sociodemographic and economic factors to networks and the trust in local and EU institutions. In addition, we take advantage of the fact that the data are geo-referenced and use matched data on nighttime light combined with regional averages of unemployment and income to control for the level of development in the surroundings of respondents' places of residence. We use instrumental variable estimations in order to address identification issues that can stem from the simultaneity of migration intentions and contentment with public services and from the omission of factors that influence both these variables. As instrumental variables we use exogeneous data on road density as well as land coverage in individuals' neighborhoods as measures of infrastructure, and we further employ individuals' assessment of the adequacy of public spending on public services, a variable that is covered in the survey (an instrumental variable).

The remainder of this paper is structured as follows. Section 1 provides an overview of related literature. The empirical setting is explained in section 2. Section 3 summarizes the data and provides descriptive statistics of the key variables. In section 4, the estimation results are presented, and section 5 concludes. Additional material is included in the annexes.

1 Literature

Traditionally, differences in incomes and labor market opportunities across countries are seen as key determinants of migration, and a large body of literature focuses on this link. Also, the relationship between education and migration has received a lot of attention (Borjas, 1987; Chiswick, 1999; Chiquiar and Hanson, 2005), and the importance of networks abroad has repeatedly been established (Docquier et al., 2014; Manchin and Orazbayev, 2018).

More recently, nonpecuniary factors feature more prominently in studies on the determinants of migration intentions. Otrachshenko and Popova (2014), for example, relate life satisfaction measures to individual migration intentions. Using data from Western and Central Europe, they find that individuals that are dissatisfied

with life are more likely to have the intention to emigrate. Similarly, van Dahlen and Henkens (2013) show for the Netherlands that discontent with the quality of the public domain (with regard to mentality, space and overcrowdedness, nature, pollution, crime, etc.) is an important set of factors for explaining migration intentions. In a recent study, Williams et al. (2018) use data from nine European countries – among them Romania as the only country also covered in our analysis – and find that although socioeconomic factors have strong explanatory power, nonpecuniary factors also play a certain role. Several related studies work with different waves and country sets of Gallup World Poll (GWP) data to understand what drives individuals' migration intentions. Dustmann and Okatenko (2014) use GWP data for sub-Saharan Africa, Asia and Latin America (2005, 2006) to study migration intentions. They find that contentment with local amenities, such as public services and public security, are key determinants of migration intentions and explain a considerable share of variation in migration intentions. Manchin and Orazbayev (2018) focus predominantly on the impact of networks but confirm that satisfaction with local amenities and local security decreases the probability of people moving away from the current region of residence (150 countries, GWP data, 2010-2013). In its flagship Transition Report (2018), the EBRD highlights the role of satisfaction with local amenities, using GWPs data for the EBRD region (2010–15). Further related studies addressing this link often use only one country and study internal migration (see for example Chen and Rosenthal, 2008). Studies by Tran et al. (2019, 2021) also address factors that are related to political outcomes and institutions, focusing on the impact of institutional quality and institutional quality differentials between host and origin countries on return migration to Vietnam. Similarly, Etling et al. (2018) look into the relationship between political discontent and migration intentions in the Arab Mediterranean region.[2]

This paper contributes to the literature in several ways. It concentrates on a region that has been faced with particular challenges related to demographic change and emigration. Furthermore, the data we use allow us to put a clear focus on public services, that is, factors that can be changed by policymakers, as opposed to studying the impact of fairly vague concepts, such as amenities. In addition, we take into account the possible endogeneity of the variable measuring dissatisfaction with public services in an attempt to limit biased coefficient estimates.

2 Empirical setting

2.1 OLS estimations

We use ordinary least square (OLS) estimations to address the impact of individuals' assessment of public services quality on their migration intentions, controlling for a range of different factors that have been shown to be relevant in this setting (see Raggl, 2019, for example).

[2] *A related strand of the literature deals with so-called "welfare migration," where the location choice of migrants is related to the generosity of the welfare system in the country of destination (see Giulietti and Wahba, 2013, for an overview). The empirical evidence for the existence of this so-called welfare magnet hypothesis is mixed, and when such magnet effects are found, they are often very small. In contrast to this literature strand, which deals with the welfare state's role as a possible pull factor for migration, this study focuses on public services quality acting as a possible push factor.*

In particular, we estimate the following basic relationship:

$$m_i = \alpha_r + \beta_d d_i + \sum_{j=1}^{J} x_{ij}^{Socio}\beta_j^{Socio} + \sum_{k=1}^{K} x_{ik}^{Econ}\beta_k^{Econ} + \sum_{l=1}^{L} x_l^{Region}\beta_l^{Region} + \sum_{m=1}^{M} x_{im}^{Network}\beta_m^{Network} + \sum_{p=1}^{P} x_{ip}^{Trust}\beta_p^{Trust} + \epsilon_i$$

m_i is a binary variable that takes a value of 1 if an individual has the intention to move abroad within the next 12 months, d_i is a measure of dissatisfaction with public services and the key variable of interest. x_{ij}^{Socio} are J variables that belong to the group of sociodemographic characteristics, x_{ik}^{Econ} represents the group of K economic factors, x_l^{Region} the L regional characteristics, $x_{im}^{Network}$ the M variables capturing network effects and x_{ip}^{Trust} are P variables capturing trust in institutions. In addition, a constant and a full set of country dummies, denoted in the equation by a country-specific constant α_r, is included in all specifications. The country dummies control for all factors that are the same for all individuals in a country, such as institutional characteristics, the political environment, historical ties to other countries, geographic location and the like. ϵ_i is the remaining error term. Standard errors are clustered at the regional level in countries where the regions are defined according to NUTS 2 or a finer classification (HR, BG, MK).

We would expect individuals who are dissatisfied with the provision of public services to have stronger migration intentions ceteris paribus. These findings would be in line with other empirical studies that highlight the relevance of non-pecuniary factors for the emergence of migration intentions.

The data allow us to study coefficient heterogeneities along different dimensions. First, the magnitude of the effects might differ by country. The ten countries in the sample differ in size, average income levels, EU membership, etc., and the importance of public services quality for migration intentions could vary across countries. We assess these possible heterogeneities by interacting the dissatisfaction variable with country dummies. Second, distinguishing by the type of service – social security, public infrastructure, education, health, defense and public safety as well as economic development – allows us to study whether the perceived quality of certain services has a higher impact on migration intentions than that of other services. We would expect ex ante that the magnitude of the effects could be related to the exposure of an individual to a specific service, however, and therefore heterogeneous effects with respect to the individual and household situation can be assumed. This exposure can be empirically approximated with interaction terms that allow, for example, the effect of dissatisfaction with education, health or social security services to differ between individuals with (school-aged) children and those without. Similar interactions are to be tested between being unemployed or retired and reacting to the quality of social security services or between being self-employed and public economic development (and business support) services.

Regarding the sign of the effects of the control variables, no large deviations from Raggl (2019) are expected: Migration intentions are expected to be stronger among the young and among men, and weaker for respondents who are married and have children (represented by a principal component based on marital status and the number of children, see below). Furthermore, being unemployed is expected to raise migration intentions, and, ex ante, a similar effect would be expected for

income (the latter has not been found in Raggl, 2019). In addition, we anticipate that having networks abroad increases migration intentions, and trust in domestic (foreign) institutions is associated with weaker (stronger) migration intentions. Apart from being interesting in its own right, the trust variables can also help capture people's general satisfaction with the institutional situation in the home country and can act as an important proxy for this otherwise unobservable factor.

As there is a large number of covariates and some of them are highly correlated with each other, we use (Polychoric) Principal Component Analyses, (P)PCA, to reduce the dimensionality of the data (see box below). For a full list and description of the variables included in the estimations, please refer to table B1 in annex B.

Box

(Polychoric) principal component analysis, (P)PCA

As in an earlier study on migration intentions (Raggl, 2019), we use (polychoric) principal component analysis to reduce the dimensionality of certain groups of covariates. Some groups of covariates contain variables that are highly correlated with each other; including all of them in a regression could cause multicollinearity issues. If we only use a selection of variables that are believed to be relevant, potentially important information might be omitted from the analysis. (P)PCA is a method that reduces the dimensionality of the data while keeping a large part of the information they contain. The method dates back to works by Pearson (1901) and Hotelling (1933). It identifies the linear combination of the variables that accounts for the greatest variance in the data. The first principal component is the linear combination of the original variables that accounts for the largest share of the variance. The second principal component is orthogonal to the first and contains the largest part of the remaining variance, etc. The analysis identifies as many components as variables are used, and if all components are used in a subsequent regression, nothing would be gained vis-à-vis including all the variables. There is no binding rule on how to decide how many components should be used in a subsequent analysis, but a general rule of thumb is that components with an eigenvalue (EV) greater than 1 should be included (Kaiser rule, scree test). As many of our variables are discrete, either binary or based on a Likert-type scale, we use polychoric PCAs (PPCAs) for these cases. Kolenikov and Angeles (2004) developed this method for discrete variables.

The table below lists the groups of variables for which we perform (P)PCAs and the components we use in the regressions.

Table

Groups of variables and components used in the regressions

Group of variables	Variables included	Component(s) used	Eigenvalue	Share of variation explained
Contentment with public services	Dissatisfaction with social security, public infrastructure, education, health, defense and public safety, and economic development	Component that represents dissatisfaction with public services	3.6	60%
Household demographics	Household size, marital status of respondent, number of children aged 6 or younger, number of children aged 6 to 15	Component that represents large families	2.4	61%
Proxy for household wealth	Ownership of the main residence, a secondary residence, other real estate, other land and car ownership	Component that represents wealth holdings	2.3	47%
Direct networks abroad	Having friends and family abroad, receiving money from abroad	Component that represents direct networks	1.8	88%
Indirect networks abroad	Share of respondents in the primary sampling unit (PSU) and in the region that have friends and family abroad, share of respondents in the PSU and the region that receive remittances	Component that represents indirect networks	2.5	62%
Trust in institutions	Demeaned trust in the government, the police, domestic banks, foreign banks, the ECB and the EU	Component 1 that represents trust in local institutions	1.9	32%
		Component 2 that represents trust in EU institutions	1.4	23%

Source: Author's compilation.

Further (P)PCAs are performed to reduce the dimensionality of the instrumental variables (see table B1 in the annex).

2.2 Endogeneity issues and instrumentation

Establishing a causal relationship between personal perceptions of the quality of public services and migration intentions is not a trivial task. Individuals might be more dissatisfied with public services in their home countries if they have migration intentions and/or third – unobservable – factors might drive both the perceived quality of public services and the intention to emigrate. The result can be biased OLS estimates.[3]

We use instrumental variables (IV) as sources of exogeneous variation and two-stage least squares (TSLS) estimations in addition to the basic OLS estimations to take into account potential endogeneity. In particular, we pursue two avenues for instrumentation. First, we use external measures of infrastructure in the close

[3] *In case of a simultaneity bias, the sign of the bias is not straightforward to assess. Even under simplifying assumptions, for this particular application it cannot be determined, as for the assessment not only the expected signs of the impact of the quality assessment on migration intentions and the impact of migration intentions on the quality assessments need to be known, but also whether the product of the two exceeds unity (see for example Basu, 2015).*

proximity of respondents' residences: road density (Meijer et al., 2018) and land use (artificial continuous and discontinuous urban fabric surfaces, based on CORINE land cover nomenclature). Broadly speaking, these variables can serve as proxies for general infrastructure in close proximity of individuals' residences and contribute to explaining contentment with the quality of public services based on the actual infrastructure in the neighborhood. These measures of infrastructure might also represent the employment opportunities in the region where the respondents live and which could compromise the exogeneity (and therefore validity) of the instruments if these employment opportunities are not controlled for in the main equation. But the main equation does control for regional economic development. It does so by including (PCA) measures that are based on nighttime light intensity in a respondent's neighborhood (measured for different radii around the respondents' residences) as well as on the average unemployment and income of respondents living nearby. Second, we make use of a question in the survey that asks about respondents' opinion on the adequacy of state spending on specific public services[4]. The idea is that the view of whether state spending on a particular service should be increased, maintained at the same level or decreased should not influence migration intentions per se, except through its influence on the perceived quality of public services. We use Kleibergen-Paap statistics and Hansen-J statistics to assess the relevance and exogeneity of the instruments and present first-stage results of the estimations in table D1 in the annex.

3 Data and descriptive evidence

We use the 2018 fall wave of the OeNB Euro Survey to address the link between the perceived quality of public services and migration intentions. The OeNB Euro Survey is an individual-level dataset created from a survey that has been conducted on behalf of the Oesterreichische Nationalbank (OeNB) in ten CESEE countries[5] since 2007. It covers approximately 1,000 randomly selected individuals per country and wave and focuses on topics such as (euro) cash holdings, saving behavior and debt, economic opinions and expectations, and experiences. In addition, socio-demographic and economic characteristics are collected, as well as information on individuals' migration intentions[6]. The 2018 survey wave contains a special module on public debt. Individuals were asked about their satisfaction with public services, in particular with social security, public infrastructure, education, health services, defense and public safety, and economic development (i.e. support for small and medium enterprises, etc.). In this study, we also employ data from external sources, which are merged with the Euro Survey: nighttime light, urban fabric measuring the biophysical coverage of the Earth (CORINE land cover data) and road density (Global Road Inventory Project, GRIP, dataset; Meijer et al., 2018) at individuals' places of residence. See table B1 in annex B for a complete list and description of the variables used for this study.

[4] *The survey question refers to the following services: social security, public infrastructure, education, health, defense and public safety, and economic development; it reads as follows: "And in which of these areas, from your point of view, should the level of state spending be increased, maintained or lowered over the next 10 years?"*

[5] *The survey covers six EU countries (Bulgaria, Croatia, Czechia, Hungary, Poland, and Romania) and four non-EU countries (Albania, Bosnia and Herzegovina, North Macedonia and Serbia). For further information, please refer to https://www.oenb.at/en/Monetary-Policy/Surveys/OeNB-Euro-Survey.html.*

[6] *The exact wording of the question is: "Do you intend to move abroad within the next 12 months?"*

3.1 Migration intentions

The data show that in the ten CESEE countries covered, the share of individuals aged 25 to 64 who intend to move abroad within the next 12 months varies between 3% in Czechia and 20% in North Macedonia (see table A1 in annex A). When weighted by population size, the share of individuals with migration intentions in CESEE is approximately 6%, indicating that 6% of the population in CESEE intend to move abroad within the next 12 months. This population-weighted average takes into account that the ten countries differ greatly in size, but this also implies that the average is strongly driven by Poland and, to a smaller degree, Romania.

Pooling the data for all ten CESEE countries, the data indicate that approximately 9.1% of the respondents aged 25 to 64 indicate that they intend to move abroad within the next 12 months. This average refers to an "average CESEE country" and does not correct for the differences in the size of countries. We can further see in the data that the share of individuals with migration intentions varies considerably with age: among those aged 29 and younger, over 20% have migration intentions, among the 30- to 39-year-olds, 12% to 13% intend to emigrate, and in the working-age population above 40 years of age, just above 5% intend to leave their home country. When we look at gender differences, the data indicate that migration intentions are more common among men than among women. This holds for both the pooled and the population-weighted CESEE averages as well as for most individual countries. With respect to educational attainment, the differences

Chart 1

Population pyramid (2018)

Source: Author's calculations based on OeNB Euro Survey data (2018) using pooled data for the ten CESEE countries covered.

are less well defined. While, driven by Poland, the population-weighted average indicates higher emigration intentions among the highly skilled, this does not hold for individual countries (except for Serbia and Poland) or for the pooled average of respondents (see table A1 in annex A).[7]

Chart 1 shows the gender-age-education-migration nexus using a population pyramid for an average CESEE country (not population-weighted). The colors represent the level of education of the gender-age group and the hatched areas the part of the subgroup that has the intention to move abroad. The chart further indicates the shape of the pyramid that we would expect if the individuals with migration intentions actually left the country. The stylized pyramid drawn by the black line is more constrictive, and the tapering at the bottom indicates the shrinking and aging population structure prevalent in CESEE.

3.2 Dissatisfaction with the quality of public services

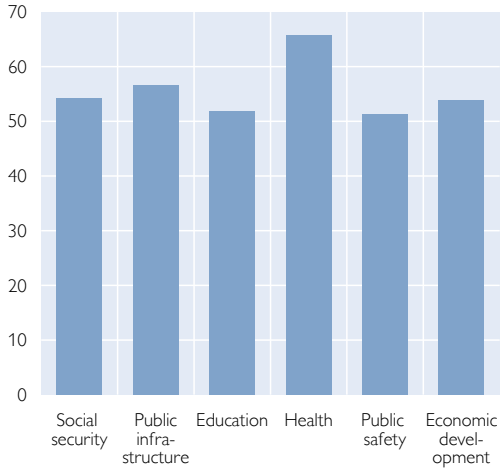
The special module on public debt in the 2018 wave of the OeNB Euro Survey contains a question on respondents' satisfaction with public services in the areas of social security, public infrastructure, education, health, defense and public safety, and economic development.[8]

The level of dissatisfaction with public services is high in CESEE. If we look at the average across all public service categories, more than 55% of respondents say

Chart 2

Dissatisfaction with public services (CESEE average)

% of respondents dissatisfied with service provision

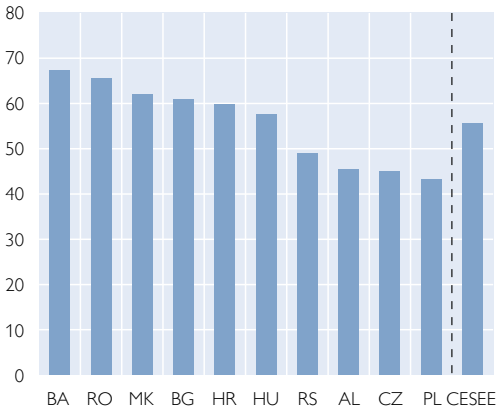


Source: Author's calculations based on OeNB Euro Survey data (2018).

Chart 3

Dissatisfaction with public services by country

% of respondents



Source: Author's calculations based on OeNB Euro Survey data (2018).

Note: The CESEE value represents the unweighted average over all ten countries.

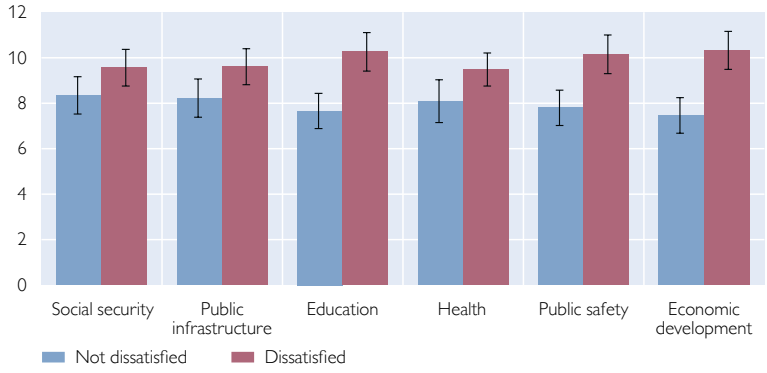
[7] *We would caution against interpreting this finding as evidence that there is no (continued) brain drain. Migration intentions among the highly skilled are sizeable, albeit not statistically significantly higher than among those with lower levels of education. Also, the data describe migration intentions and not actual emigration. To the extent that the highly skilled are more likely to act on their intentions, actual migration can be relatively more frequent among those.*

[8] *The exact wording of the question is the following: "Consider the following areas where the state spends money. How satisfied are you with the delivery of public services in these areas in [YOUR COUNTRY]? Social security, public infrastructure, education, health, defense and public safety and economic development." The possible answers are the following: "Very satisfied, satisfied, dissatisfied, very dissatisfied, don't know, no answer."*

Chart 4

Migration intentions and dissatisfaction with public services

Share of individuals with migration intentions in % (with 95% confidence intervals)



Source: Author's calculations based on OeNB Euro Survey (2018).

that they are either strongly dissatisfied or dissatisfied with the public services provided in their country. Dissatisfaction is high for all service types, but particularly so for health services (see chart 2). As regards the differences across countries (chart 3), the data reveal that in Poland and Czechia, but also in Albania and Serbia, dissatisfaction is below the sample average. In Bosnia and Herzegovina, dissatisfaction is highest; here, an average of close to 70% of respondents are not satisfied with the provision of public services.

Chart 4 provides first descriptive evidence on the relationship between people's contentment with public services and individuals' migration intentions after pooling these data for all ten countries. It shows that migration intentions are stronger among individuals that are dissatisfied with public services. This finding holds for all service categories and is particularly striking for education and economic development services. Among those not dissatisfied with education services, for example, 7.7% intend to emigrate, while among those dissatisfied with the public provision of education, over 10% intend to leave their home countries.

As such a correlation can be driven by other (observable or unobservable) factors, we estimate OLS regressions that control for sociodemographic, economic and regional characteristics, network effects, etc. as well as TSLS regressions to mitigate a possible bias in the estimates due to reverse causality and/or omitted variables.

4 Estimation results

4.1 OLS estimation

Table 1 shows the standardized coefficients of OLS estimations when the data for all countries are pooled. Starting out with a parsimonious specification in (1) that contains an index of the perceived quality of public services, sociodemographic characteristics and a full set of country dummies, we successively add sets of further covariates. The (standardized) coefficients of the PPCA index that measures the degree of dissatisfaction with public services are positive and significant in all specifications. They range between 0.046 and 0.064, i.e., a 1 standard deviation increase in the dissatisfaction index increases the likelihood of having migration intentions by 0.05 standard deviations. The standard deviation of the migration intentions variable in the sample is approximately 0.28 (and the mean approximately 0.08), i.e., a 0.05 standard deviation increase is equivalent to an approximately 1.4 percentage point increase in migration intentions. With an average of 8% of respondents in the sample having migration intentions, this is a nonnegligible effect.

With regard to other covariates, the results closely mirror Raggl (2019), a study that relies on OeNB Euro Survey data collected a year earlier, i.e. in 2017. Women are less likely to have migration intentions, just like respondents who have

small children or large families and who are married. Also, the likelihood of migration intentions declines with respondents' age[9]. Unemployment is a strong predictor of migration intentions, while (equivalent) income is not statistically significant. Respondents' wealth, approximated by a PPCA of the ownership of the main residence, a second or other residence, land and/or a car, is negatively associated with migration intentions. By contrast, migration intentions increase significantly if people have networks abroad, either direct and indirect ones, with the latter being measured by the networks of respondents living in close proximity (primary sampling unit and region).

4.2 Heterogeneous effects

The estimates discussed so far present results that are based on the pooled sample of all ten countries in the survey, with country fixed effects having been controlled for. As the ten countries are very different, we interact the variable indicating dissatisfaction with public services with country dummies. The resulting country-specific coefficients are plotted in chart 5.[10] While the estimated coefficients in many countries are close to the pooled estimate (indicated by the horizontal line), for some countries they are insignificant. With the exception of Bosnia and Herzegovina, the effects in non-EU CESEE countries are above the pooled average. By far the highest impact is estimated for Albania, where the coefficient estimate is twice as high as for Romania and Serbia, the countries with the second- and third-highest coefficients.

This high effect for Albania might give rise to the presumption that the overall effect in the pooled sample might be driven by a single country (e.g. Albania). For robustness, we run ten pooled regressions, omitting one country in each regression. The resulting regression coefficients of the dissatisfaction with public services variable are plotted in chart C1 in annex C. It shows that while the overall coefficient is smaller when we omit Albania, the estimates remain statistically significant and positive in all specifications.

[9] *The relationship between migration intentions and age is nonlinear, and the decline slows down with increasing age.*

[10] *Please note that these are coefficient estimates and not standardized coefficients as they are based on interactions between variables.*

Table 1

OLS estimation (standardized coefficients)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Socio-dem	Economic	Wealth	Regional	Networks	Trust	PSU-FE
PPCA: dissatisfaction with public services	0.049** (2.18)	0.062*** (2.82)	0.064*** (2.83)	0.061*** (2.92)	0.047*** (3.14)	0.047*** (3.03)	0.048*** (3.32)
Female	−0.053*** (−4.67)	−0.056*** (−4.74)	−0.056*** (−4.65)	−0.054*** (−4.53)	−0.055*** (−4.48)	−0.049*** (−4.17)	−0.046*** (−3.80)
Age	−0.498*** (−5.69)	−0.457*** (−5.04)	−0.438*** (−4.88)	−0.436*** (−4.85)	−0.439*** (−4.99)	−0.424*** (−4.86)	−0.378*** (−4.75)
Age sq.	0.251*** (3.25)	0.219*** (2.78)	0.203** (2.60)	0.202** (2.58)	0.212*** (2.71)	0.200** (2.53)	0.181** (2.44)
Medium education	0.004 (0.22)	0.011 (0.73)	0.011 (0.72)	0.017 (1.08)	0.041** (2.43)	0.045** (2.60)	0.058*** (2.70)
High education	−0.019 (−0.83)	−0.011 (−0.50)	−0.010 (−0.49)	−0.005 (−0.27)	0.029* (1.78)	0.031* (1.88)	0.035* (1.74)
PPCA: Large family	−0.066*** (−6.02)	−0.085*** (−6.44)	−0.084*** (−5.91)	−0.084*** (−5.91)	−0.079*** (−5.80)	−0.080*** (−5.43)	−0.055*** (−3.22)
Log(size of town)	0.007 (0.41)	0.031 (1.62)	0.029 (1.55)	0.033 (1.37)	0.010 (0.44)	0.011 (0.47)	
Log(equiv. income)		−0.164 (−0.59)	−0.163 (−0.58)	−0.110 (−0.39)	−0.189 (−0.73)	−0.231 (−0.91)	−0.326 (−1.17)
Log(equiv. income) sq.		0.092 (0.35)	0.090 (0.34)	0.093 (0.35)	0.129 (0.52)	0.158 (0.65)	0.287 (0.99)
Unemployed		0.101*** (5.77)	0.099*** (5.72)	0.090*** (5.05)	0.093*** (5.56)	0.089*** (5.23)	0.081*** (4.78)
PPCA: wealth			−0.002 (−0.08)	−0.005 (−0.25)	−0.039** (−2.14)	−0.029* (−1.67)	−0.029* (−1.73)
PPCA: direct networks					0.151*** (6.97)	0.148*** (6.51)	0.141*** (5.71)
PCA: indirect networks					0.137*** (4.09)	0.137*** (4.00)	
PCA: trust in local inst.						0.002 (0.13)	
PCA: trust in EU						0.037*** (2.95)	0.017 (1.05)
R^2	0.092	0.108	0.106	0.108	0.151	0.153	0.080
N	9,407.000	7,123.000	7,055.000	7,029.000	6,969.000	6,568.000	6,593.000

Source: Author's calculations.

Note: The table contains standardized beta coefficients. t statistics in parentheses.
The dependent variable is binary and takes a value of 1 if the respondent intends to move abroad within the next 12 months. The addition "PCA"/"PPCA" in a variable name indicates that the variable is taken from a (polychoric) principal component analysis.
All specifications contain a constant. Specifications (1) to (6) include country fixed effects, specification (7) includes PSU fixed effects. Specifications (4) to (6) include three principal components representing regional economic development.
** p < 0.1, ** p < 0.05, *** p < 0.01*

The country-specific estimates point toward differences in the average effects between EU and non-EU CESEE countries, with Romania and Bulgaria being notable exceptions. When we interact the dissatisfaction variable with an EU dummy (in the pooled sample), we see this confirmed: The relationship between dissatisfaction with public services and migration intentions is statistically significantly lower in EU CESEE countries.

Distinguishing by the six different types of public services, the estimates plotted in chart 6 show that dissatisfaction with the public social security system, health services, services related to economic development and the public infrastructure are associated with statistically significant increases in migration intentions. Here, the variables capturing dissatisfaction with each service are dummy variables, hence we refrain from portraying standardized coefficients and show the unstandardized coefficient estimates instead. Dissatisfaction with a public service type is associated with a 1.2 to 1.6 percentage point increase in migration intentions. Dissatisfaction with education and defense and safety does not show up as significant.

We further investigate heterogeneous effects with respect to individuals' exposure to public services.[11] More specifically, we interact respondent-specific characteristics that indicate that a respondent may be particularly exposed to an individual service with a dummy that indicates dissatisfaction with this service. We find that having children under the age of 6 leads to a significant effect of dissatisfaction with education services and increases the effect of dissatisfaction with health and defense and public safety. Furthermore, among the self-employed, the impact of dissatisfaction with public services related to economic development is higher than among non-self-employed. We also interact dissatisfaction with social security with having small children, being unemployed or retired, but do not find statistically significant interactions.

Chart 5

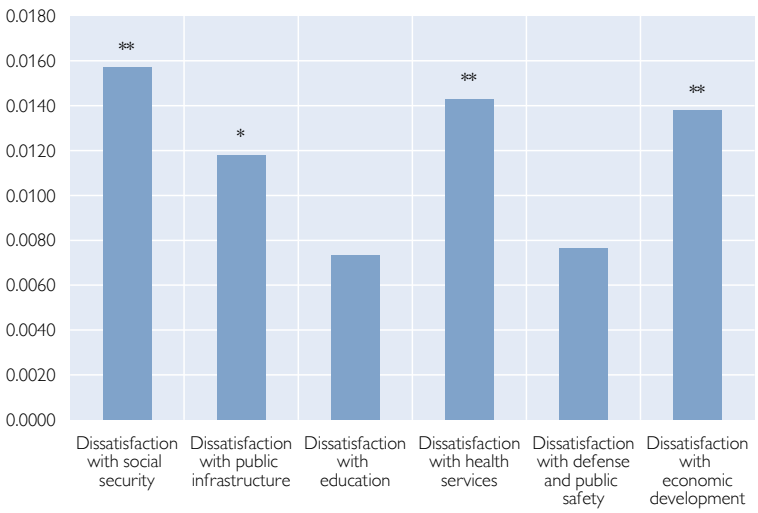
OLS: coefficients by country

Source: Author's calculations based on OeNB Euro Survey data (2018).

*Note: Country-specific coefficients are based on interactions of the dissatisfaction index with country dummies wth the specification (6) in table 1. The horizontal line indicates coefficient estimates in the pooled sample (0.007). *, ** and *** indicate a 10%, 5% and 1% level of significance, respectively.*

Chart 6

OLS estimates: distinguighing by type of service



Source: Author's estimations based on OeNB Euro Survey data (2018).

*Note: All specifications include a full set of covariates and country fixed effects. *, ** and *** indicate a 10%, 5% and 1% level of significance, respectively.*

[11] *The regression outputs are not displayed in this paper due to space limitations, but they are available upon request.*

4.3 IV estimation

In order to consider possible endogeneity issues that can cause biases in OLS estimates, we perform instrumental variable (IV) estimations using different IVs. Table 2 shows the results and indicates the IVs used in the bottom panel (the corresponding first-stage results are displayed in table D1 in annex D).

The results remain positive and statistically significant after instrumentation, and the coefficients increase in magnitude. When only externally merged geo-referenced data are used as IVs (road density and urban fabric), the IVs are weak, as indicated by low Kleibergen-Paap statistics. The high coefficient estimates in columns (2) and (3) should thus be disregarded due to weak instruments. The first-stage results, displayed in table D1 in the annex, confirm that urban fabric has no significant impact on the perceived quality of public services, and also the PCAs based on different road types are only weakly associated with the rating of public services quality. The first-stage F statistic improves considerably, however, when the variable measuring the respondents' view of the adequacy of public spending on public services is added as instrument. The first-stage results show that respondents who think that state spending on public services should be maintained at the current level (as opposed to increased) exhibit a lower degree of dissatisfaction with public services. This confirms that the opinion on the adequacy of state spending can be related to the perceived quality of public services. Columns (4) to (5) display the results for different combinations of IVs, all including the adequacy of state spending as instrumental variables, and indicate that coefficients are considerably larger than when estimated with OLS. When we standardize the coefficients in (4) to (6), they average at approximately 0.1 and are thus twice as high as the OLS standardized coefficients. A 1 standard deviation increase in dissatisfaction with public services thus increases migration intentions by approximately 3 percentage points.

While contentment with public services is not the most important factor for explaining migration intentions, with sociodemographic factors, unemployment and networks explaining a large share of the variation in the data, it is certainly an important nonpecuniary factor that robustly relates to individuals' aspirations to emigrate.

Table 2

IV estimations

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	IV	IV	IV	IV	IV
PPCA: dissatisfaction with public services	0.00755***	0.124**	0.0925**	0.0145***	0.0161***	0.0160***
	(3.80)	(2.48)	(2.11)	(2.71)	(3.00)	(2.98)
Observations	6,615	6,604	6,604	6,615	6,604	6,604
Kleibergen-Paap F		4.400	3.173	27.33	24.11	22.50
Hanson-J		1.633	7.073	24.25	31.58	36.34
Hanson-J p		0.652	0.215	0.390	0.248	0.164
Instrumental variables						
PCA road density (4 components)		Yes	Yes	No	Yes	Yes
PCA urban fabric (2 components)		No	Yes	No	No	Yes
State spending inadequate		No	No	Yes	Yes	Yes

Source: Author's calculation.

*Note: All specifications include a list of covariates and a full set of country dummies. t statistics in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01.*

5 Conclusions

Data from a recent wave of the OeNB Euro Survey suggest that across CESEE, between 3% and 20% of individuals aged between 25 and 64 intend to leave their home countries within the next 12 months. The population-weighted CESEE average, which takes into account the considerable differences in country size, indicates that around 6% of individuals in the region intend to emigrate. Average migration intentions in the pooled sample, which represents an "average CESEE country," amount to 9%. Across the ten countries in the sample, average migration intentions vary considerably and are highest in North Macedonia (20%) and lowest in Czechia (less than 3%). Descriptively, the data confirm that young people and men have stronger migration intentions.

Ongoing emigration from CESEE, especially of young people, adds to population aging, declining labor forces and increasing dependency ratios, and poses further demographic challenges to the countries in the region. Many factors that have been identified as relevant drivers of migration intentions are difficult to directly address by policymakers, such as sociodemographic factors or networks abroad. For this reason, we think it is particularly important to study contributing factors that can be tackled by policymakers. Therefore, we focus on individuals' contentment with public services in their home countries, studying its relationship to migration intentions. Descriptively, we see that migration intentions are stronger among respondents who are dissatisfied and weaker among those who are not dissatisfied with the quality of public services. This finding is confirmed in an OLS framework, where we control for sociodemographic and economic factors, proxies for wealth holdings, economic development in the home region, network effects and trust in local and EU institutions. Respondents who are more dissatisfied with public services are more likely to have the intention to move abroad. This effect holds for our index of dissatisfaction that combines the responses of the six public services categories distinguished in the survey: social security, public infrastructure, education, health, defense and public safety, and economic development. Apart from education and public safety, the relationship is also significant when we distinguish between public services categories. We allow the effects of dissatisfaction with public services to differ across countries and find that in many countries, the effect is similar to the average effect in the sample. A notable exception is Albania, where the coefficient estimate is more than twice as high as in Romania and Serbia, the two countries that rank second and third in terms of effect size. Robustness checks confirm, however, that the overall effect is not driven by Albania, or another single country in the sample. Instrumental variable estimations, which we carry out to address possible endogeneity issues, reassure the OLS findings: The relationship between dissatisfaction with public services and migration intentions is positive and statistically significant. The IV estimates indicate a higher coefficient estimate than the OLS framework.

The link between people's contentment with public services quality and migration bears the risk of a vicious cycle: With more individuals emigrating, public finances can get under increasing pressure, which leaves less room for improving the quality of public services or may even lead to a further deterioration. This, in turn, may further add to emigration pressures. At the same time, there is also the chance of creating a virtuous cycle: Appropriate policies would lead to a strengthening of public services in CESEE countries. Sound social security systems, high quality

education and health care, good infrastructure, safe living conditions and publicly supported regional economic development initiatives would provide for an environment that may reduce individuals' aspirations to move abroad, thereby strengthening public finances and creating space for public service improvements that further incentivizes people to stay. At the same time, these developments can have a positive impact on return migration and/or immigration to CESEE. Public services quality is certainly not the only factor that influences migration intentions, but it is a relevant one and, importantly, one that policymakers have the power to change.

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Annex A: Migration intentions by gender, education and by country

Table A1

Share of individuals aged 25 to 64 with migration intentions

	Gender			Difference	Education			Difference
	All	Men	Women	Men vs. women	Low	Medium	High	High vs. low + medium
	%							
Czechia	2.7	3.3	2.0		10.9	2.0	4.8	
Poland	3.7	5.8	1.9	**	1.9	2.9	7.6	*
Hungary	4.3	3.6	5.0		3.3	3.9	6.0	
CESEE average (population-weighted)[1]	**6.0**	**7.5**	**4.7**	***	**4.8**	**5.8**	**7.8**	**
Croatia	6.8	8.3	5.5		2.1	6.3	9.5	
Romania	6.9	7.6	6.3		0.0	7.7	4.4	
Bulgaria	7.5	8.1	7.0		14.9	6.7	7.7	
Average over 10 countries[2]	**9.1**	**11.0**	**7.3**	***	**9.4**	**8.8**	**9.8**	
Serbia	11.1	13.9	8.4	**	7.8	9.4	18.7	***
Bosnia and Herzegovina	12.9	16.7	8.8	***	5.2	16.4	10.8	
Albania	14.2	17.1	11.7	**	17.7	15.1	12.4	
North Macedonia	20.0	24.2	16.0	**	20.6	22.0	13.3	**

Source: Author's calculations based on OeNB Euro Survey data (2018).

*Notes: Survey weights applied. The columns labeled "Difference" indicate whether the mean is statistically different between two subgroups. Statistical significance is based on t-tests from robust OLS estimations of migration intentions on gender and education dummies, respectively. *, ** and *** indicate a 10%, 5% and 1% level of significance, respectively.*

[1] *Survey-weighted country averages are weighted by the population aged 25 to 64 of each country.*

[2] *Simple average over survey-weighted averages of the ten countries.*

Annex B: Variables used in the OLS and IV estimations

Table B1

List of variables used in OLS and IV estimations

Variable	Description
Dependent variable	
Migration intentions	Dummy variable that takes a value of 1 if respondent intends to move abroad within the next 12 months; respondents stating "don't know" or "no answer" are excluded from the analysis.
Quality of public services	
PPCA: dissatisfaction with public services	Principal component that represents low satisfaction with the six categories of public services; the PCA is based on the six original variables asking about satisfaction with public services (Likert-type scale of answers).
Dissatisfaction with…	Dummy variable that takes a value of 1 if respondent is (very) dissatisfied with…
… social security	… social security (unemployment compensation, public pension, benefits for families and children)
… public infrastructure	… public infrastructure (e.g. public road and town construction, railway network, public transport)
… education services	… education (e.g. public kindergartens, schools, universities)
… health services	… health (e.g. public hospitals)
… defense and public safety	… defense and public safety (e.g. police, justice system)
… economic development	… economic development (e.g. support for small and medium-sized companies, investment allowances, financial support for disadvantaged regions)
Sociodemographic factors	
Age, age squared	Age of respondent and its square
Medium education	Dummy variable that takes a value of 1 if respondent has medium education (i.e. lower and upper secondary, post-secondary but non-tertiary)
High education	Dummy variable that takes a value of 1 if respondent has high education (i.e. first and second stage of tertiary)
Female	Dummy variable that takes a value of 1 if respondent is female
PPCA: large family	Principal component that represents members of large families, i.e. married individuals from large households, with small children
Log(size of town)	Logarithm of the size of the residence town
Individual economic factors	
Log(equiv. household income) [sq.]	Logarithm of the equivalized household income [and its square]; equivalized household income is computed using a weight of 1 for the first adult in the household, 0.5 for each additional person aged 13 and over and 0.3 for each child under the age of 13. (It is more common to use the age of 14 as a cutoff between a weight of 0.5 and 0.3, but this is not possible in our data, and we use 13 instead.) Non-response in the income variable enters as missing values.
Unemployment	Dummy variable that takes a value of 1 if respondent is not working but seeking a job
PPCA: wealth	Principal component that represents real estate ownership (ownership of residence, secondary residence, other real estate and other land, including car ownership)
Regional development	
PCA: prosperous region	Principal component that represents individuals living in regions with low unemployment, moderate income, high activity and low growth in activity (prosperous, stable region)
	Regional income/unemployment is calculated as the (survey-weighted) average of equivalized household income/individual unemployment using survey weights. Economic activity is measured as the logarithm of night light intensity in 2015, 2016, 2018 (data source: Earth Observation Group, Visible and Infrared Imaging Suite, VIIRS). Growth in activity is measured as the log-difference in night light intensity between 2005 and 2013 (data source: Earth Observation Group, Defense Meteorological Satellite Program – Operational Linescan System, DMPS-OLS). All variables are calculated at different levels of regional aggregation: For night light data, we use the 10km and 20km radius around respondents' residences and the NUTS 2 level; average income and unemployment are aggregated to the PSU and the regional level. PSU is the primary sampling unit and represents households in close proximity of the respondent's residence, the regions are defined based on NUTS 2 classifications – or finer in some countries (HR, BG, MK).
PCA: depressed region	Principal component that represents individuals living in regions with high unemployment, low income, moderate activity and moderate growth in activity
PCA: developing region	Principal component that represents individuals living in regions with moderate unemployment, high income, low activity but high growth in activity

Source: Author's compilation.

Note: Unless otherwise noted, the source of all variables is the OeNB Euro Survey carried out in fall 2018.

Table B1 continued

List of variables used in OLS and IV estimations

Variable	Description
Network effects	
PPCA: direct networks	Principal component that represents individuals with direct networks abroad. PPCA contains a dummy variable that takes a value of 1 if respondent and/or their partner receives remittances from abroad and a dummy variable that indicates close family living abroad.
PCA: indirect networks	Principal component that represents individuals with indirect networks abroad. PCA contains the share of remittance receivers in the PSU and in the region and the share of respondents in the PSU and in the region that has family living abroad.
Trust in institutions	
PCA: trust in local institutions	Principal component that represents trust in national institutions (trust is measured on a Likert-type scale; trust variables are demeaned before they enter the PCA)
PCA: trust in the EU	Principal component that represents trust in the EU (The PCA is performed based on trust in the government/cabinet of ministers, the police, domestically owned banks, the national central bank, foreign owned banks, and the EU.)
INSTRUMENTAL VARIABLES	
PCA road density (4 comp.)	The first four components of a PCA on the following indicators of road density: The density (m/km^2) of five types of roads (highways, primary, secondary, tertiary and local roads) based on 8km/8km raster data as well as based on vector data calculated for 5km/10km/20km radii around the place of residence (data source: Global Road Inventory Project (GRIP) dataset, Meijer et al., 2018).
PCA urban fabric (2 comp.)	The first two components of a PCA on the following indicators of urban fabric: CORINE continuous and discontinuous urban fabric in 500m/1km/2km/5km/10km/20km radii around the place of residence (data source: CORINE landcover data).
PPCA: inadequate state spending on public services	Principal component that represents individuals that consider state spending on the six types of public services as inadequate. The six original variables enter the PPCA.

Source: Author's compilation.

Note: Unless otherwise noted, the source of all variables is the OeNB Euro Survey carried out in fall 2018.

Annex C: Robustness

Chart C1

Robustness of coefficient estimate to omission of countries

Coefficient estimate of dissatisfaction index

Source: Author's calculations based on OeNB Euro Survey data (2018).

Annex D: First-stage results of IV estimations

Table D1

IV estimations – first-stage results corresponding to columns (2) to (6) in table 2

	(2)	(3)	(4)	(5)	(6)
	1st stage IV	1st stage IV	1st stage IV	1st stage IV	1st stage IV
PCA: high road density	−0.0164 (−0.87)	−0.0200 (−0.89)		0.00433 (0.24)	−0.00350 (−0.16)
PCA: highways	−0.0344** (−2.41)	−0.0357** (−2.49)		−0.0192 (−1.45)	−0.0201 (−1.51)
PCA: primary roads	0.0419** (2.46)	0.0425** (2.49)		0.0393** (2.43)	0.0399** (2.46)
PCA: few medium roads	−0.0171 (−0.85)	−0.0206 (−1.00)		−0.0312 (−1.64)	−0.0314 (−1.60)
PCA: high urban fabric		−0.0167 (−0.57)			0.00225 (0.08)
PCA: high urban fabric close to home		−0.0209 (−0.69)			−0.0237 (−0.83)
State spending on social security					
Maintained			−0.242*** (−4.83)	−0.243*** (−4.82)	−0.243*** (−4.83)
Lowered			0.218*** (2.62)	0.216*** (2.58)	0.214** (2.55)
Do not know			0.234* (1.87)	0.226* (1.81)	0.224* (1.79)
No answer			0.0810 (0.12)	0.0856 (0.13)	0.0796 (0.12)
State spending on public infrastructure					
Maintained			−0.309*** (−6.41)	−0.310*** (−6.41)	−0.309*** (−6.39)
Lowered			0.0559 (0.78)	0.0601 (0.84)	0.0616 (0.86)
Do not know			0.236 (1.56)	0.242 (1.60)	0.244 (1.61)
No answer			1.766** (2.46)	1.770** (2.45)	1.762** (2.42)
State spending on education					
Maintained			−0.306*** (−5.99)	−0.300*** (−5.82)	−0.299*** (−5.80)
Lowered			0.0280 (0.27)	0.0270 (0.26)	0.0266 (0.26)
Do not know			0.268* (1.85)	0.277* (1.90)	0.277* (1.90)
No answer			1.110*** (2.85)	1.121*** (2.85)	1.125*** (2.88)
State spending on health					

Source: Author's calculations.

Note: t statistics in parentheses .
** p < 0.1, ** p < 0.05, *** p < 0.01*
Adequacy of the state spending on the different public services: All answer categories are included in the estimations, with the response "state spending should be increased" being the reference category.
First-stage estimations also include all control variables of the second stage, but they are omitted from this table.

Table D1 continued

IV estimations – first-stage results corresponding to columns (2) to (6) in table 2

	(2)	(3)	(4)	(5)	(6)
	1st stage IV	1st stage IV	1st stage IV	1st stage IV	1st stage IV
Maintained			–0.303***	–0.304***	–0.304***
			(–5.17)	(–5.16)	(–5.15)
Lowered			0.130	0.122	0.124
			(1.32)	(1.24)	(1.25)
Do not know			0.416**	0.414**	0.415**
			(2.26)	(2.25)	(2.25)
No answer			0.404	0.389	0.399
			(0.56)	(0.53)	(0.55)
State spending on defense					
Maintained			–0.0630	–0.0645	–0.0645
			(–1.30)	(–1.33)	(–1.33)
Lowered			0.135**	0.134**	0.135**
			(2.10)	(2.07)	(2.08)
Do not know			0.555***	0.543***	0.543***
			(4.83)	(4.74)	(4.73)
No answer			–0.248	–0.278	–0.272
			(–0.75)	(–0.86)	(–0.85)
State spending on economic devel.					
Maintained			–0.0269	–0.0293	–0.0285
			(–0.54)	(–0.59)	(–0.57)
Lowered			0.156*	0.150*	0.152*
			(1.80)	(1.72)	(1.74)
Do not know			0.591***	0.590***	0.590***
			(6.07)	(6.08)	(6.08)
No answer			0.403	0.435*	0.432
			(1.53)	(1.65)	(1.64)
Observations	6,604	6,604	6,615	6,604	6,604

Source: Author's calculations.

Note: t statistics in parentheses .
** p < 0.1, ** p < 0.05, *** p < 0.01*
Adequacy of the state spending on the different public services: All answer categories are included in the estimations, with the response "state spending should be increased" being the reference category.
First-stage estimations also include all control variables of the second stage, but they are omitted from this table.

The e-motion of car manufacturing in CESEE: the road ahead

Tomáš Slačík[1]

Central, Eastern and South-Eastern European (CESEE) countries have benefited considerably from the grand-scale relocation of car production sites to emerging markets over the last two decades. On the back of strong foreign direct investment, the automotive industry has thus become a major economic pillar in several countries and firmly integrated into global, predominantly European, value chains. More recently, the automotive industry has seen some challenging times, though. Global and particularly European car production has been losing steam, and the industry has been hit by major black swan events, most painfully the coronavirus pandemic and Russia's invasion of Ukraine. What is more, the global automotive industry has been undergoing unprecedented structural shifts on the demand and supply side, such as autonomous driving, shared mobility, connectivity and, most notably, the transition to electric vehicles.

Against the background of these great changes and challenges, the present paper explores the emergence of the largely foreign-owned automotive industry in CESEE and its level of preparedness for managing the risks and uncertainties and seizing the opportunities implied by the ongoing development of the automotive industry. After collecting and analyzing relevant qualitative information we find that the CESEE car industry will be walking a thin line between adopting new technologies and sticking to the internal combustion engine for longer than Western countries. For CESEE countries to maximize the benefits and minimize the risks of the technological transformation in the car industry the key priority is to preserve close links with Germany, stay tuned for battery production and focus on activities and promising industries with higher value added.

JEL classification: F15, F60, L62
Keywords: automotive, electric, battery, transformation, CESEE

Over the last two decades, the frontiers of automotive manufacturing have been shifting toward emerging markets worldwide. The relocation of production from advanced countries has been a big asset for Central, Eastern and South-Eastern European (CESEE) countries in particular. The automotive industry has thus come to play an important role in several countries in the area, particularly Czechia, Slovakia, Slovenia (now among the top countries in terms of car production per capita worldwide), Hungary, Poland and Romania. Backed by strong inflows of foreign direct investment (FDI) in recent decades, the industry has been integrated into European and global value chains, and the sector has become a key growth driver for these economies.

However, the automotive industry has been hit hard by the COVID pandemic globally and in Europe in particular. In Europe, motor vehicle production plummeted by nearly a quarter year on year in 2020 (–13% worldwide) and dropped by

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another 4% from a record low base in 2021 (+3% worldwide).[2] Aside from subdued demand and the impact of numerous lockdowns and (cross-border) mobility constraints, this collapse was the result of major supply chain disruptions. In particular, semiconductor shortages have been slowing down car production significantly since late 2020. Meanwhile, Russia's invasion of Ukraine and the ensuing economic sanctions have added to the strain on already battered automotive supply chains. Disruptions stem from the suspension of car production by several manufacturers, including Czech Skoda, and from manufacturers being cut off from key supplies of automotive inputs by Russian and Ukrainian firms such as wire harnesses and raw materials. In addition to the real ramifications, the war in Ukraine has put further upward pressure on already elevated prices of crucial raw materials and energy.

The pandemic- and war-triggered shocks to the automotive industry arrived amid a cyclical slowdown as car production had stagnated or even contracted for several years even before the pandemic across the globe, including Europe (especially Germany). Nonetheless, CESEE countries with a strong automotive focus largely defied these developments and navigated the challenges comparatively well. On top of these cyclical trends, the global automotive industry has been undergoing a fundamental transformation driven by unprecedented structural shifts on the demand and supply side. These include, in particular, autonomous driving, shared mobility, connectivity, new players entering the automotive arena and, last but not least, electrification as the most widespread means to address the ever-stricter CO_2 emission targets. The COVID-19 crisis as well as the war in Ukraine are likely to accelerate many of these trends reflected in, inter alia, changes in supply chains, more rapid digitalization as well as acceleration of the electrification process to fast-track independence from fossil fuels.

Indeed, the automotive sector's future is very much oriented toward electric mobility, at least in Europe. Apart from mounting peer and market pressures, this trend is largely driven by strengthening global efforts to address climate change and regulate carbon emission. With respect to the latter, Europe has been the world's trend setter and frontrunner. Since the ever-stricter CO_2 emission regulation standards refer to tailpipe emissions only, electric vehicles are carbon-neutral by definition. As a result, all major traditional automakers keep announcing ambitious electrification targets and time schedules. With car producers expanding and accelerating the provision of new electric vehicle models, their adoption has gained pace and the European market has moved into the driving seat regarding electrification. While pure electrics, plug-in hybrids and hybrids[3] accounted for some 4.5% of all new passenger car registrations across the EU in 2017, this share climbed to

[2] *See International Organization of Motor Vehicle Manufacturers (2021 Statistics | www.oica.net).*

[3] *Electrification can take different forms: pure battery electric vehicles (BEV); plug-in hybrid electric vehicles (PHEV) powered by petrol and/or a battery pack that can be plugged in to an external electric power source for charging; and hybrid electric vehicles (HEV) in which an internal combustion engine is aided by a battery that is charged through regenerative braking. A different avenue of electrification are fuel cell electric vehicles (FCEV). Instead of a battery, these rely on an electrochemical cell that converts the chemical energy of a fuel (typically hydrogen) and an oxidizing agent (often oxygen) into electricity. While several automakers view the fuel cell technology as very promising and keep developing it (long-term advocates have been above all Toyota and Hyundai-Kia), others (e.g. Volkswagen Group or Tesla) have ruled out this option. In fact, since hydrogen-powered cars are still costly and lack the necessary infrastructure, they only serve a niche market.*

about 40% in 2021.[4] However, despite the recent boom of electric cars sales, internal combustion engine vehicles will not vanish overnight and will continue to play a role. Especially in CESEE and other emerging countries, the transition to electric vehicles is expected to be much slower than in advanced markets.

Given the advancing powertrain transformation, the development of battery technology and battery production will play a crucial role in the future. Battery packs and their main features such as size, weight and driving range are not only set to become the most important performance component of electric vehicles, creating differentiation among competitors, but also the key cost determinant. With China accounting for about three quarters of the Li-ion battery[5] production capacity, the European automotive industry needs to develop a competitive and innovative battery industry with all up- and downstream stages. To cover the rising battery demand, it will likely take some 20 battery pack production sites (so-called gigafactories) in Europe in 2030 and about 35 in 2040 (Deloitte, 2021).

Against this background, the present paper seeks to sketch out where the largely foreign-owned automotive industry in CESEE is coming from and where it is heading in light of the current dynamics and high uncertainties in the sector. By collecting and analyzing relevant qualitative economic arguments we aim to shed some light on what these historical structural and cyclical developments in the automotive industry imply for the CESEE economies and how they will walk the thin line between seizing the opportunities and managing the risks associated with electrification on the one hand and continuing to meet demand for (not) outgoing internal combustion engines on the other.[6] The paper is structured as follows. While the next section recapitulates the development of the automotive industry in CESEE over the last 30 years, section 2 collects evidence to assess how the car industry in the region is braced for the big trends of the near future. Section 3 complements the macroeconomic view with a firm-level perspective based on rather unique firm survey data collected by the European Investment Bank. Section 4 discusses the potential future impact of the big trends in the automotive sector, particularly of car electrification, on major macroeconomic variables in CESEE before last section concludes.

1 Dawn and heyday of the automotive industry in CESEE during transition

Building on the long tradition in mechanical engineering and a well-educated workforce, Western automotive companies grasped the historic opportunity brought about by the collapse of communism in 1989. They thus not only revitalized local brands such as Skoda (Czechia) or the Dacia (Romania) but also shifted their own production eastward. The largest share of CESEE automotive production is held by Volkswagen, which allocates almost a third of its European manufacturing to the region, closely followed by Stellantis[7] and Renault. In addition, some Korean

[4] *ACEA (2022).*

[5] *Li-ion batteries are expected to stay the dominant battery technology used in electric vehicles in the foreseeable future.*

[6] *At this stage we abstain from any quantitative analysis as in light of the dynamics and complexity of the topic any such analysis – unavoidably based on widely distributed assumptions about a large set of possibly (un)known unknowns – can cover only a very limited subarea of the matter and is subject to a high level of uncertainty.*

[7] *Stellantis was formed in 2021 through a merger between the Italian-American conglomerate Fiat Chrysler Automobiles (FCA) and the French PSA Group (Peugeot S.A.).*

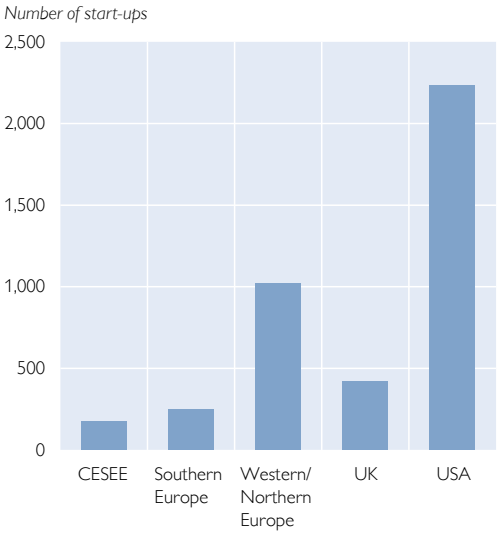
and Japanese automakers have a substantial presence in the region. Altogether, more than every fifth motor vehicle factory in the EU is located in CESEE. Along with the automakers, a whole myriad of their suppliers shifted their production eastward. Furthermore, while the absolute number of start-ups in the automotive sector in Europe and in the CESEE region in particular is well below the number of US start-ups (chart 1), CESEE countries are home to several young and innovative automotive companies. Indeed, in relative terms the share of automotive start-ups is not only higher in CESEE than in other European regions but also higher than in the USA (chart 2). One of the most prominent examples of a successful automotive newcomer is Rimac, the Croatian producer of electric hyper-cars, which recently took over the iconic brand Bugatti.

1.1 The presence of CESEE start-ups in the automotive sector

The automotive industry thus gained an important role in several CESEE countries over the last three decades. The combined value added by the sector in the ten CESEE countries represents more than 12% of the total automotive value added in the EU. Some CESEE countries have come to be highly specialized in automotive manufacturing. Indeed, in Czechia, Hungary and Slovakia, motor vehicle manufacturing is the lead manufacturing industry, like in Germany, generating about one-fifth of the manufacturing gross value added. In terms of aggregate output and employment, the automotive sector in CESEE is also comparable to Germany with which

Chart 1

Number of start-ups in the automotive sector[1]



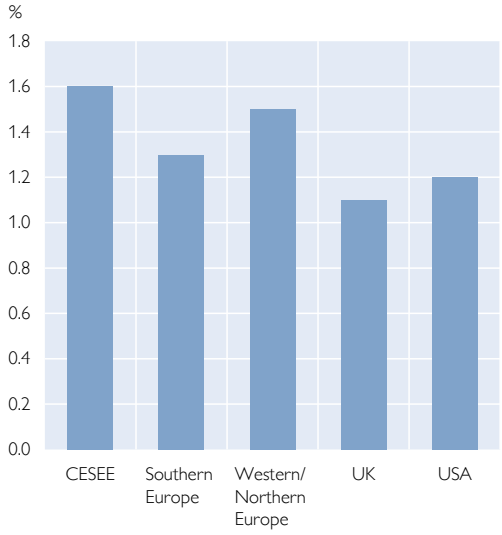
Source: Crunchbase, Eurostat, US Census Bureau, authors' calculation.

Note: CESEE: Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. Southern Europe: Cyprus, Greece, Italy, Malta, Portugal and Spain. Western/Northern Europe: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, the Netherlands and Sweden.

[1] The figures relate to firms that were founded between January 2008 and June 2021 and are still active in the automotive sector.

Chart 2

Share of start-ups in the automotive sector[1]



Source: Crunchbase, Eurostat, US Census Bureau, authors' calculation.

Note: CESEE: Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. Southern Europe: Cyprus, Greece, Italy, Malta, Portugal and Spain. Western/Northern Europe: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, the Netherlands and Sweden.

[1] The figures relate to firms that were founded between January 2008 and June 2021 and are still active in the automotive sector.

the industry in CESEE is closely intertwined. The sector thus employs about 1 million people in the CESEE region, some 37% of total EU automotive employment, despite the dramatic increase in robotization in recent years.

The automotive sector in particular and manufacturing in general has been the main target of the FDI flows that started pouring to CESEE countries in the 1990s, with Hungary having attracted the highest manufacturing share (43% of FDI stocks). Over the last two decades, the investment rate in the automotive sector measured as the share of gross fixed capital formation relative to gross value added averaged more than 36% in CESEE, nearly twice as much as in the rest of the EU.

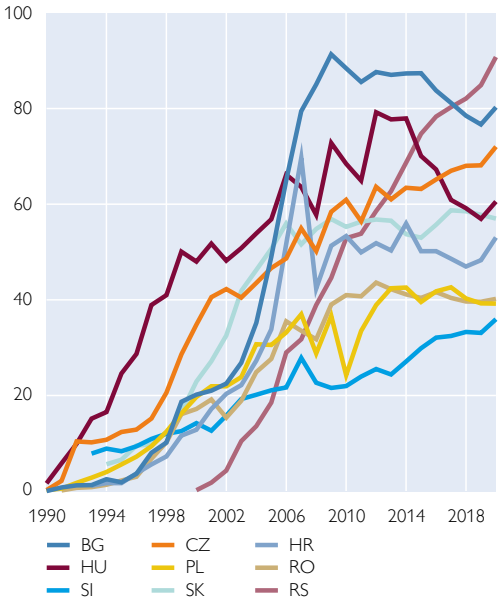
However, as chart 3 shows, FDI stocks have remained rather flat in most CESEE countries since the global financial crisis in 2009. This echoes the fact that the strong relocation of automotive production to the CESEE region slowed down substantially after the global financial crisis. As a result, in contrast to the EU as a whole, the automotive industry in most CESEE countries experienced a markedly higher growth in value added between 2000 and 2008 than in the period after the financial crisis (chart 4). In the wake of strong FDI inflows, the automotive sector in CESEE countries has become one of the region's key export drivers. Automotive exports thus accounted for a record high of 34% of total exports in Slovakia in 2019 and for more than 20% in Hungary, Czechia and Romania.

1.2 Growth of FDI stocks and value added by the automotive sector in selected CESEE countries

Moreover, FDI inflows were crucial in integrating the CESEE automotive sector into global and regional value chains, as a result of which the share of foreign value

Chart 3

Growth of inward FDI stocks

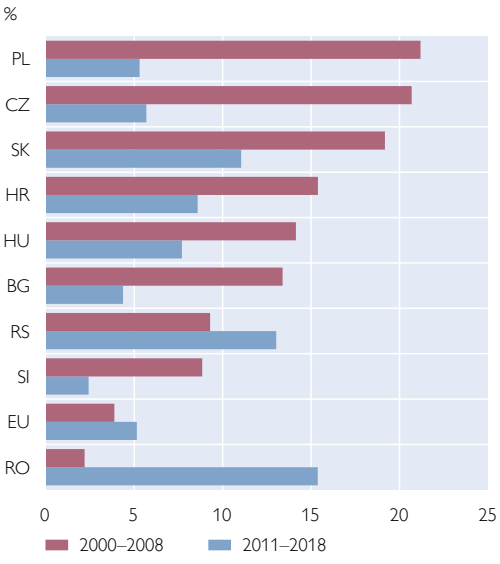


Source: wiiw FDI-database.

Note: Special-purpose entities excluded.

Chart 4

Annual average growth rates of value added by the automotive sector

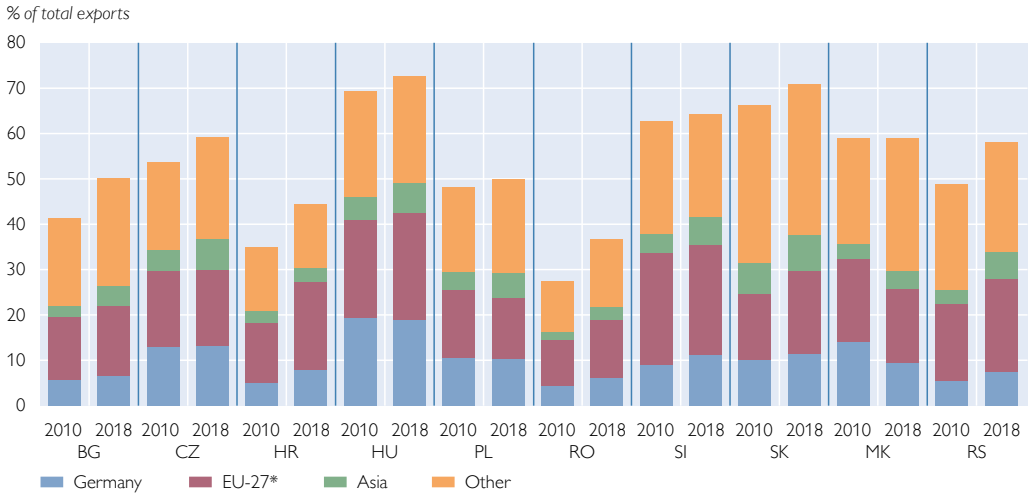


Source: Eurostat.

Note: Automotive sector defined as NACE rev. 2, C29 (motor vehicles, trailers and semi-trailers). The data for the EU include the EU-27 and the UK.

Chart 5

Foreign value-added content of exports of transport equipment in selected CESEE countries



Source: wiiw multi-country input-output database (wiiw MC-IOD).

Note: EU-27 denotes EU-27 without domestic manufacturing and Germany. Asia includes China, South Korea and Taiwan. Transport equipment comprises NACE rev. 2, CL, C29 (motor vehicles, trailers and semi-trailers) and C30 (other transport equipment).*

added in exports of transport equipment has risen to levels as high as 70% in Hungary, Slovenia and Slovakia, compared to less than 30% in Germany (Reiter and Stehrer, 2021). While the automotive sector has some of the longest value chains of any industry, it is, at the same time, organized into three main blocks that generally source within their respective regions: the EU, North America and Asia (OECD, 2012). In line with this stylized fact, the lion's share of the foreign value added in CESEE countries' exports of transport equipment comes from the EU, particularly Germany (chart 5). The German value added content constitutes a major share of exports in Hungary (19%) and Czechia (13%). The EU value added share in automotive exports is highest in Slovenia (24%) and Hungary (23%).

The deep integration of the CESEE automotive industry in global and particularly regional value chains and the high interlinkages with Germany notwithstanding, it has to be borne in mind that the automotive sector has a very different functional profile in Germany than in CESEE countries. The latter tend to specialize in value chain functions with lower value added and serve as factory economies in the European production networks (Stöllinger, 2021). Hence, the sector in CESEE typically shows a revealed comparative advantage in production while other more skill- and knowledge-intensive pre- and post-production functions – including headquarter services and R&D, but also sales and business services – are underrepresented. Conversely, Germany's automotive industry has a comparative disadvantage in production, but substantial comparative advantages in headquarter services, R&D and business services, i.e. functions which tend to generate higher value added and pay higher wages.

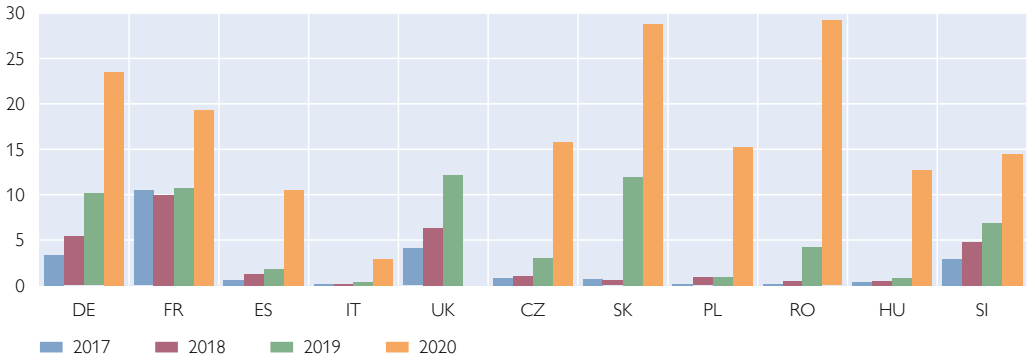
2 Automotive industry in CESEE in e-motion?

Turning to electrification, the picture across the region is somewhat varied, and automotive players in CESEE are largely dependent on decisions taken at their mostly foreign headquarters. Nonetheless, in general, CESEE countries are to a large extent involved in the electrification process. Moreover, many appear to have the potential to reap significant benefits from the electrification trend or even to become its key focal points, at least when it comes to the projected production of electric vehicles. For instance, Slovenia, Slovakia and Czechia are expected to have the highest level of battery electric vehicle production per capita in Europe in 2030 (Transport & Environment, 2021). Moreover, vehicle production in some countries in the region is projected to become exclusively (Slovenia) or predominantly (Poland for instance) focused on battery electric vehicles by 2030. In contrast, battery electrics will account only for about 50% of car production in Germany and for about 30% in Romania where the shift to electric vehicle production will be less significant and/or happen at a slower pace. In most of the CESEE countries, we see an emerging shift toward electric vehicles. In Czechia, all automotive players producing in the country (Skoda, Hyundai and Toyota) have launched at least some full electric vehicle or hybrid production. Particularly Skoda (Volkswagen Group) – which is investing EUR 2 billion in e-mobility – wants to turn Czechia into an e-mobility hub. In Slovakia, Stellantis has EUR 180 million in investment plans with the aim of gradually launching mostly hybrid and electric vehicles. Volkswagen has been producing its electric e-Up in Slovakia since 2013. Jaguar Land Rover is adding plug-in hybrid electric cars to its production portfolio in Slovakia. Stellantis' FCA is investing EUR 165 million in its Polish plant to produce new hybrid and electric vehicles. Moreover, Volkswagen and MAN produce electric vans in the country and Poland is already the leader in manufacturing of electric buses. Furthermore, in 2020 the Polish government announced plans to create a state-owned electric vehicle company, ElectroMobility Poland, which is expected to launch its e-car production in fall 2024. In Hungary, the BMW plant to be opened in 2025 will exclusively produce electric cars, making it the key focal point of BMW's strategy for e-mobility. Daimler announced plans to invest EUR 141 million in Hungary to add fully electric vehicles to its Hungarian production. The electric drives for the Audi e-tron have been manufactured in Hungary since 2018. The electric models for the Premium Platform Electric (PPE), developed jointly with Porsche, are also to be assembled at the Hungarian plant. In Slovenia, the Renault Twingo EV accounted for one-third of the Revoz plant's output in 2021. In addition, the Slovenian plant also manufactures the Smart Forfour EV under a partnership with Daimler. While Romanian Dacia (Renault Group) has unveiled its first 100% electric model (Dacia Spring), the market's most affordable electric vehicle will not be made in Romania but rather at the parent company Renault's facility in China. Ford has announced plans to invest USD 300 million in Romania, aiming to electrify the entire commercial vehicle range from 2024 on. The Bulgarian manufacturing facility (EUR 143 million investment) of German electric car manufacturing startup Next.e.Go Mobile is scheduled to begin operations in 2024. Rimac, the Croatian e-hyper-car producer, takes on a special role in the CESEE region, contributing to innovation in the electric vehicle branch and producing supplies for already established producers.

Chart 6

Exports of electric and hybrid cars

Export share of total cars in %



Source: Eurostat Comext.

Note: Total cars denotes motor cars and other motor vehicles principally designed for the transport of less than ten persons (CN8703). Alternative cars include hybrid cars, plug-in models and pure electric cars. 2020 data for the United Kingdom not available.

Going hand in hand with the strengthening production of electric vehicles in CESEE has been the rising significance of electric powertrain technologies in the region's exports in recent years. The year 2020 saw a particularly strong jump, with the share of electric and hybrid vehicle exports in total car exports climbing as high as 30% in Slovakia and Romania (see chart 6).

In addition to the production of electric vehicles, CESEE countries are making significant efforts to secure a role in battery production. On the back of the strongly rising demand for batteries, Deloitte (2021) estimates that 16 to 22 gigafactories will have to be built in total in Germany, Czechia, Hungary, Poland and Slovakia to keep electric vehicle assembly in this region. This is because the heavy weight of batteries renders long-distance logistics and shipping costly so that it is reasonable to place the production of batteries close to the assembly of electric vehicles. Against this background, Poland, Hungary, Slovakia and Czechia have already taken action to attract investment in gigafactories. While there has been a gigafactory in operation in Poland since 2017 and there are two in Hungary, one more is currently planned in each of these two countries. In addition, one gigafactory is planned in Slovakia and (up to) two in Czechia. Poland, whose exports of Li-ion batteries already amount to 2% of total exports, has attracted investments in gigafactories by means of direct financial support, free land transfer and tax incentives. Similarly, the Hungarian government has incentivized investments in its two existing gigafactories and planned future ones via direct financial support as well as free provision of the enabling infrastructure or some utilities. In addition to some financial support in favor of a planned gigafactory, Slovakia has set up the Slovak battery alliance, an independent advocacy group, to kick-start its battery industry. In Czechia, the government has so far only signed a memorandum of understanding with the electricity company CEZ concerning support for a gigafactory project.

Yet despite the strong involvement of the CESEE region in electrification, the implications are far more complex. The shift in production toward electric vehicles entails risks and opportunities for CESEE and the respective firms. Car manufacturers will need to find a right balance between electric and internal combustion

engine vehicles, depending on the market they serve. This entails not only large investments in new and possibly also still in outgoing technologies but in light of the high uncertainty also optimization challenges when it comes to organizing R&D and production. Hence, some car producers in the CESEE region such as Skoda and Dacia are planning a much slower transition to electric vehicles, as they have been and will be serving markets where the onset of e-mobility will be slower. Skoda for instance has been mandated to manage activities and to strengthen the position of the entire Volkswagen Group in India and South-East Asia. This involves the launch of a slew of competitively priced mass-market cars with an internal combustion engine. Moreover, Skoda has also been charged with developing cars on a common platform (MQB-A0) for the entire Volkswagen Group. Based on this platform, individual car brands in the Volkswagen Group will produce vehicles destined in particular for India, Russia, South America and Africa. Overall, the reasons why internal combustion engine production will stay longer in CESEE are mainly the following: (i) the tendency of older technologies to persist longer in peripheral locations; (ii) the CESEE automotive industry's relatively weak innovation capacities and (iii) its continued (labor and energy) cost advantage in the more labor-intensive internal combustion engine production (see Pavlínek, 2021; and CLEPA/PwC, 2021).

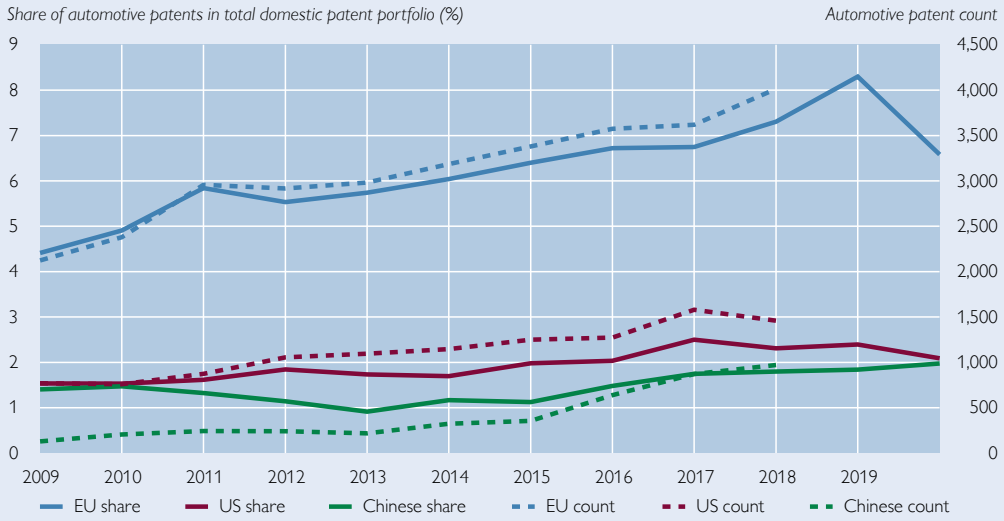
Box

CESEE's relatively limited innovative power strongly focused on the automotive sector, especially electric vehicles

Europe is a global leader in R&D investment in the automotive industry. One euro out of three spent in R&D in the EU goes to the automotive sector. However, R&D expenditures by car manufacturers are heavily concentrated in some EU countries, notably Germany and France. As a result, the EU is in pole position for innovative development in the automotive sector, as the steady upward trend for automotive patents – well ahead of the USA and China – suggests (chart B.1).

Chart B1

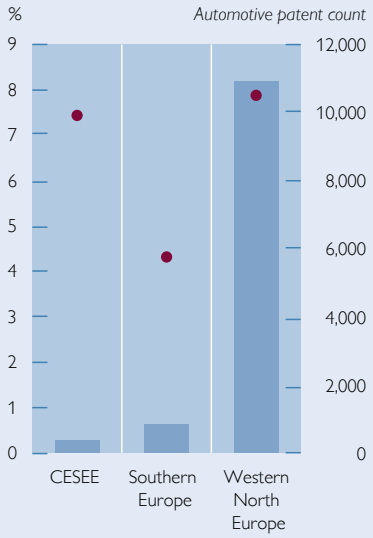
Evolution of automotive patents in the EU, the USA and China



Source: Authors' calculations based upon PATSTAT (PCT) data in collaboration with ECOOM (Centre for R&D Monitoring, Leuven, Belgium).

Chart B2

Number and share of automotive patents in Europe



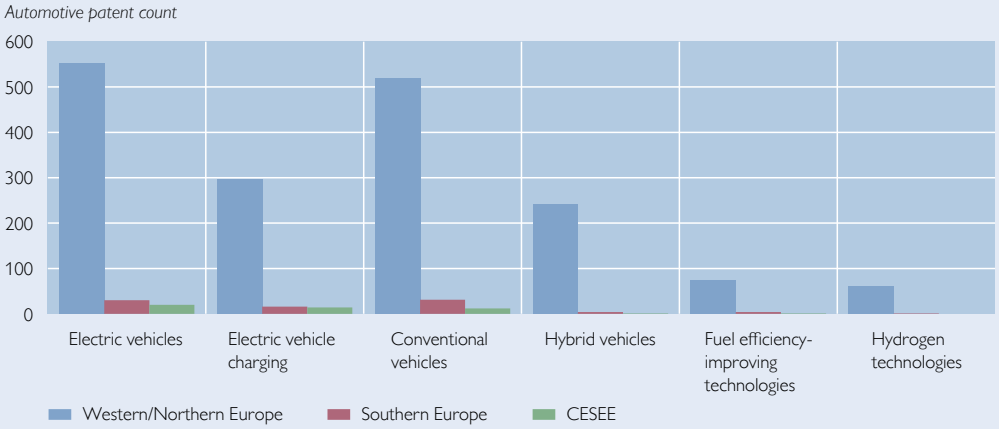
Source: Authors' calculations based upon PATSTAT (PCT) data in collaboration with ECOOM (Centre for R&D Monitoring, Leuven, Belgium).

Yet in line with the above-mentioned functional specialization, the innovative power of the CESEE region's automotive sector is limited. The absolute number of patents related to automotive innovation in the region is rather low compared to the other European regions. However, in relative terms, automotive patents account for close to 8% of all patents in CESEE, which is in line with the rest of Europe and points to an important relative specialization in this area (chart B.2). In particular, the CESEE region has seen a major uptake of climate-friendly patents in the automotive sector over the last 15 years. These patents are mainly related to the development of electric vehicles and electric vehicle charging (see charts B.3 and B.4). This relative specialization in electric vehicles is stronger than in other European regions. However, while the CESEE region has evolved into a significant knowledge center for vehicle electrification, it noticeably lags behind with respect to innovation in renewable energy and the related supportive technologies which are indispensable to making the electrification of vehicles truly climate-friendly. To sum up, CESEE countries do have a strong relative presence in innovation in the automotive sector as the region engages in cutting-edge research, development and innovation in addition to basic car assembly and part manufacturing. However, the large players in Western and Northern Europe clearly remain the technological leaders.

Green patents in the transport sector in 2018

Chart B3

Number of green transport patents

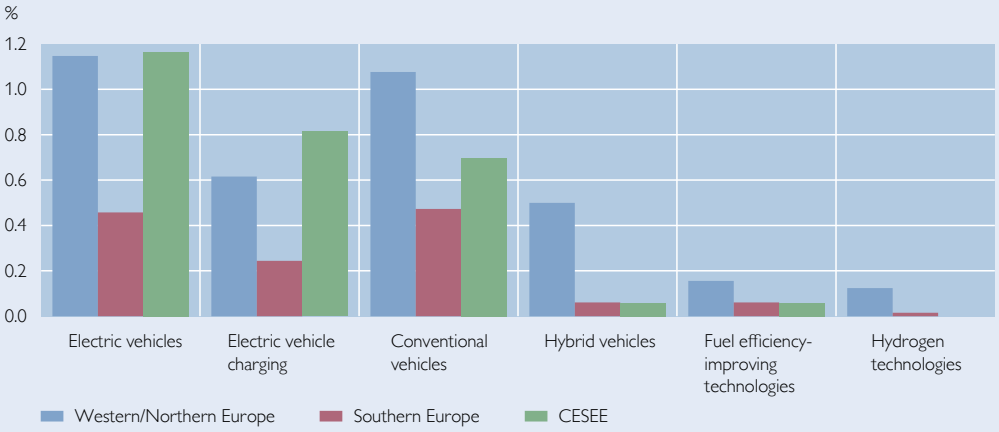


Source: Authors' calculations based upon PATSTAT (PCT) data in collaboration with ECOOM (Centre for R&D Monitoring, Leuven, Belgium).

Note: The classification of "green" domains is broadly based upon the methodology of Haščič and Migotto (2015). CESEE: Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. Southern Europe: Cyprus, Greece, Italy, Malta, Portugal and Spain. Western and Northern Europe: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, the Netherlands and Sweden.

Chart B4

Share of green transport patents in total patents



Source: Authors' calculations based upon PATSTAT (PCT) data in collaboration with ECOOM (Centre for R&D Monitoring, Leuven, Belgium).

Note: The classification of "green" domains is broadly based upon the methodology of Haščič and Migotto (2015). CESEE: Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. Southern Europe: Cyprus, Greece, Italy, Malta, Portugal and Spain. Western and Northern Europe: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, the Netherlands and Sweden.

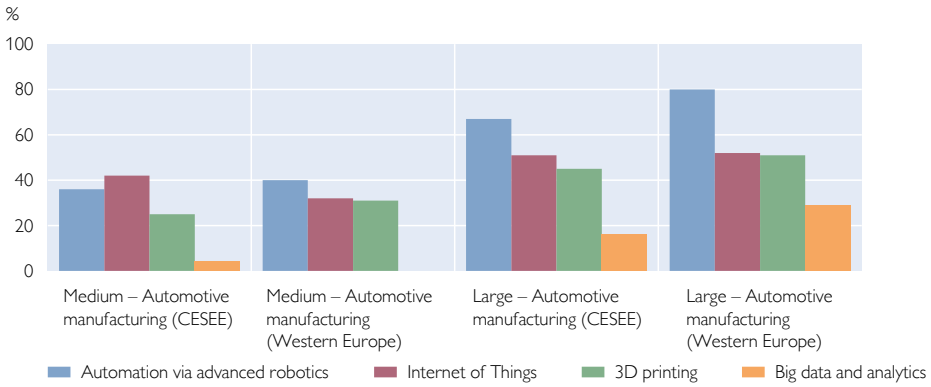
3 Transition in the automotive sector through firms' lens

The European Investment Bank's Investment Survey (EIBIS)[8] provides a unique opportunity to look at some aspects of the transition in the automotive sector – particularly those related to investment and investment financing issues – from the firms' perspective. This gives us a chance to better understand the firms' ability to undergo these changes. Automotive firms invest about two-thirds of their funds in tangible assets. Machinery and equipment take the largest share of investment (over 50%). Intangible assets such as capitalized R&D expenditures, software and patents account for 29% of automotive investment expenditures in CESEE, somewhat less than in the rest of the EU (33%) but more than in other industries in CESEE (24%). Automotive firms innovate and make substantial use of digital technologies, especially those more related with manufacturing processes, for instance in advanced robotics. Large firms, which are less common in CESEE, innovate

[8] *EIBIS is an EU-wide survey that gathers information mostly on investment and investment finance of SMEs and larger corporates. The survey covers approximately 12,000 firms across the EU-27, 600 in the United Kingdom and 800 firms in the United States. (The latter was covered only in the last two waves, which results in a rather small sample of US automotive firms. This is why the US observations are omitted from the analysis here). The sample used in the present paper contains 143 automotive firms from CESEE countries, 150 automotive firms resident in other EU countries or the United Kingdom (Western Europe) and 1,206 heavy manufacturing firms from CESEE. These firms were interviewed from 2016 to 2020 in five survey waves, some more than once. All firms in the sample have more than 50 employees, and about half of them have more than 250 employees. About 80% of firms from CESEE and about 60% of firms in the rest of the EU and UK supply automotive parts and components to car producers.*

Chart 7

Use of digital technologies in the automotive sector



Source: EIBIS 2016-20 and EIB staff calculations.

Note: The columns reflect the combined shares, in per cent, of the answers "Implemented in parts of your business" and "Organised entire business around it."

Q42c: Can you tell me for each of the following digital technologies if you have heard about them, not heard about them, implemented them in parts of your business, or whether your entire business is organized around them?

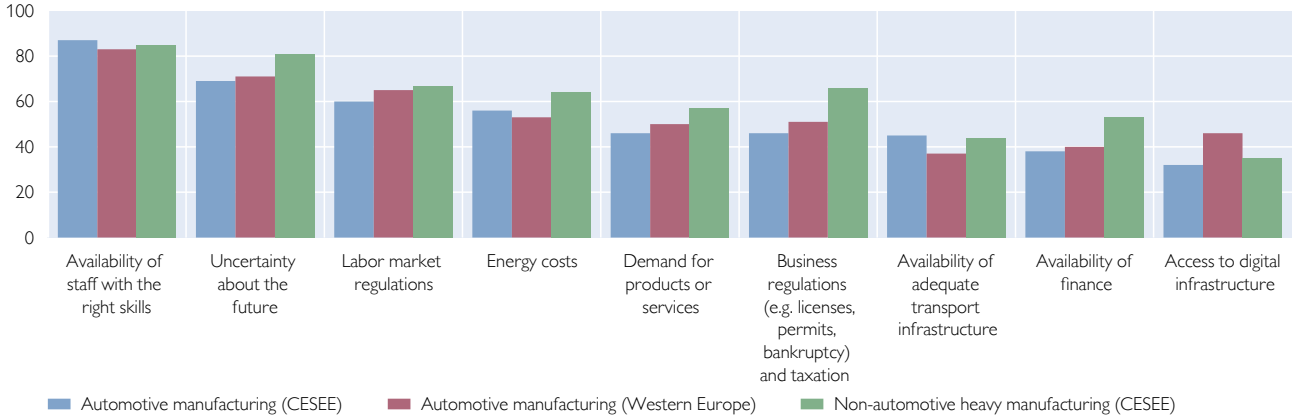
more and tend to make more use of digital technologies and other intangible assets (chart 7).

The survey also unveils that about two-thirds of investment finance comes from own funds, and the rest from external finance. While this distribution is similar in both CESEE and Western European automotive firms, there are significant differences in the structure of external investment finance. Nearly three out of four automotive firms in Western Europe source their external finance from bank loans, compared with only 62% in CESEE. About a quarter of external funding comes from leasing or factoring, both in CESEE and the rest of Europe. For the remainder in CESEE, grants are a significant source of funding. This is most likely

Chart 8

Investment barriers

% of respondents perceiving obstacles to investment



Source: EIBIS 2016-20.

Q38: Thinking about your investment activities, to what extent is each of the following an obstacle? Is it a major obstacle, a minor obstacle or not an obstacle at all? The columns reflect the combined shares of "a major obstacle" and "a minor obstacle."

related to more common eligibility for European Structural and Cohesion Funds (ESIF).

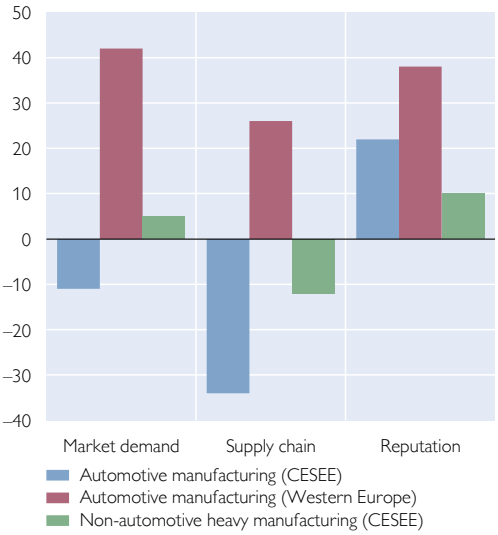
Lack of suitably qualified staff and uncertainty are the largest investment barriers all over Europe. In CESEE this holds true for both manufacturing firms in general and automotive firms in particular. However, companies are concerned also about the elevated uncertainty as well as the high energy costs (chart 8). Both in CESEE and Western Europe, the concerns expressed about uncertainty refer particularly to concerns related to (i) climate change impacts and new technologies to tackle that impact as well as (ii) regulatory conditions.

Indeed, climate change mitigation policies are having a substantial effect on the automotive industry. Most firms believe the transition towards more sustainable business may have a negative impact on demand and supply chains over the next five years, while their reputation might benefit. In this respect, CESEE auto firms are significantly more pessimistic than auto firms in the rest of Western Europe but also more than their peers in heavy industries (see chart 9). This pessimism probably derives from the fact that the automotive sector in CESEE is dominated by suppliers that are not as innovative as, and more financially constrained than, their peers in Western Europe. Furthermore, on their path toward climate transition they would need to not only reduce their production emissions but also change, in some cases significantly, their product line and business strategy.

Chart 9

Impact of climate transition over the next five years

Balance of positive and negative answers in %



Source: EIBIS 2020.

Note: The columns reflect the net balance of "positive impact" and "negative impact" answers.

Q58: What impact, if any, will this transition to a reduction in carbon emissions have on the following aspects of your business over the next five years?

4 Major macroeconomic impacts of car electrification on CESEE

The big trends in the automotive sector, car electrification in particular, are likely to have significant macroeconomic impacts on the CESEE economies, which have the potential to keep playing a significant role in the automotive industry. Structurally, the shift to e-mobility may not be driven exclusively by traditional automakers and well-established automotive firms but also by potential newcomers. These may be start-ups, big techs or firms from other geographical regions, particularly China whose firms are – with strong support from the Chinese government – eyeing massive expansion to Europe in terms of sales, production and R&D. Moreover, technological developments provide new opportunities for firms well beyond the automotive industry, such as those from the IT or chemical sectors.

Battery costs have declined significantly over the last decade on the back of economies of scale, innovation and improved production efficiency. On this ground they are largely expected to keep falling, but some experts also argue these factors have been all but exhausted (Michalek, 2021). Moreover, since the demand for raw

materials is set to increase sharply and outpace supply,[9] some caution regarding predictions about how fast and to what extent battery costs will continue falling is warranted as raw materials account for more than 50% of the battery costs. Hence, likely excess demand for raw materials, rising energy prices in the wake of efforts to combat climate change and geopolitical tensions as well as higher R&D expenditures are likely to make (real) prices of (both new and old) cars go up and thus less affordable for some consumers.

Fiscal costs of car electrification in the region have been limited so far but could rise noticeably. This is not only due to the large investment needs for infrastructure, energy production and transmission, but also possible fiscal support to nudge the uptake of electric cars among consumers on a mass scale. Furthermore, motor vehicles currently generate a significant share of governments' tax revenues,[10] the bulk of which comes from taxes on fuel and lubricants. Experience from pioneering countries in the realm of e-mobility thus suggests that putting the fiscal consequences of mobility electrification on a sustainable footing without jeopardizing the demand for electric vehicles turns out to be a rather tricky exercise for fiscal authorities.

One of the most significant impacts of the transition to e-mobility will be felt in the labor market as electric motors are much less labor-intensive than internal combustion engines. There are only few available estimates for the net job balance of powertrain electrification in Europe, let alone for CESEE. Nonetheless, irrespective of the net job balance, there is an unchallenged consensus that big trends in the car product market will entail massive structural transitions in the labor market between industries, job profiles and regions. According to CLEPA/PwC (2021) – a recent and possibly most comprehensive estimate – in a baseline scenario aligned with the European Commission's Fit for 55 proposal there will be up to 270,000 net job losses between 2020 and 2040 in the European automotive industry (see table 1).[11] The impact on employment in CESEE is likely to be mitigated or delayed because the region is expected – as mentioned above – to remain reliant on the production of internal combustion engine vehicles and parts for some time. As a result of the concentrated internal combustion engine production and lower investments in the automation of the outgoing technology, Czechia, Poland and Romania are expected to increase their automotive employment levels until 2025–2030. While Romania's car industry is projected to suffer a major employment drop

[9] *By way of example, the IEA (2021) estimates that demand for lithium for use in batteries will swell by a factor of 30, demand for rare earth elements used for making electric vehicle motors is projected to expand by a factor of ten by 2030. The booming demand for these metals will be met by constrained supply as opening up new mining operations is a long-term process with uncertain and volatile cash flows. Moreover, it is increasingly difficult to comply with environmental, social, governance and other regulatory standards (Bloch et al., 2018). In addition, there is considerable market concentration both among mining companies (Schneyer, 2011) as well as at country levels.*

[10] *Motor vehicles generate tax revenues totaling nearly EUR 400 billion in 13 key European markets (ACEA, 2020), mostly by means of taxes on acquisition (VAT, sales tax, registration tax), ownership (annual circulation tax, road tax) and motoring (i.e. taxes on fuels and lubricants). Belgium raises the highest average total tax revenues per vehicle followed by Austria. Cars thus contribute about 9.4% to the Belgian general government's overall revenues, 8% in Austria.*

[11] *It has to be borne in mind that even in the absence of the transition to e-mobility, trends like automation and the shift from manual to automatic gearboxes would most likely reduce employment in the automotive industry between 2020 and 2040. Hence, instead of comparing employment under a vehicle electrification scenario in 2040 to actual employment in 2020 a possibly fairer comparison would be between employment in 2040 under the electrification scenario and a counterfactual scenario without the transition to e-mobility.*

Table 1

Projected employment of full-time equivalents by the electric vehicle and internal combustion engine sectors

		2020	2025	2030	2035	2040
Germany	Internal combustion engines	132.7	134.3	105.3	10.5	10.5
	Electric vehicles	17.9	34.6	39.6	50.4	57.3
	Total	*150.6*	*168.9*	*144.9*	*60.9*	*67.8*
Italy	Internal combustion engines	72.9	73.8	6.6	6.6	6.6
	Electric vehicles	1.1	3.7	5.0	7.4	8.2
	Total	*74.0*	*77.5*	*11.6*	*14.0*	*14.8*
France	Internal combustion engines	24.0	24.3	2.1	2.1	2.1
	Electric vehicles	3.8	12.0	15.7	27.0	29.4
	Total	*27.8*	*36.3*	*17.8*	*29.1*	*31.5*
Spain	Internal combustion engines	70.0	70.9	99.0	6.5	6.5
	Electric vehicles	2.0	18.9	28.1	37.4	39.4
	Total	*72.0*	*89.8*	*127.1*	*43.9*	*45.9*
Czechia	Internal combustion engines	37.0	37.5	25.4	33.3	16.9
	Electric vehicles	3.7	11.6	15.2	21.7	23.9
	Total	*40.7*	*49.1*	*40.6*	*55.0*	*40.8*
Poland	Internal combustion engines	51.7	52.3	68.8	49.7	25.3
	Electric vehicles	3.5	9.4	12.3	17.0	18.7
	Total	*55.2*	*61.7*	*81.1*	*66.7*	*44.0*
Romania	Internal combustion engines	54.0	54.7	71.2	4.6	4.6
	Electric vehicles	2.2	13.2	16.8	22.1	24.0
	Total	*56.2*	*67.9*	*88.0*	*26.7*	*28.6*
EU-27	Internal combustion engines	599.3	606.8	512.7	153.4	98.3
	Electric vehicles	46.2	139.9	179.6	247.9	272.2
	Total	*645.5*	*746.7*	*692.3*	*401.3*	*370.5*

Source: CLEPA/PwC (2021).

thereafter as a result of the shutdown of internal combustion engine production, Poland and Czechia will experience a more gradual decline. Moreover, Czechia in particular is expected to see a strong increase in electric vehicle-generated value added from 2030 on, to the extent that overall employment levels by 2040 could be broadly similar to those of today (see table 1).[12] While Hungary was not covered by the study, its internal combustion engine sector is also sizeable.

5 Conclusions and policy implications

CESEE countries have benefited a great deal from the eastward shift in the automotive industry over the last two decades, which has brought large investments and made several CESEE countries important parts of automotive production and supply chains. More recently, the automotive industry has suffered multiple parallel blows by cyclical and one-off shocks, which came on top of big structural trends on the demand and supply side, in particular the transition to electric vehicles. The latter brings significant opportunities for the CESEE region not only with respect to the production of electric vehicles but also in the associated crucial battery industry. While the CESEE countries are fully involved in these trends, they are

[12] *Estimates of the impact of the transition to electric vehicles on employment are sensitive to assumptions on the insourcing/outsourcing of batteries. All estimates by CLEPA/PwC (2021) have been made on the assumption that there will be a full battery value chain based in Europe, from the processing of raw materials to the final battery assembly. Battery production is thus expected to account for 70% of the electric powertrain value added and will as such be indispensable for employment in Europe.*

likely to trail behind the Western European countries when it comes to the adoption of the new technologies and thus the transition of the industry, bringing both advantages and disadvantages. The impact of mobility electrification on the future structure and macroeconomic performance of CESEE economies thus seems ambiguous.

For CESEE countries to maximize the benefit from the electric vehicle revolution, the key priority is to preserve close links with Germany – the emerging global e-mobility hub – and stay tuned for battery production. To overcome the functional specialization trap of CESEE economies in general and of their automotive industry in particular, it is vital to attract FDI and activities with higher value added. Hence, while keeping the importance of the automobile industry and its new trends in mind, it is essential for CESEE economies to diversify and address risks by refocusing their attention on other promising sectors and industries of the future. The IT and chemical sectors, digitalization and robotization are among the most promising areas. To address the businesses' major concerns and support future sources of economic growth, governments should concentrate on supporting the development of the required human capital and – in view of the rising electricity demand and costs – on the provision of affordable sustainable energy sources.

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Russia's large fintechs and digital ecosystems – in the face of war and sanctions

Katharina Allinger, Stephan Barisitz, Andreas Timel[1]

Russia's financial landscape has changed rapidly in recent years, with the lines between banks and tech firms ever more blurring and giving rise to large fintech firms. We are going to look at these changes from a perspective before and after Russia's invasion of Ukraine in February 2022. Pre-war, tech firms such as Yandex or VK and financial firms such as Sberbank started diversifying into each other's business by broadening service offers to consumers via so-called digital ecosystems. From an international perspective, two things stand out: first, with Sberbank, Russia's largest bank is attempting to fully rebrand itself as a technology company. Second, the Russian government facilitates these developments both directly and indirectly, e.g. by pushing the country's digital transformation while simultaneously exercising more control over foreign tech firms. From a post-invasion perspective, international sanctions pose several challenges to large fintech firms; and so do economic and geopolitical developments. Going forward, the firms will face major issues in advancing their digital ecosystems. As to technology-related sanctions, we show that Russia continues to substantially depend on technologies from abroad, despite pre-war efforts to reduce this dependence. Russia's economy in general and its tech and fintech firms in particular are thus vulnerable to international technology sanctions. As to sanctions evasion, particularly through crypto assets, we currently see limited potential for circumvention. Clearly, sanctioning countries need to perceive sanctions as a dynamic tool that they must adjust regularly to address potential loopholes and circumvention tactics.

JEL classification: G20, G28, O30, F51
Keywords: fintech, digital ecosystems, Russia, sanctions

Fintech[2]-driven innovations and changes in the financial system have attracted much attention among policymakers and researchers. As many fintech studies focus on countries like the USA and China, it is not widely known that the Russian financial market has, in recent years, likewise seen a fast pace of financial inclusion, digitalization and adoption of fintech services (CBR, 2021c; Melkadze, 2021). Noteworthy fintech developments in Russia include (1) the growing scene of smaller fintechs, (2) the blurring lines between large financial institutions and tech firms, (3) the relatively sizeable crypto economy and (4) a digital ruble pilot recently launched by the Central Bank of the Russian Federation (CBR). The relatively advanced stage of fintech adoption in Russia may be explained by numerous factors. Among other things, banks have embarked on a digitalization drive and tech firms have started to enter finance. Russia has a strong base of science and tech graduates, and the CBR and the Russian government have taken an overall supportive stance on digitalization (see Ernst & Young, 2019; Switzerland Global Enterprise, 2021).

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[2] *We define "fintech" broadly and in line with the European Commission as "technology-enabled innovation in financial services that could result in new business models, applications, processes or products" (see e.g. "FinTech Action plan" EUR-Lex - 52018DC0109 - EN - EUR-Lex (europa.eu)).*

However, Russia's invasion of Ukraine on February 24, 2022, with its far-reaching political, economic and humanitarian consequences around the globe and in particular in Ukraine and Russia, is set to leave its mark on Russia's fintech developments. We try to balance the pre- and post-invasion view[3] regarding one particular fintech development, namely the rise of fintech conglomerates in Russia and their digital ecosystems. Digital ecosystems include many different services (and potentially platforms[4]) which people may access via one single process, often with an app as customer interface (for an illustrative example, see figure 1) (World Bank, 2018). The financial system in Russia has been moving toward competing digital ecosystems. Such ecosystems are being built either by tech firms adding financial services to their offer (e.g. Yandex NV) or by banks diversifying their nonfinancial service portfolio (e.g. Sberbank of Russia PJSC). While the rise of digital ecosystems is not unique to Russia (see e.g. China's WeChat/Tencent or Alibaba), few countries have seen such fast progress over recent years as Russia. The aggressiveness with which Russian banks have embarked on this transformation is, however, rather unique. Particularly Sberbank, Russia's largest bank, stands out, as it aims to become a consumer technology company.

Throughout this study, when we discuss "large fintechs," we refer to businesses building digital ecosystems that include financial services. This way, we set them apart from the broader space of mostly smaller fintechs. We focus on them for two reasons. First, from a research perspective, it is exciting to examine the fast-changing financial landscape and aggressive tech expansion of Russia's largest banks as well as the regulatory challenges that this transformation entails. Second, these firms play a major role in Russia's economy given their significant size. In addition, they are now affected by difficulties at both a financial and a technological level, e.g. through sanctions and other, partly related, disruptions.

The study is structured as follows: in section 1, we provide a brief overview of digitalization in Russia and its impact on fintech developments. The latter have been strongly influenced by the Russian government's aim to transform Russia into a global digital leader, with a view to achieving digital sovereignty and reducing technological dependence on foreign countries, particularly the USA. In section 2, we discuss Russia's digital ecosystems and regulatory risks identified internationally and by the CBR. In section 3, we look at the digital ecosystems and their providers in the light of international sanctions and challenges. Given their relevance for both fintech players and the Russian economy in general, we zero in on technology-related sanctions. We also briefly discuss the potential for sanctions evasion. Section 4 concludes.

1 Murky outlook for Russia's ambition to become a global digital leader

Russia's government is keen to become a major digital player on a global scale. We analyze some of the motives behind this ambition, focusing on the government's drive to reach digital sovereignty.

[3] *Throughout the study, "war" refers to the military conflict that resulted from Russia's invasion of Ukraine on February 24, 2022. The cutoff date for this study was end of April 2022, but we integrated selected important developments until mid-June 2022 during the revision process. Given the fast-changing environment and complexity of the topic, we would like to note that this study has been done on a best-effort basis.*

[4] *Digital platforms are information systems catalyzing multisided marketplaces. Value is created as producers and users interact (World Bank, 2018) – a famous nonfinancial example is Booking.com.*

1.1 Still much to catch up on top innovators

Russia's overarching goal of becoming a global digital leader also encompasses innovations in finance. According to a report published by the World Bank (2018), digital transformation had become a top priority for Russia's government, with Russia having successfully created both digital and nondigital factors to support its digital transition – even though work remained to be done in certain areas.

The projects and initiatives launched by the Russian government include "The National Digital Economy Programme of the Russian Federation" and the "National Strategy for the Development of Artificial Intelligence for the period until 2030" (for further examples, see European Commission, 2021). On the upside, Russia has made great strides in some areas, e.g. in providing both e-government and payment systems, reportedly outstripping some Western countries (The Economist, 2022b). On the downside, the Russian government has to date failed to make substantial progress on several initiatives and targets. Cases in point are the aim to increase the share of high-tech exports or gross domestic expenditures on research and development (Epifanova and Dietrich, 2022).

Table 1 summarizes some composite indicators related to fintech, innovation and the business environment in Russia. Based on this evidence, Russia is performing quite well relative to its peer countries, here defined as the BRICS countries Brazil, India, China and South Africa. Russia tops, or at least matches, the performance of Brazil, India and South Africa[5] on most indicators, but fares mostly worse than China. However, Russia's overall rank suggests that there is still substantial

Table 1

Russia's rank in fintech and innovation-related indices relative to BRICS countries

	Russia	Brazil	India	China	South Africa	Number of countries/ cities	Russia's rank 3 years previously[1]
Country indices	*Rank*[2]						
Ease of Doing Business (World Bank), 2020	29	124	62	32	84	190	40/190
Global Competitiveness Index 4.0 (World Economic Forum), 2019	43	71	68	28	60	141	43/138
Global Innovation Index (GII) (World Intellectual Property Organization), 2021	45	57	46	12	61	132	46/129
Fintech adoption rate (Ernst & Young, 2019), 2019[3]	3	16	1	1	3	27	n.a.
The Global Fintech Index (Findexable), 2021	19	14	23	15	44	83	32/65
City indices[4]							
The Global Fintech Index (Findexable), 2021	18	4	13	9	97	264	30/238
IFZ Fintech Study (IFZ, 2021), 2021	31	34	33	9	32	35	26/30

Source: Authors' compilation.

[1] *Global Innovation Index: comparison with 2019; Global Fintech Index: comparison with 2020; given availability.*
[2] *Colors indicate relative ranking among the BRICS countries from green (best rank) to red (worst rank).*
[3] *Identical scores (e.g. China = India = 87%) are shown as the same rank.*
[4] *The highest-ranking cities of the BRICS countries are Moscow, São Paulo, New Delhi (Findexable)/Mumbai (IFZ), Hong Kong and Cape Town.*

Note: BRICS stands for Brazil, Russia, India, China and South Africa.

[5] *And of many other upper-middle-income countries not shown in the table.*

room for improvement and catch-up with the highest-ranking, mostly high-income, countries. The country's recent progress in innovation and competitiveness rankings has been more limited than in broader "doing business" or fintech indices (see last column of table 1)[6].

Note that, beyond indices and rankings, Russia is one of only few countries globally that has its own information and communications technology (ICT) champions. For instance, the search engine of Yandex is nearly as popular as Google. The social media platform VK belonging to VK Company[7] (VK) is more popular than Facebook/Meta[8]. Wildberries is Russia's leading enterprise in e-commerce, followed by Ozon, whereas in many other countries Amazon is the undisputed leader. Kaspersky Lab is the local no. 1 for cybersecurity services (Collman, 2021; Epifanova and Dietrich, 2022).

1.2 Reaching digital sovereignty – an important goal of Russia's government

In advocating digital transformation, the Russian government pursues different goals. Among other things, it wants to foster economic development and efficiency, but for geopolitical reasons it also strives for digital sovereignty. The term "digital sovereignty" has recently gained importance in policy discussions, but its interpretation varies. Germany, for instance, has put the emphasis on self-determination in shaping the digital transformation. For Russia, as Litvinenko (2021) argues, digital sovereignty is about controlling the flow of data and discourse within Russia.

This "control motive" ties in with Russia's legislation on the internet becoming ever more restrictive, which, according to researchers, started around the political protests of 2011–12, in which the internet and social media played an important role (Litvinenko, 2021; Epifanova and Dietrich, 2022). Legislation passed in the last decade[9] – for instance, the heavily criticized "sovereign internet law" in 2019 – has aimed to increase the Russian government's ability to monitor and control the data flow within Russia. Such legislation has also extended to and affected the operations of international big tech companies such as Google or Facebook/Meta in Russia (Ilyushina et al., 2019; Epifanova and Dietrich, 2022). Russia's government has successively built – and repeatedly used – the technological and legal tools to fine or even (temporarily) ban these companies from the Russian market if they failed to comply with Russian laws, e.g. related to storing data on Russian territory or establishing representative offices in Russia (AFP, 2021; Seddon, 2021). Since the start of the war against Ukraine, Russia has further tightened its control over information spread in Russia (Barker and Tiirmaa-Klaar, 2022)[10].

Also, while promoting national ICT champions and solutions, the Russian government has also taken action to maintain some control over these ICT companies,

[6] *However, it is difficult to compare and interpret these indices over time, as both methodologies and samples change and the indices mostly measure relative and not absolute progress.*

[7] *Formerly known as Mail.ru Group – a rebranding to VK occurred in October 2021.*

[8] *According to VK's Q4 2021 investor presentation, the VK social network had 72.5 million monthly active users, while Statista.com reported that Facebook had roughly 66 million users in Russia before the invasion. This figure does not include WhatsApp and Instagram, which also belong to Meta and had large active user bases before the invasion.*

[9] *See Litvinenko (2021) for a detailed discussion of the origins and evolution of the Russian government's increasingly strict legislation and control of the internet in Russia.*

[10] *Note that EU countries have also closed Russian websites and banned Russian TV channels.*

some of which are internationally active and/or incorporated. For instance, in December 2021, entities affiliated with state-owned Gazprom acquired a controlling stake in VK Company, which is listed on the London stock exchange and owns Russia's largest social media platform VK (Epifanova and Dietrich, 2022). In 2019, Yandex agreed to adapt its governance structures, de facto guaranteeing that it remains under Russian control[11], even though Yandex is listed on Nasdaq, incorporated in the Netherlands and operates on global markets (Seddon, 2019).[12]

Moreover, the "control motive" also translates into the Russian government's aim to become less technologically dependent on other countries, particularly the USA. Thus, instead of simply promoting high-quality ICT services regardless of their origin, the Russian government has in many instances favored national solutions.

In this context, the aim to innovate and modernize has occasionally clashed with the aim to control and foster national solutions. Innovation tends to benefit from open and unrestricted cross-border competition and exchanges of information, products and services. This contrasts with action taken to foster digital sovereignty, such as tightening control of the internet, or with other measures meant to restrict the exchange of information or access to technology. For instance, Russia has obliged its national ICT champions to preinstall national versions of apps on mobile phones sold in Russia (Seddon, 2021), while simultaneously tightening legislation on foreign big techs. Ever stricter controls and monitoring of internet traffic and related regulations have made it more difficult and unattractive for foreign big techs to expand their offers in Russia, and has even pushed some companies out of the market. Such action can reduce the choices available to Russian consumers, some of whom might want to use services not affiliated with the Russian government.

Another example in this context is import substitution. Governments tend to resort to it to promote national firms and industry development. Yet, import substitution can come at the cost of – at least initially – using products and services that are of lower quality and/or cost more than available foreign alternatives – the typical infant industry dilemma. The Russian government has also used import substitution to promote national tech industries. For instance, it decided that only domestic systems and software were to be used to build Russia's 5G infrastructure. The government thus awarded a contract to state-owned Rostec, even though up to that point Russia had almost fully relied on telecommunications imports and Russian companies lack experience in the mass production of 5G equipment (Epifanova and Dietrich, 2022). Such import substitution is risky given that the 5G infrastructure is critical for operating and developing innovative services.

2 Border between technology and finance is blurring in Russia

What has certainly fueled the rise of Russian fintechs are (1) the supportive stance of both the Russian government and regulators coupled with (2) investments and initiatives to promote domestic ICT developments and (3) a cautious stance toward foreign big techs. At the same time, the government's drive for digital sovereignty may have weighed on innovations and fintechs overall. As the Russian financial

[11] *Between 2009 and 2019, Sberbank held a "golden share" in Yandex, which allowed Sberbank to effectively veto transactions involving more than 25% of Yandex's stocks.*

[12] *We refer to these companies as Russian tech firms throughout the study given their history and influence structures, even though some are not incorporated in Russia. This also seems to be in line with market perceptions and actions taken by these firms after the start of the war (see section 3).*

market has started to increasingly use platforms and digital ecosystems[13], the border between tech companies and financial institutions has become blurred.

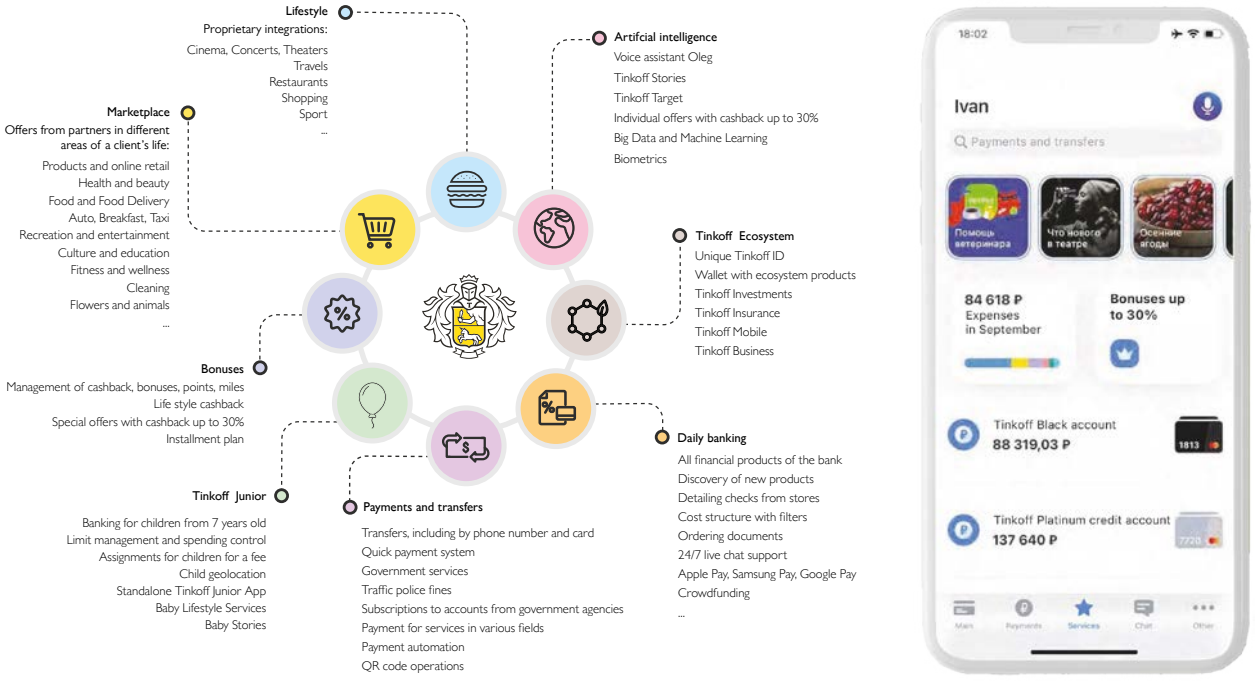
2.1 Large fintech companies launch digital ecosystems

For finance and banking in Russia, the emergence of digital ecosystems has been a two-way street: large Russian tech companies have moved into finance and financial intermediaries have started to diversify. Both have been creating digital ecosystems that offer a multitude of services to customers, including financial services (see figure 1 for an example).

Similar to other countries, large tech players in Russia have expanded into finance. A case in point is Yandex, which after a decade-long partnership with Sberbank, which soured, finally acquired Acropol Bank in July 2021. In August 2021, Yandex.Market started a partnership with Tinkoff Bank to offer loans to businesses selling on the platform. Following Chinese examples (e.g. WeChat/Tencent or Alibaba App), VK recently launched a "super app" for private and work purposes, which also includes its VK pay services. VK currently largely partners with financial institutions, e.g. Chinese banks and Sberbank, to offer financial services. Other firms that have started expanding their offerings and diversifying toward financial services are MTS (core business: telecommunications) and Ozon and Wildberries (core business: e-commerce; both recently acquired banks). In table 2, the firms discussed in this section are marked in bold.

Figure 1

Example of a digital ecosystem: Tinkoff Super App ecosystem



Source: Tinkoff (2021).

[13] *See footnote 4 for definitions.*

Table 2

Selected Russian banks by size and owner[1]

Rank by total assets	Name of bank	Approximate market share (%)	Total assets (EUR million)	Immediate parent/global ultimate owner	Country of ultimate owner
1	**Sberbank of Russia**	34.0	399,879.616	Ministerstvo Finansov Rossiiskoi Federatsii/ Russian government	RU
2	**VTB**	17.0	200,128.364	Federal Agency for State and Property Management/ Russian government	RU
3	Gazprombank	7.1	83,071.450	Federal Agency for State and Property Management/ Russian government	RU
4	Alfa-Bank	4.4	51,878.333	AB Holding/ABH Holdings	RU
5	Otkritie Financial Corporation	3.3	38,295.997	Central Bank of the Russian Federation/ Russian government	RU
6	Russian Agricultural Bank OJSC	3.6	42,136.451	Federal Agency for State and Property Management/ Russian government	RU
7	Credit Bank of Moscow	2.7	32,194.662	Rossium Concern/Avdeev Roman Ivanovich	RU
8	Promsvyazbank	2.6	30,961.255	Federal Agency for State and Property Management/ Russian government	RU
9	AO Raiffeisenbank	1.4	16,246.098	Raiffeisenbank International AG	AT
10	UniCredit Bank AO	1.2	14,300.739	UniCredit SpA	IT
11	Rosbank	1.3	15,117.462	Interros Capital (pre-war: Société Générale)	RU
12	Sovcombank OJSC	1.4	16,363.088	n.a./Sovcombank OJSC	RU
13	DOM.RF JSC	1.2	14,691.204	Federal Agency for State and Property Management/ Russian government	RU
14	Bank Rossiya OAO	1.2	13,575.850	Bank Rossiya OAO	RU
15	Bank Saint Petersburg PJSC	0.7	8,077.445	Bank Saint Petersburg PJSC	RU
16	SMP Bank LLC	0.6	7,540.419	SMP Bank LLC	RU
17	**Tinkoff Bank**	0.8	9,478.955	TSC Group Holding PLC	CY
…					
37	**OJSC MTS Bank**	0.2	2,375.607	Mobile Telesystems B.V./Mobile Telesystems PJSC	RU
…					
274	**LLC Ozon Bank***	0.0	4.655	Internet Resheniya OOO (trades as Ozon) acquired Onei Bank OOO in 2021	RU
…					
313	**Yandex Bank JSC*** (previously Akropol Bank)	0.0	13.713	Yandeks.Market Lab/Yandex N.V.	NL
…					
356	**Wildberry Bank LLC***	0.0	7.749	Bakalchuk Tatyana Vladimorovna	RU

Source: BankFocus Bureau van Dijk (BvD), Central Bank of the Russian Federation.

[1] *Banks discussed in section 2.1 are marked in bold.*

*Note: Information on banks from BvD on consolidated level for 2020; if unconsolidated: bank name marked with *. Data as reported by BvD: differences between 2020 consolidated total assets and the rank could stem from the data point and consolidation method underlying the country ranking. Market share in % is an approximation using total assets of monetary financial institutions (MFIs) as reported by the Central Bank of the Russian Federation. Given rapid shareholder and ownership changes (see section 3), the table may not contain all recent changes.*

Interestingly, some Russian banks have expanded into technologies more aggressively than their peers in other countries.[14] First and foremost, Russia's largest bank, Sberbank, rebranded itself as "Sber" in 2020, and announced its aim to become a major consumer technology company. In the first half of 2021, Sberbank invested about USD 1 billion toward this aim, e.g. via its research labs dealing, among other things, with robotics, blockchain and artificial intelligence (AI) and via acquisitions[15]. Note that Sberbank has been one of the main drivers of AI development in

[14] *Even though investments in new technologies and other areas have become more common also in financial industries of other jurisdictions.*

[15] *See, for instance, Acquisitions by Sberbank | Tracxn.*

Russia (The Economist, 2022b). On top of this, Sberbank has created its own ecosystem, expanding into business areas where Yandex and VK have been active for years. Pre-invasion, Sberbank's target was to earn a particular share of its net operating income from its nonbank ecosystem holdings, namely 5% by 2023 and around 30% by 2030.[16] Another bank working hard on building a diversified ecosystem is Tinkoff Bank, Russia's fast-growing largest digital bank. Founded in 2006 and following a rapid expansion, it is now Russia's third-largest retail bank.[17] Tinkoff Bank was listed as a systemically important financial institution by the CBR in October 2021. In December 2019, it launched what it called "Europe's first Super App," which includes a broad range of financial, leisure and lifestyle services offered by Tinkoff and its partners (see figure 1).[18] Russia's Digital Development and Communications Ministry lists Tinkoff Bank and several of its subsidiaries as information technology companies (Interfax, 2022). VTB, Russia's second-largest bank, has likewise announced its plan to expand into other key industries.

The digital ecosystems of Russian tech and financial companies are quite diverse because they have largely been built around the core business of the respective companies, be it financial services for banks, or social media, search engine data, e-commerce and the like in the case of tech companies. In 2021, the core business areas still accounted for the bulk of revenues, with newer business areas growing fast. Ecosystems also differ in that some companies diversify mostly by offering partner services, while others launch new services of their own. Most companies invest in advanced technologies, including AI and robotics, and they partner with or buy innovative start-ups, but the extent of such investments varies. The demand for digital ecosystem apps in Russia is strong: in the first eight months of 2021, Ozon's, Wildberries' and Sberbank's apps were downloaded 9 million times (in Russia) on major app stores, while the apps of VK, Yandex.Go (Yandex's taxi and delivery app) and Tinkoff were downloaded 7 million times (Tinkoff, 2021).[19]

2.2 Fintech digital ecosystems bring new regulatory challenges

In various countries, the rise of platforms and ecosystems offering financial services has attracted the attention of regulators, mostly as a result of big techs entering the financial sector. Big techs and platforms thrive on data analytics, network externalities and interwoven activities (abbreviated as DNA). Taken together, these activities create a positive feedback loop. Network externalities means that more users make a service more valuable for existing users. This leads to more data being generated that can be used in data analytics and commoditized and/or fed into additional services that, in turn, create more value for users of the platform or ecosystem. This business model gives rise to specific benefits and risks (Bank for International Settlements, 2019; Zamil and Lawson, 2022).[20]

[16] *See, for instance, Sberbank's Investor Day Presentation "Strategy 2023": Презентация PowerPoint (sberbank.com).*

[17] *In terms of total assets, it is currently Russia's 17th-largest bank, according to rankings by BankFocus/Bureau van Dijk.*

[18] *See Tinkoff history: milestones in the Company's development (tinkoffgroup.com).*

[19] *To put these figures into perspective: in the same period, TikTok's and Telegram's apps were downloaded 15 million times, WhatsApp and Instagram 10 million times and YouTube 3 million times.*

[20] *Please note that a comprehensive discussion of risks and benefits is beyond the scope of this study. Readers interested in learning more about this topic may consult the excellent reports cited in this section.*

For consumers, platforms and digital ecosystems can have economic benefits, including a greater offer of goods and services, lower costs as well as ease of access, i.e. one login, many services. Businesses, in turn, may reach more customers without establishing costly branch networks; they may moreover share rules and expenditures, e.g. for customer support and logistics (CBR, 2021a). Platforms and digital ecosystems can also be important tools for promoting cross-sectoral digital transformation (World Bank, 2018). Over the past years, innovative financial services offered on digital ecosystems are likely to have contributed to the fast digitalization of finance in Russia.

However, the CBR (2021a) has also echoed concerns known from the broader international discussion on this topic. For reasons of scope, we only focus on selected key risks: (1) market concentration and domination, (2) deteriorating profitability of financial services, and (3) contagion and business risk.

First, market concentration is a major concern given that in the past platforms have occasionally shown very fast growth, not least due to the network effects implicit in their business models. Brits et al. (2021) argue that, beyond "standard" concerns about market power and competition, three types of concentration risk are particularly relevant for the financial sector: concentration of services, distribution and data. Concentration of services means that financial institutions offering more and more digital services might become dependent on a small set of providers of certain widely used technologies, such as cloud services, AI or software. This could lead to systemically important cyber risks. To address these risks, it will be necessary to revise regulations, e.g. regarding the definition and treatment of outsourcing and a greater focus on contractual relationships between financial and nonfinancial companies. As many companies based in sanctioning countries have restricted their business with Russian entities (see section 3), concentration of services might increase quickly in Russia given that the number of companies that may supply certain key technologies is limited.

Concentration of distribution refers to certain companies, platforms or ecosystems dominating the customer relationship, in particular the front end. This could hamper financial service providers' ability to appropriately manage and assess risks relating to customers. Moreover, it could also have repercussions for trust along the financial value chain. If a "super app" or particular services offered within the app suffer from reputational damage, e.g. data leaks or misselling, this could spread to the broader ecosystem. This may damage the trust in the financial system regardless of whether the financial institution is involved in the affected ecosystem via a partnership model or as the provider of the front-end app (Brits et al., 2021).

Data concentration amplifies the risks of concentration of services and of distribution. In this context, it is also important to ensure that concentration of data does not lead to a buildup of entry barriers or to data misuse – for instance in the form of price discrimination or exclusion of high-risk groups from certain markets, such as insurance (Bank for International Settlements, 2019). In Russia, given the high share of state ownership and control, data could also be used by publicly owned firms for political purposes.

Second, ecosystem providers could start subsidizing their banking business with profits from other ecosystem services to gain more customers. Given the abovementioned DNA loop of digital ecosystems, banking services could function as a "hook" to generate more data that are then commoditized in other ways within

the ecosystem. This could undermine the profitability of stand-alone financial services, making it more difficult for financial institutions not involved in ecosystems to sustain their profitability (CBR, 2021b; Zamil and Lawson, 2022).

Third, another concern for the CBR (2021b) and other regulators are contagion and business risk, for instance, through concentrations of immobilized assets[21]. Such assets are mainly investments in equity and hybrid instruments, tangible assets and intangible assets. From a regulatory perspective, such assets entail risks for banks as they (1) do not create predictable cash flows, (2) cannot be used as collateral to obtain liquidity, (3) often have ill-defined valuations for lack of a liquid market for these assets and (4) occasionally, e.g. in the case of equity investments in start-ups, can be subject to high impairment risks. As such, they are usually subject to specific treatment when it comes to calculating regulatory capital. For instance, regarding investments in nonfinancial businesses, many countries worldwide have been much stricter than Russia. Some countries, e.g. the USA, have even completely banned investments by banks in nonfinancial businesses. In light of increased ecosystem investments, which are a particular form of immobilized assets, the CBR (2021d) has been working on tightening regulation on such assets in Russia.

Benefits and risks clearly vary across ecosystem providers and depend on the characteristics of the ecosystem. Companies pursuing partnership models may, for instance, be less prone to a concentration of immobilized assets on their balance sheets. Moreover, the abovementioned risks and benefits are not unique to Russia. They have also been discussed and analyzed in the context of other countries and have led to regulatory changes (e.g. Bank for International Settlements, 2019; Zamil and Lawson, 2022). However, in Russia, some risks, such as risks spilling over from financial services to the tech business and vice versa, may now be manifesting themselves faster than the CBR initially expected, amid technology-related and financial sanctions as well as the general economic turmoil that is hitting the different business areas of integrated fintech firms. Fortunately for Russia, ecosystem development is still in its infancy. Moreover, the CBR started to analyze risks early and was planning several new regulatory measures pre-invasion. The measures include regulating investments in immobilized assets, discussing an adjustment of the internal capital adequacy assessment process (ICAAP) and classifying banks operating large, diversified ecosystems as systemically important banks (CBR, 2021b).

3 Outlook for digital ecosystems has changed radically due to war in Ukraine and sanctions

In the following subsections, we discuss some recent challenges faced by digital ecosystem providers. The issues relate to international sanctions and the broader economic and geopolitical environment[22]. The changes are not only interesting from a regulatory perspective, but also from an economic perspective, given the considerable size and significance of the fintech conglomerates operating in the financial and technology sector of the Russian economy. Five years from now, Russia's digital ecosystems and their providers will look very different from what they would have looked like had there been no war in Ukraine.

[21] *The official term the CBR uses for these assets.*

[22] *Given the rapidly changing environment and complexity of the topic, this section is necessarily incomplete. Please also note the cutoff date mentioned in footnote 4. Regarding sanctions, the interested reader could consult other sources listing sanctions, such as Russia Sanctions Tracker | Ashurst and Russland FAQ: Informationen für Unternehmen - WKO.at (in German only).*

Note that at the time of writing, of the companies discussed in section 2.1 (Sberbank, VTB, Tinkoff Bank, Yandex, VK and MTS, Ozon and Wildberries), only VTB and Sberbank have been directly sanctioned by the EU or USA.[23] Companies not directly sanctioned are likely to have taken or take mitigating action as they might face sanctions in the future. Plus, such companies may be affected in other ways, e.g. via sanctions on individuals (leading to reorganizations of management) or sanctions on the import of certain goods and services into Russia (see below).

3.1 Financial sanctions likely to have largely indirect effects on digital ecosystems

Financial sanctions usually aim at restricting the ability of certain entities to obtain international financing or to access foreign assets. In the case of financial institutions, they can extend to financial transactions with entities of the sanctioning jurisdiction. Sanctions related to SWIFT, the global payment messaging system, may even severely limit all international financial transactions of the sanctioned institution. Indirectly, it also becomes more difficult for clients of the targeted financial institutions to effect financial transactions. As of mid-June, the USA and the EU have published long lists of financial and nonfinancial entities that are subject to financial sanctions. Ten banks have been excluded from SWIFT, namely Bank Otkritie, Novikombank, Promsvyazbank, Bank Rossiya, Sovcombank, Vnesheconomobank (VEB), VTB Bank, Sberbank, Credit Bank of Moscow and Joint Stock Company Russian Agricultural Bank, i.e. JSC Rosselkhozbank.

Financial sanctions are impacting targeted entities through three major channels: (1) reduced access to funding from foreign entities and international capital markets, (2) transactions with foreigners and/or in foreign currencies are difficult or even impossible, which reduces the ability to offer goods or services abroad, and (3) confidence effects, also related to the impact of (1) and (2) on firms' available liquidity. All three effects combined have certainly weighed on Russian banks' foreign operations. For instance, in early March, European regulators ordered that Sberbank Europe be dissolved and its subsidiaries be dissolved or sold over liquidity concerns. Financial institutions face an additional important channel: deteriorating macroeconomic conditions lead to issues in the private sector that lower the asset quality on bank balance sheets.[24]

However, while financial sanctions can be very powerful, several factors still mitigate their effects in Russia. For example, as long as some Russian banks have access to SWIFT, banks can transact with the rest of the world via the nonexcluded banks. Crypto assets have also been widely cited as a potential circumvention mechanism (see section 3.4). Finally, while SWIFT is an extremely important messaging system, it is not the only system. A case in point is a transaction system ("System for Transfer of Financial Messages"), which Russia developed in response to sanctions imposed in 2014 related to the conflict in Crimea, which it can now use to reroute national transactions.

As digital ecosystems in Russia are rooted in the domestic financial system, financial sanctions are likely to have only limited direct effects on the operation of

[23] *Some companies, however, face sanctions from individual countries (e.g. Wildberries is on Poland's national sanctions list) or have seen certain services banned in selected countries (see, for example, Yandex/Estonia below).*

[24] *Based on existing research on financial sanctions and their macroeconomic effects, the current financial sanctions are likely to contribute to a deterioration of macroeconomic conditions in Russia (see e.g. Gurvich and Prilepskiy, 2015; Pestova and Mamonov, 2019).*

the financial arms. By contrast, indirect effects are more substantial. Risks to digital ecosystems clearly also stem from the providers' liquidity and solvency position. Here, financial sanctions do play a role, but so do the overall loss in confidence associated with being sanctioned and its implications for obtaining financing, the collapse of stock market prices of listed companies and other issues, as discussed in the following sections.

3.2 Major revisions of business models due to sanctions (and risks)

Different types of sanctions (financial and nonfinancial, entity- and individual-based) have led to changes in organizational structures and business strategies. Because of sanctions it may become difficult or unattractive to develop certain services further. For instance, Sberbank announced in early June that it was closing SberGames, its gaming division, due to external restrictions for Russian developers on the global market (Bne IntelliNews, 2022a). In a similar vein, post-invasion, many international partnerships and expansion plans were terminated or stalled. Yandex, for example, decided to put several international expansion plans on hold, a number of partner companies have announced that they would end the partnership (Lee, 2022), and some countries, e.g. Estonia[25], have banned Yandex's services, also related to data concerns. Thus, sanctions may lead to ecosystems with less diverse or lower-quality service offers, which could make the ecosystems less attractive and profitable going forward.

Moreover, since the onset of the war, some digital ecosystem providers have had to radically re-evaluate their business model to salvage the future of their ecosystem development. As a case in point, the USA reported on April 6, 2022, that Sberbank and its subsidiaries would be put under full blocking sanctions[26]. While being under sanctions might be less relevant for some subsidiaries/services (e.g. domestic taxi services or domestic financial transactions), it could be crucial for others (e.g. gaming, technology development). Possibly as a result of the sanctions, Sberbank announced in mid-May that it was selling several businesses belonging to its digital ecosystem, including SberCloud and its Speech Technology Center, to a relatively unknown company called Noviye Vozmozhnosti (Bne IntelliNews, 2022b).

Besides the sale or termination of business arms, several companies have also reported – sometimes multiple – management reshuffles or changes in shareholder structures as a result of sanctions on individuals or out of concerns regarding effective governance. Such organizational changes, particularly when forced and pushed through quickly, might imply increased risk for companies. For instance, TCS Group Holding, which owns Tinkoff Bank, announced in early April that it was "ring-fencing" its Russian business by transferring governance powers from the Board of Directors based in Cyprus to a Management Company controlled by the Russian management team of Tinkoff Bank[27]. Some weeks later, after posting a critical tweet regarding the war in Ukraine, Oleg Tinkov, founder and important

[25] *See The government prohibits Yandex from offering taxi services in Estonia | Eesti Vabariigi Valitsus.*

[26] *Full blocking sanctions are the most severe financial sanctions in the USA, prohibiting US citizens, regardless of their location, from engaging in transactions with or for the benefit of targeted individuals and entities. Moreover, property belonging to such entities or individuals that is under control by US citizens is frozen.*

[27] *See Tinkoff news (tinkoffgroup.com).*

shareholder of TCS Group, rushed through the sale of his share in the group. 35% of TCS Group were acquired by Interros, which is associated with Russian oligarch Vladimir Potanin. Tinkoff Bank announced that it would rebrand in 2022 and cease to use its old brand (Nechepurenko and Troianovski, 2022).

3.3 Impact of technology-related sanctions likely high

The third channel we cover in some depth are technology-related sanctions fintech companies with a core in tech are clearly most concerned about. Yandex, for instance, has already explicitly cited tech sanctions as a potentially severe medium-term obstacle to its operations.[28] Yet, tech sanctions also affect any Russian business wanting to provide innovative digital customer solutions and to develop and use cutting-edge technology.

Far-reaching tech sanctions were imposed on Russia by the USA, the EU and other jurisdictions, including Japan, South Korea, Taiwan and Singapore, all of which are major producers and exporters of advanced technological goods. China, which exports large volumes of high-tech goods[29], has not followed suit, however.

While sanctions vary somewhat across jurisdictions as to their precise wording and implementation, they are particularly strict for military end use or end users and dual-use goods. Also, Russia-wide sanctions apply to sensitive technologies that include microelectronics, telecommunications items, sensors, navigation equipment, avionics, marine equipment, and aircraft components. Moreover, the USA also imposed sanctions on goods produced outside the USA that use US software, technology or equipment.[30]

Tech sanctions will bite because, despite some Russian success stories regarding technology development, Russia is nowhere near technological independence. In 2018, Russia's trade deficit (exports minus imports over total trade volume) in advanced technologies[31] came to 69%, compared with 21% for the USA and 2.4% for the EU-27. Moreover, Russia's share in global patenting in advanced technologies was around 0.3% between 2016 and 2018, compared with around 22% in both the USA and the EU, and around 15% in China (European Commission, 2021). Discussing specific key ICT subindustries, Epifanova and Dietrich (2022) conclude that Russia's position in the hardware sector is quite weak, while its position regarding software is stronger, but also relies on Western companies. According to the authors, several multinational companies are critical for Russia's tech sector, e.g. SoftBank Group based in Japan, TSMC based in Taiwan, ASML based in the Netherlands or US (mobile) operating system and open-source repository providers such as Microsoft (Windows, GitHub), Apple (iOS) and Google (Android). All these companies' business in Russia is at least partially covered under the sanctions regime and some companies have joined large multinational private firms that have announced that they were voluntarily halting all new business in Russia.[32] The

[28] *See Yandex — Company news — Yandex Provides Update on Impact of Current Developments.*

[29] *See High-technology exports (current US$) - China, United States, Russian Federation, European Union | Data (worldbank.org).*

[30] *See e.g. Russia's war on Ukraine: A sanctions timeline | PIIE (last accessed on April 14, 2022).*

[31] *Advanced technologies include advanced materials, advanced manufacturing, artificial intelligence, augmented and virtual reality, big data, blockchain, cloud technologies, connectivity, industrial biotechnology, the Internet of Things, micro and nanoelectronics, mobility, nanotechnology, photonics, robotics and security.*

[32] *Currently, it is difficult to say whether this full suspension of business will be permanent or whether some business will resume in line with the imposed international sanctions.*

internet is a critical backbone of digital services, and its functioning in Russia might be negatively affected by foreign companies that provide, for instance, internet services and data transport pulling out of the country (Epifanova and Dietrich, 2022; Bateman, 2022).[33]

Regarding the effectiveness of tech sanctions, it helps understand that achieving true technological independence is almost impossible for any country given the complexity of ICT products and integration of ICT supply chains. The use of semiconductors, a vital part of most modern electronic devices, is a prime example. Varas et al. (2021) pointed out that no other industry has the same high investment needs in R&D and capital expenditure. This has resulted in highly specialized and interdependent global supply chains that rely on free trade. According to Varas et al. (2021), there are more than 50 nodes across the semiconductor supply chain[34], where one region accounts for more than 65% of the global market share. This creates vulnerabilities; however, rebuilding the full supply chain on the regional level would require massive investments and result in much higher prices for semiconductors and the products that use them.

3.4 Sanctions need to be continuously updated to prevent circumvention

The Russian private and public sector will certainly attempt to evade sanctions and possibly succeed in some cases. For reasons of scope, we focus this section on tech sanctions, but its broader conclusions also apply to other international sanctions.

As to replacing sanctioned technologies, Russia may benefit from selective technological cooperations with China, which has also been targeted by Western sanctions and is making important efforts to reduce its technological vulnerability[35]. In early February 2022, an official Sino-Russian friendship and cooperation declaration emphasized increased efforts to be put in the two countries' bilateral technological partnership stretching from e-commerce via cloud management to AI (Le Monde, 2022). In any case, the substitutability of many advanced tech products and services is limited, either because there are no substitutes available given the high concentration of certain ICT products or because a switch would only be possible by accepting a loss in quality, potentially compatibility, and thus performance. Nonetheless, President Putin issued a decree in mid-April 2022 that makes it compulsory to obtain permissions for imports of foreign hardware or software for use in Russia's information infrastructure. Moreover, the decree bans the use of foreign software in critical infrastructure from January 1, 2025 (Reuters, 2022).

Owing to some loopholes, it will still be possible to obtain sanctioned technologies or goods. For instance, the Russian Ministry of Industry and Trade has waved restrictions on parallel imports of certain foreign goods, meaning that it allows imports without the permission of the intellectual property owner. Ozon is reportedly

[33] *Russia has been working on a "sovereign internet" that should be able to operate independently of the global internet. However, it is unclear if and when Russia could achieve this technologically very complex task (as we know little about the progress on this project).*

[34] *Russia and Ukraine are mostly relevant in the supply chains as providers of raw materials. Ukraine is a major supplier of neon gas, while Russia mostly supplies important metals, such as aluminum, nickel and copper. The geopolitical situation is therefore putting further pressure on the already stressed semiconductor supply chain.*

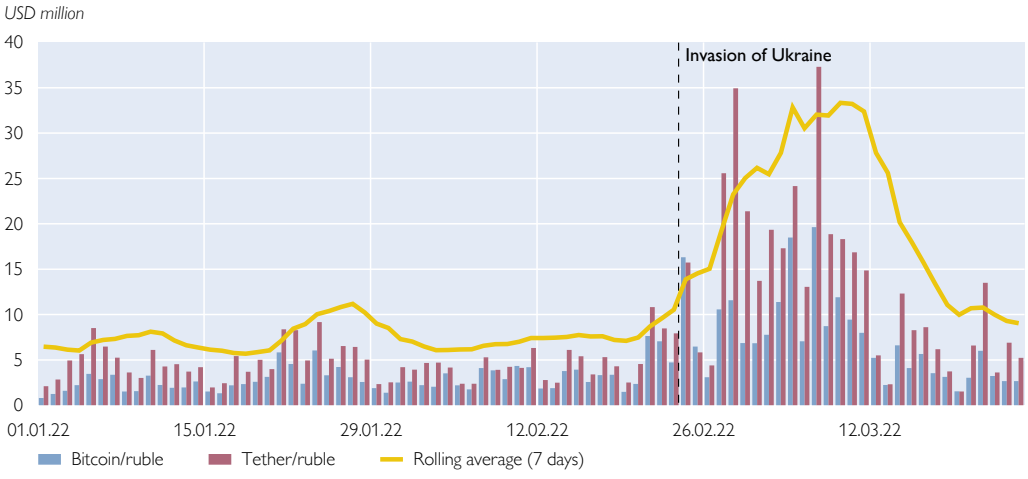
[35] *China has been previously sanctioned by the West, e.g. under secondary sanctions, Huawei was cut off from access to sophisticated chips (semiconductors) using US technology. Consequently, as of end-January 2022, some big Chinese chipmakers – benefitting inter alia from lavish state subsidies – had reportedly established chip production lines "cleansed of US technology" (The Economist, 2022a).*

already selling consumer electronics obtained via parallel imports[36]. Another tool for evading sanctions that has been widely discussed in the media and by policymakers are crypto assets. For instance, ECB President Christine Lagarde voiced her concerns about Russia's interest in the crypto economy as an instrument for bypassing sanctions, noting that the ECB was seeing a significant number of suspicious Russian crypto activities and was monitoring the situation (Look, 2022). After Russia's invasion of Ukraine, swaps of rubles to Tether and bitcoin increased markedly (see chart 1), probably a reaction to protect financial wealth amid the depreciating ruble exchange rate, inflation fears and sanctions.[37]

However, various factors limit the ability to use crypto assets to evade sanctions in general, and tech sanctions in particular. First, the USA and the EU are trying to close loopholes in this area. For instance, the EU reacted by classifying crypto assets as "transferable securities," which implies that crypto assets should be treated like financial instruments with regard to sanctions. Note that this approach is not perfect; transferable securities are governed by the Markets in Financial Instruments Directive (MiFID II), which, however, allows for some differing classification approaches across EU member states. The Markets in Crypto-Assets Regulation (MiCA), which is expected to be finalized in 2022, is set to close certain regulatory gaps in this area. Second, large parts of the crypto economy, e.g. major exchanges and crypto service providers, have declared that they would comply with sanctions. Some exchanges even claimed to have gone beyond official sanctions by blocking transactions with all Russian banks (Dörner and Müller, 2022). While this is a positive sign for the effectiveness of sanctions, what complicates monitoring whether sanctions are honored and to what extent is the fact that across EU countries many players in the crypto economy are regulated differently, or not at all.

Chart 1

Volume of bitcoin and Tether swaps with ruble



Source: KAIKO.

[36] See *Ozon начал продавать электронику, ввезенную по параллельному импорту - РИА Новости, 23.06.2022 (ria.ru)*.

[37] *Two weeks into the war, crypto trades reverted to their former level.*

Box

Uncertain legal outlook for crypto assets in Russia

Russia's crypto economy is quite substantial, both in terms of mining and investments (CBR, 2021b). Regarding mining, a part of China's mining activities shifted to Russia after China's wide-ranging ban of crypto mining. As a result, Russia became the third-largest crypto mining country in the world. In late March 2022, the Russian Ministry of Energy called for an urgent legalization of mining and an introduction of regional energy quotas for bitcoin farms. The Ministry of Industry and Trade and the Ministry of Construction, Housing and Utilities followed up in April by also calling for an experimental legal mining regime.[38] Regarding investments, according to crypto ownership estimates published by TripleA[39], Ukraine and Russia are among the countries with the highest shares of the population holding crypto assets (around 12%, compared to e.g. 8% in the USA and 5% in the UK).

Until December 2021, Russia's official policy stance on the crypto economy was not quite clear. Some rejectionist indications for crypto mining and token issuance contrasted with signs of more lenient regulation. In January 2022, the CBR surprised the market by publishing a consultation paper on the trends, risks and regulation of crypto assets (CBR, 2022). In this paper, the CBR outlined that crypto assets should mainly be seen as high-risk assets, which lead to considerable systemic risks and are deeply ingrained in the money laundering business. The CBR recommended a complete ban of the crypto economy – mining, holding or investing in crypto assets, and especially using crypto assets as a means of payment.

The Russian government partially disagreed with the CBR's view, and it seems that the Russian Finance Ministry's more lenient view on crypto assets is prevailing: on February 18, 2022, the Russian Finance Ministry submitted a draft law on digital currency, which prohibits crypto assets as a method of payment but permits them as investment instruments and allows crypto exchanges to officially operate under strict customer identification and quality standards regimes. The Finance Ministry noted in its press release of February 21 that "proposals received from the Bank of Russia will be taken into account in further work on the draft law insofar as it does not contradict the approach of the Russian Ministry of Finance"[40]. On April 8, the Finance Ministry announced that it had finalized the draft law and sent it to the government of the Russian Federation.

Third, the crypto economy is unlikely to provide enough liquidity to allow for a large-scale circumvention of sanctions, such as for larger international payments. Trades on the ruble spot market[41] were, for instance, still roughly 13% larger in volume than all global bitcoin transactions, despite the steep rise in the volume of bitcoin transactions over the past years. This argument has less validity for smaller payments, e.g. the selective circumvention of restrictions on technological inputs or the use by private individuals to safeguard their wealth. Finally, all crypto transactions are permanently visible on blockchains, and may therefore be analyzed and tracked by authorities and analysts. This renders crypto transactions less suitable for circumventing sanctions, particularly for large transactions that are easily detectable, but also to a lesser extent for smaller payments, e.g. for buying technological goods.

[38] See https://news.bitcoin.com/russian-finance-ministry-amends-bill-on-digital-currency-adds-crypto-mining-provisions/.

[39] See Global Cryptocurrency Ownership Data 2021 - TripleA (triple-a.io).

[40] See Минфин России :: Пресс-центр :: Минфин России направил в Правительство России проект федерального закона «О цифровой валюте» (minfin.gov.ru).

[41] CBR Database, https://www.cbr.ru/eng/hd_base/.

A dynamic tool, sanctions need to be constantly adapted as sanctioned entities find loopholes and ways to circumvent the existing sanctions. Export sanctions have, so far, had a severe, but not devastating impact on Russia's economy (see e.g. Chorzempa, 2022). If loopholes remain temporary and small, then the effect could intensify over time, as it will become more difficult for Russia to repair and replace essential ICT equipment, and for tech-dependent sectors to continue operating smoothly and develop innovative, cutting-edge solutions. This will ultimately damage Russia's economic power. Several other factors could likewise hamper the long-term outlook for Russia's technological advancement. As foreign companies are leaving Russia and new investments in Russia become riskier or are banned altogether, it will get more difficult to find partners for knowledge transfers, say via joint ventures. Given the economic consequences of the war, both the Russian public and private sector are likely to have to scale down the amount of funds they can spend on new investments. Chances are that well-educated Russians will be more motivated to emigrate for economic and political reasons, which could lead to skills shortages – although migrations following the Western sanctions and economic stagnation of 2014 did not stop Russia from achieving technological successes.

4 Summary and conclusions

In recent years, the Russian government has been pursuing a serious digital transformation agenda. It wants to foster economic development and efficiency, but – for geopolitical reasons – it also strives for digital sovereignty and control. On the one hand, Russia's experience with digital transformation illustrates how economic motives can clash with motives to nationalize and control. After all, innovation tends to benefit from specialization, competition and cooperation across borders. On the other hand, Russia's pursuit of greater technological independence has contributed to a variety of domestic ICT services and public infrastructures.

In addition, Russia's digital transformation has also contributed to rapid changes in the financial landscape. As to fintechs, the lines between tech firms and banks have been blurring fast, with digital ecosystems having become an important feature of the financial market. Pre-war Russia is therefore an interesting case study for a fast-changing financial landscape as well as the regulatory challenges that such a transformation entails. Compared to countries that undergo similar changes, Russia stands out as its largest bank, Sberbank, has been on the forefront of these developments.

Currently, the business models of Russia's large fintechs are being hit by international sanctions, and the firms have to grapple with a host of other issues related to the geopolitical context. Regarding technology-related sanctions, the Russian economy remains vulnerable, and particularly its tech and fintech firms. Despite its efforts to this effect, the Russian government has not yet managed to significantly reduce the country's technological dependence on foreign countries. The effect of sanctions is, however, somewhat mitigated by Russia having acquired experience in dealing with sanctions. It has built services and infrastructures, including payment systems, that are useful in the current context (Gagné Mapp, 2022). The Russian government is set to speed up its drive for digital sovereignty, but for lack of key technological inputs, this will become more difficult and costly. For advanced ICT products and services, which are highly specialized and complex, rebuilding regional supply chains would, for some technologies, require massive investments and might still result in costlier and inferior products (Varas et al., 2021). Overshadowed

by the war against Ukraine, Russia's fintech and ecosystem landscape will, over the next five years, develop differently from the path it had been on before the invasion. As large fintech firms play a crucial role in the Russian economy, adverse developments regarding their business should be watched closely.

The effectiveness of (tech) sanctions will play a critical role in determining the negative impact on the Russian economy over time. While sanctions are likely to be circumvented on a small scale, present possibilities for large-scale circumvention seem limited. For instance, using crypto assets to bypass sanctions on a larger scale is complicated by several factors. In any case, for sanctions to really bite, the sanctioning jurisdictions need to constantly monitor loopholes and evasion practices.

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