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The role of foreign-owned entities in building economic resilience in times of crisis: The case of European digital and technologically-intensive firms during the Covid-19 pandemic

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Keywords: *foreign direct investment; pandemic; technological intensity; resilience; corporate performance*

Abstract

Research background: Over the decades, foreign-owned entities (FOEs) have become an important part of the economic landscape considered as behemoths of globalisation, but also transmitters of positive effects such as technology or know-how spillovers. In times of volatili-

ty and uncertainty, firms' contribution to building a resilient economy is at the top of the public agenda.

Purpose of the article: The purpose of the article is two-fold. Firstly, we test, how FOEs perform in this stressful time of volatility and uncertainty. Secondly, we examine the contribution to resilience by digital and technologically intensive sectors.

Methods: The study utilises the Bureau van Dijk (BvD) Orbis firm-level database as a primary data source. The results are derived with the use of two econometric approaches. Firstly, we estimate a static model utilising the ordinary squares estimator. Secondly, we re-estimate the equations using a two-step System GMM estimator. It introduces a lagged dependent variable into the model and implements a correction for endogeneity among covariates by including instruments (in levels and differences).

Findings & value added: We use size, age, ownership, gearing, and intangibility as firms' financial performance determinants, together with the sector-, country- and time-fixed effects. FOEs compared to domestic ones generated a higher revenue growth rate. In times of crisis high-tech and digital firms are more resilient. However, ownership does not matter in this respect. We contribute to the discussion about functions performed by FOEs in crisis and turbulent times, in which resilience issues are on top of the agenda. Our research intends to bridge the gap between the performance of FOEs, micro-level analysis, and resilience.

Introduction

Over the decades, foreign-owned entities (FOEs) have become an important part of the economic landscape. According to Forsgren (2008), FOEs have many faces. On the one hand, they are behemoths of globalisation, bringing negative consequences to the FDI-receiving nations. On the other hand, their activity streamlines positive effects, stemming from the transfer of investment capital, intangible assets, tacit knowledge, and technology transfer.

The global economic environment has become turbulent and unpredictable. After the Covid-19 pandemic, it has become even more volatile through Russia's invasion of Ukraine. The global economic slowdown is on the horizon.

As over the decades, world has become volatile, uncertain, complex, and ambiguous (VUCA), the literature on resilience has proliferated, and its various understandings have developed. Resilience has been discussed mainly in the macroeconomic context (Diop *et al*., 2021), with focus on openness and reactions to crises. The research often concentrates on factors affecting volatility of FDI (Gnangnon, 2018; Gnangnon & Iyer, 2017; Rao & Zhang, 2019), while the influence of FDI on resilience is rarely inquired (Landman *et al*., 2023), and FDI variable is introduced in the aggregated form (Li *et al*., 2019; Pretorius *et al*., 2021). Firm level analysis on resilience

are rarely performed and their coverage (number of countries and firms) is limited (Todo *et al*., 2022). Micro-level dimension of resilience is investigated by the occasion of natural disasters (Hallegatte *et al*., 2017; Kato & Okubo, 2022), especially in the context of households' income (Bernini *et al*., 2020). While it is acknowledged that firms' performance matters not only for the sector in which a firm operates, but also for the creditors, the financial system and finally, for the entire economy, the related analysis are restricted to SMEs, single or a limited number of countries (Abdel Fattah *et al*., 2020; Arcuri *et al*., 2019; Arcuri & Levratto, 2020; Qamar *et al*., 2023).

We contribute to the discussion about functions performed by FOEs in crisis and turbulent times, in which resilience issues are on top of the agenda (Frigotto *et al*., 2022). Research on resilience does not put the necessary attention to the heterogeneity of firms (Martin & Sunley, 2015), which stays in contrast to international economics (Mayer & Ottaviano, 2008; Melitz, 2008). Our research is intended to bridge the gap between the performance of FOEs, micro-level analysis, and resilience. The study identifies the role of FOEs and firms' technological intensity in absorbing the negative effects of the crisis. The results provide evidence that FOEs were more resilient during the crises, as were digital and high-tech firms. However, it was the sectoral heterogeneity rather than the ownership status that created this resilience in the case of tech FOEs. The implications of this study open a new branch of discussion on firm-level factors affecting resilience, and the need to include a series of new variables.

The aim of the article is twofold: (i) to examine the performance of FOEs during the stressful and volatile period of the COVID-19 pandemic, (ii) to investigate the contribution of digital and technology-intensive sectors to resilience. The study uses Bureau van Dijk Orbis firm-level data, covering nearly 2 million firm-year observations in 2011–2020, from 276 k firms in 26 European countries. The data prior to any analyses were cleaned and winsorized between 1st and 99th percentile. The results are derived using two econometric approaches, an ordinary least squares estimator and a two-stage system GMM, followed by a series of tests verifying instruments' validity.

The article is structured as follows. In the literature review, we discuss the phenomenon of resilience, which is high on the discussion agenda. We identify the gap in research, related to the nexus of firm-level analysis, FOEs' role, and resilience. Section research methods presents and justifies hypotheses. It describes our methodological approach, the dataset, and the

quantitative tools used. Then, the results are presented and discussed. Conclusions summarise the article, embrace the policy implications and highlight the limitations of the research. In addition, this section briefly points out possible directions for further research.

Literature review

In a volatile open economy, subject to dynamic changes and shocks (game changers), resilience has become a key issue in doing business, and of the public debate. According to Martin and Sunley (2015), resilience is an idea "whose time has come". The Covid-19 pandemic has not ended yet, and the world economy has been hit by Russia's invasion of Ukraine. This kind of economic environment is described as VUCA and shows the necessity of continual adaptations to changes and dangers (Evans & Reid, 2013). There are various understandings of resilience, such as elasticity under stress, the time needed to come back to the equilibrium, managing variability, interactions scalability, renewal and learning, and transformations (Faggian *et al*., 2018; Frigotto *et al*., 2022; Gunderson & Holling, 2002; Manca *et al*., 2017). An interesting, somehow alternative approach to resilience has been proposed by Martin and Sunley (2015). Contrary to treating resilience predominantly as a sort of bouncing back, it can also be bouncing forward, which seems useful in an inquiry of FOEs to resilience. Due to their ownership advantages (combined with localisation and internalisation ones), FOEs stimulate pro-competitive changes and adjustments in line with the Schumpeterian concept of creative destruction. It is, therefore, a means to go out of stagnation and to move forward, towards higher competitiveness and resilience states.

The literature review shows the gap as regards the micro-level of resilience. Although there is a common understanding that different spatial scales shall be considered, the micro level of resilience is usually attributed to humans (individuals), not firms (Bergström & Dekker, 2014; Hallegatte *et al*., 2017; Wilson, 2012a, 2012b). Albinowski *et al.* (2015) consider the competitiveness of firms as a determinant of micro-level resilience, which affects macro-resilience. The nexus between firm performance and resilience can be derived from international economics theory and empirical research. Resilience also comes from exports, as it broadens sales perspectives and can be a stabiliser of revenue, while the domestic market stag-

nates or declines. Exporters are the most productive firms (Mayer & Ottaviano, 2008; Melitz, 2008), able to "bounce forward". Moreover, FOEs reveal a significant premium over domestic firms as regards exporting capacity. The postulate of Mayer and Ottaviano (2008) well corroborates with the resilience imperative: the extensive margin of exports is more important than the intensive one. It is more resilient to have more exporters with low exports per firm, than the opposite.

According to Wilson (2012a), resilience comes from the intersection of economic, environmental, and societal capital. Attaining resilience needs to balance the character and scale of interactions with the global economy. Too much isolation results in over-dependency on local skills and resources (which are not competitive enough); on the other hand, over-globalisation leads to autonomy losses and susceptibility to external shocks. This kind of argumentation well resonates with the postulates of Mayer and Ottaviano (2008) related to export margins.

The role of micro-level factors has been pointed out by Wilson (2012a) and Vaughan (2016), concerning international prestige, experience, and organisational culture, which links resilience with FOEs characteristics and activity. Due to their distinctive features encapsulated in the OLI paradigm (Dunning & Lundan, 2008) and functions (Forsgren, 2008), incl. size, financial power, soundness, organisational maturity, and experience, FOEs can contribute to resilience. Hymer (1960) has well described the nature of FOEs as not only providers of capital, but rather the transmitters of tacit knowledge and assets, which nowadays are interpreted as foundations of competitiveness and resilience. Due to their experience, FOEs are also expected to possess an ability to foresight and adjust to shocks (Madni & Jackson, 2009). It resonates with other resilience aspects, which are the degree of preparedness and the ability to manage shocks and adverse changes (Béné *et al*., 2012; Cutter *et al*., 2008; Mitchell & Harris, 2012; Pfefferbaum *et al*., 2007).

The literature does not provide unequivocal evidence on how FDI contributes to resilience. Cavallo and Frankel (2008) did not confirm the statistically significant stabilising effect of FDI on the recipient economy. Guimarães and Morris (2003) point out that FDI may raise the likelihood of a crisis, transmitting external shocks to the national economy. On the other hand, Crespo and Feldkircher (2012) identified the FDI role as reducing the global shocks affecting the economies of the European emerging markets, describing FOEs as shock absorbers. According to Gnangnon and Iyer

(2017), openness (induced also by the FDI inflow) increases vulnerability, but at the same time helps to mitigate the consequences of shocks. Kinoshita (2011) points structural composition of the incoming FDI that matters for vulnerability, stipulating that FOEs in the non-tradable sector contribute to volatility.

Contribution to resilience can also be derived indirectly from FOEs features, which are size (Abdel Fattah *et al*., 2020; Carreira & Silva, 2010; Coad *et al*., 2013; Pollard, 2003), financial soundness (Abdel Fattah *et al*., 2020; Colombo & Stanca, 2006; Hutchinson & Xavier, 2006), access to financing (Bun, 2021; Harrison & McMillan, 2001; Héricourt & Poncet, 2009), experience in risk management (Albulescu & Briciu, 2010), leadership and knowledge capabilities (Forsgren, 2008; Gibson & Tarrant, 2010) and access to talent pool (ABSL, 2023a; Acs *et al*., 2007). Schriber *et al.* (2019) mention flexibility, stemming from the ability to shift resources across countries and from the overlapped resources and capabilities (redundancy) (Madni & Jackson, 2009).

The various functions of FOEs have been already well described in the literature, however, the nexus between FDI and resilience remains highly unclear. Moreover, as there are many faces of FOEs (Forsgren, 2008), also resilience can be understood in many ways, which conceptually makes bridging the gap between both even more difficult. Depending on circumstances, FOEs stabilising function (long-lasting perspective, accumulated knowledge, and capacities) can be on top of the merits in crisis time; while for economic expansion other features are more important (agility, export competencies).

Research methods

To inquire into FOEs' contribution to the resilience we test two hypotheses.

H1: *FOEs perform better than domestic entities, and contribute to economic resilience in times of crises.*

The literature review shows various functions FOEs perform. They are multidimensional creatures in the global economy (Forsgren, 2008), connecting nations' and their regions with global trends, which brings both positive and negative consequences. Much depends on the combination of

the investor's OLI advantages and motives, with the recipient economy's characteristics.

According to Iammarino *et al*. (2020), due to FOEs' specific features resulting from OLI paradigm, they positively affect the development of the competitive and productive industries and improve resilience. Many of FOEs advantages stem from their size, productivity and export capability (Horobet, 2018; Nazarczuk & Umiński, 2019). Especially in the domain of exports, FOEs performance is outstanding, what is fundamental for competitiveness (Joebges, 2017). The positive impact of FDI on resilience also stems from its lower volatility, compared to other international flows (Pagliari & Hannan, 2017; Umiński & Borowicz, 2021) and ability to adjust (flexibility) in turbulent times (Schriber *et al.*, 2019). As stipulated by Kalotay and Sass (2021), due to the link with productivity, fixed and sunk costs, FDI was more stable and resilient than other international flows in past crises. Different faces of FOEs, coupled with various understandings of resilience as such, justify H1: the nexus between FOEs and resilience is unclear and needs verification. By formulating H1, we intend to look into the "brighter"/positive side of FOEs' activity (Forsgren, 2008).

H2: *FOEs advantage depends on tech and digital advancement.*

Accelerated adoption of digital solutions, boosted by the Covid-19 pandemic, leads to the dynamic growth of tech and digital-oriented FDI (Casella & Formenti, 2018). FOEs (MNEs in particular) play a dominant role in technology transfer across nations. However, sectors differ in terms of FDI penetration ratio, ability to absorb FDI-related advantages as well as position on the technological ladder. Digitalisation changes the structure of FOEs' motives and may even result in the retreat of FDI. It undermines the importance of market-seeking and resource-seeking motives of FDI and increases the knowledge-seeking function. FDI in digitalisation intensive sectors can generate relatively high revenues, from moderate productive assets (asset-lite international footprint) (Banalieva & Dhanaraj, 2019). According to Kalotay and Sass (2021), each crisis, inc. Covid-19, has idiosyncratic nature and foreign investors must re-experience the issue of resilience. The trajectory of FOEs performance in crisis stems from many factors, incl. motivation of the investment. Kalotay and Sass (2021) underline the changing environment in which FOEs perform, and a shift towards intangibility. Technologically intensive and digital FOEs can more easily access

foreign markets, and the direct physical presence is not necessary. The pandemic has accelerated the digitalisation, which results in the growing differences between non-digital and digital firms (ABSL, 2023a, 2023b; UNCTAD, 2022; Veugelers *et al*., 2019).

The study utilises the Bureau van Dijk (BvD) Orbis firm-level database as a primary data source. The dataset covers active manufacturing, services, and agricultural firms, employing more than 10 people in 2011–2020 from 26 European countries (Table 1) with extensive sector coverage (Table 2). The database comprises 1 966 486 firm-year observations, which depict 276 315 firms, out of which 41,359 are FOEs, distinguished from non-FOEs on the grounds of the Global Ultimate Ownership (GUO) threshold of at least 25.01%. Firms with unknown GUO status were excluded from the analysis.

Before any calculations, we cleaned the dataset from missing or negative observations regarding important variables, such as operating revenue, total assets, employment, or intangible fixed assets, similar to Gal (2013), Cevik and Miryugin (2021). Next, following Öztekin (2015) to minimalize the impact of spurious outliers on the obtained results, we winsorise all firm-level data between the 1st and 99th percentile of their distribution.

The selection of variables used in the study came from an extensive literature review. However, one should mention that there is no universal approach to assessing financial soundness or a set of financial constraint measures. Therefore, out of 51 firms' performance indicators of credit constraints and financial soundness identified in the literature review, we decided to use the following: operating revenue growth, size (of the firm), age, leverage (gearing ratio), and the ownership structure. To grasp sector differences between firms, we extend descriptives by adding sectoral variables: high-technology and digitalisation intensity. The complete list of variables used in the study is presented in Table 3.

The reasoning behind the use of particular variables is the following. Financial soundness is measured by profitability (San Jose & Georgiou, 2009; Sundararajan *et al*., 2002; Zapodeanu & Cociuba, 2010), proxied by operating revenue. It captures the complexity of business models in a changing environment (Wagenhofer, 2014) and constitutes the basis for various financial profitability ratios (incl. profit or cost margins). It has been ranked as the second most important metric for reporting to outsiders (Graham *et al*., 2005) and has some advantages over profit: homogeneity and consistency; directly indicating changes in performance; and manage-

ability. A stable increase in operating revenue illustrates a firm's resilience to unforeseen events (Gilbert *et al*., 2012). Based on the above, our study of corporate financial health treats operating revenue growth as a dependent variable, following Lee and Lin (2019), Sharma *et al.* (2019).

As for control variables, the impact of a firm's age on financial performance can be twofold. First, older firms, as more experienced, enjoy the advantage of learning. Experience helps to deal with unexpected problems and external shocks. Second, they may suffer from inertia and ossified structure, which may lead to disability in adapting to the rapidly changing environment (Majumdar, 1997).

Following Vijayakumar and Tamizhselvan (2010), and Pokharel *et al.* (2020), we hypothesise that size positively impacts financial soundness. Following Secchi *et al*. (2016), we proxy size by total assets.

The presence of ownership on the list of variables directly stems from the research subject and is justified by H1. Douma *et al.* (2003), Barbosa and Louri (2005), Pasali and Chaudhary (2020), and Klein (2016) treat foreign ownership as a crucial element of financial performance.

The gearing ratio measures financial indebtedness. The literature generally treats high indebtedness as a factor worsening the firm's financial position (Forte & Moreira, 2018). It may significantly increase sensitivity to economic downturns and directly impacts financial health. It is used as a vulnerability and financial distress indicator (Kim, 2019a, 2019b; Klein, 2016).

Justification for sectoral variables directly relates to H2. High-tech and digital-intensive firms operate in unstable and unpredictable business surroundings. It results in higher risk and leads to financial uncertainty (Carpenter & Petersen, 2002). Also, demand for high-tech products is highly volatile as the technology life cycle has shortened. High-tech firms in the unprecedented times of global volatility have to manage disrupted GVCs, leading to obstacles within their supply chain (Wu *et al*., 2005). We use two typologies: technological intensity by OECD and van Ark *et al.* (2019). On the other hand, technological advancement provides a competitive advantage, and an ability to generate relatively high revenues (asset-light international footprint).

Econometric strategy

To test firms' performance and financial soundness, we develop a series of panel estimations to unveil the nature and factors affecting firms' resilience to this shock. In this regard, we develop a series of estimations, with the operating revenue growth as a dependent variable of a general form:

$$y_{itsc} = \alpha_1 Pandemic_t + \alpha_2 Firm_{isct-1} + \alpha_3 INT_{itsc} + \eta_s + \eta_c + \eta_t + \varepsilon_{isct} \quad (1)$$

where i denotes firm, t stands for a year, s depicts sector, and c indicates country. *Pandemic* stands for the Covid-19 outbreak variable, whereas $Firm_{isct-1}$ is a vector of variables depicting firms (mostly lagged by one year). INT_{its} represents a vector of interaction terms, further unveiling factors affecting the reception of the Covid-19 crisis. The η_s coefficient denotes sector-fixed effects, η_c stands for country-fixed effects, whereas η_t introduces time-fixed effects. Their inclusion enables controlling for the unobserved country- and sector-heterogeneity, representing i.e., different environments for firms' operation. Moreover, the inclusion of year-fixed effects helps to account for different global/regional economic situations. Since observations belonging to a firm are correlated, we introduce robust standard errors (SE) clustered at the firm level to reduce the information incorporated in SE compared to unclustered errors.

The results are derived with the use of two econometrical approaches. Firstly, we estimate a static model utilising the ordinary least squares estimator (Table 4). However, reverse causality and omitted variable bias might be at stake, which can lead to obtaining imprecise relationships among the covariates. Therefore, we further examine the results with a dynamic approach, testing for robustness. Because we utilise a panel with a large no. of firms and a low no. of years, and given the financial nature of the inquiry, we re-estimate the equations using a two-step System GMM estimator (Arellano & Bover, 1995; Blundell & Bond, 1998). It introduces a lagged dependent variable into the model and implements a correction for endogeneity among covariates by including instruments (in levels and differences). A two-step procedure is more efficient than a one-step one, especially with a finite sample correction for SE, proposed by Windmeijer (2005). The use of difference GMM would exclude fixed effects and variables constant over time from the model (incl. our variable of interest — ownership status).

To fulfil the model assumptions, we acknowledge the existence of first-order autocorrelation, but cannot confirm the second-order one. Further on, we countercheck the instruments' validity with the Hansen J-test. Its insignificant p-value indicates the lack of the overidentification problem due to the proliferation of instruments.

Results

An extensive firm-level dataset throughout 2011–2020, with wide sector coverage, enables obtaining comprehensive findings on firm performance. All of the estimations presented in this section include country, sector, and year-fixed effects to intercept unobserved heterogeneity and common shocks across firms from different sectors and countries. Despite different econometrical approaches, the image of the aftermaths of the Covid-19 outbreak is persistent, showing significant differences between foreign-owned and domestic-owned firms and sectoral heterogeneity in firms' reaction to the pandemic, acknowledging the robustness of the results.

Table 4 reports the findings depicting the aftermaths of the Covid-19 pandemic on firm performance, measured by the change in operating revenue. Column 1 presents a baseline scenario for the whole-time frame of the analysis, indicating variables affecting operating revenue growth. These include the size of firms, the ratio of intangible assets to total assets, leverage (gearing ratio), firms' age, and ownership status. The significance and the signs of coefficients are in line with the literature, signalling higher growth rates in smaller firms, having a higher share of intangible assets, being less leveraged (in terms of the ratio of total debt to total assets), younger and foreign-owned.

Columns 2 to 6 include the pandemic variable, intercepting the negative impact of the Covid-19 outbreak together with a series of interactions, which show differences among firms in the absorption of the shock. Unarguably, the coronavirus pandemic has significantly cut firms' operating revenue (on average by ca. 11%), yet its scale was highly diversified.

For instance, foreign-owned entities were more resilient than domestic firms in reaction to the shock, as signalled by the interaction term between the pandemic variable and FOE status (column 3), which slightly mitigated the adverse effects of the revenue loss (1%). Therefore, we may conclude that FOEs were more resilient (keeping other factors constant) than domes-

tic-owned entities in absorbing negative changes due to the Covid-19 outbreak in 2020, which also leads to the acceptance of the H1 hypothesis.

Significant differences also concern firms from particular sectors. In this regard, digital sector entities had higher revenue growth rates in less turbulent times and during the Covid-19 crisis (column 4) than firms from other sectors. Similar sector characteristics depicted high-tech firms, which also possessed a clear advantage over non-high-tech entities. To some extent, high-tech and digital firms mitigated the harmful effects of the crisis, unlike entities from other sectors (columns 3-4). The effect was slightly higher for high-tech firms (4.1%) than those from the digital sector (2.5%) in comparison to entities from other sectors.

Knowing the relatively better situation of FOEs over non-FOEs, digital and high-tech firms over the ones from other sectors during the Covid-19 crisis in columns 5 and 6 (Table 4), we further examine the issue. Due to insignificant interactions between FOEs, the pandemic, and the high-tech sector, as well as FOEs, the pandemic, and the digital sector, the obtained results do not allow the acceptance of the H2 hypothesis. As a matter of fact, given the magnitude of a series of variables and their interactions, sector heterogeneity was a more important factor in differentiating the growth pace of firms' revenues in 2020 than advantages attributed to firms' ownership status.

To test the robustness of the results, we rerun estimations utilising a two-step system GMM approach, which enables the inclusion of the lagged dependent variable and overrides the potential problem of endogeneity, i.e., due to reverse causality. Their results acknowledge the stability of the results compared to static panel models concerning the significance and the signs of the vast majority of variables (Table 5). The age variable was the only one that changed its sign in the dynamic approach, whereas the inclusion of the lagged dependent variable led to the following observation. A higher growth rate of revenues in the previous period translated, on average, to obtaining lower growth rates in the next period.

The remaining differences amounted to the magnitude of the negative effects of the Covid-19 outbreak, which were significantly higher (-20.0-23.3%) than in the static setting (-11.4%), proving that the Covid-19 outbreak was an unprecedented shock for firms. In this vein, the magnitude of the positive effect of FOEs, digital and high-tech firms was also higher, further signalling the results' robustness. Also, in the dynamic approach,

the tri-fold interactions between FOEs, pandemic, and selected sectors were insignificant.

Discussion

Martin and Sunley (2015) and Evans and Reid (2013) signalised that the time of resilience and VUCA has come. We see it even more, observing the economic situation after 2019 as the global economy does not face a single-factor crisis. It is multi-faceted, with permanent volatility and uncertainty instead (Covid-19, Russia's invasion of Ukraine, inflation, and the energy crisis).

FOEs have many faces (Forsgren, 2008), therefore it is difficult to unequivocally predict their contribution to resilience. Our research results corroborate with findings by Madni and Jackson (2009) and Crespo *et al.* (2012) in which FOEs as shock absorbers. Moreover, our findings are in line with Béné *et al.* (2012), Mitchell and Harris (2012), and Cutter *et al.* (2008), who underline FOEs' preparedness as well as shocks and adverse changes manageability. We would need, however, a longer data span to fully address the bouncing forward capabilities of FOEs. Our findings are not in line with Guimarães and Morris (2003), who indicate that FDI is a shock transmitter. Our perception of FDI is similar to Gnangnon and Iyer (2017); although FOEs may increase vulnerability through economic openness, at the same time due to their features stemming from OLI advantages, they absorb the shocks.

There are two main streams in the literature on the role of firm size and age in resilience. On the one hand, larger and more mature firms can reverse the negative consequences of the shock due to their experience, technological capabilities, and organisational capital (Levinthal, 1991; Mueller & Stegmaier, 2015). On the other hand, large and aging firms lose their vitality and can be characterised as having limited adaptive capacity in a volatile business environment (Aldrich & Auster, 1986). Our research is consistent with the view that smaller and younger firms have higher growth rates (Low & Brown, 2017) and we conclude that they have been able to adapt to a rapidly changing environment in Covid-19 times.

Attracting digital and tech FDI can increase digital capabilities and competitiveness. It is crucial for future growth, recovery, and resilience, especially as MNEs are often "born digitals". Stephenson (2020) shows

however that there is no clear evidence of the nature of FDI in this respect. FOEs have very different assets footprint, some of them can be significantly asset-lite, and others perform very similarly to traditional non-digital ones. The accelerating dynamics of technological changes amplified by the Covid-19 pandemic and Russia's invasion of Ukraine provide an opportunity how this kind of FDI performs. Srinivasan and Eden (2021) depict the nuances of the born-digital MNEs and traditional brick-and-mortar MNEs' digitalisation. Zhan and Santos-Paulino (2021), however, underline that the Covid-19 pandemic exacerbates existing constraints of MNEs and can undo the progress achieved so far on the road to sustainable development goals. Our research partially conforms to this scepticism. FOEs are performing relatively better during the pandemic, the same holds for firms from the digital and tech sectors. However, we do not find evidence for digital and tech FOEs doing better, than non-FOEs. It may stem from the fact that in digital and tech sectors (foreign) ownership premium has reduced, also due to technology transfers.

Conclusions

We have confirmed differences between FOEs and domestic firms as regards contribution to resilience. We have captured different crisis effects on firms' financial performance, depending on their technological and digital intensity. The outbreak of the pandemic depicted the ability of firms to absorb shocks. FOEs proved to be more resilient. The status of FOE mitigated the negative impact on revenues, which makes us accept H1.

Furthermore, technological, and digital advancement also favour resilience. High-tech and digital firms, compared to others, experience higher revenue growth, and can undercut the negative impact of a pandemic outbreak.

In the case of tech- and digitally intensive firms, foreign ownership plays a lesser role in building resilience. Thus, we could not accept H2.

Our results strongly contribute to the discussion about various consequences of pandemic crisis; some of them can be observed in the longer term only, and must be reckoned with in different forms of ownership perspective. FOEs are an immanent part of the economic openness, and as such may either contribute to the volatility, or cushion the external shocks. In contrast to other research, ours is based on comprehensive database, that

covers huge number of firms from various countries, across different sections including technological advancement. Our attitude towards FDI is novel. We consider FOEs not as much as embodiment of globalization and its consequences, but rather as an important element of resilience. Our results bring new insights into the behaviour of FOEs, which becomes even more important, as we expect the impact effect (dynamization FDI), resulting from intensified regional economic integration, due to the globalization becoming more regionalized (Enderwick & Buckley, 2020). We also contribute to the discussion on micro aspect of resilience and ownership differences.

In VUCA environment, in particular, policy towards foreign investors shall be effective and oriented towards those that can contribute to resilience. It implies increasing efforts to attract FOEs to high-tech and digital-intensive sectors, such as knowledge-intensive business services.

Our analysis has some limitations. The pandemic variable could be included as a continuous, rather than a dichotomous one, utilising another scale of countries' sensitivity to the Covid-19 outbreak. Considering the limited scope of the study and a variety of variables potentially proxying the scale of Covid-19 aftermaths (cases, deaths, excessive deaths, etc.), we intend to include them in further studies, together with additional controls for country-level anticyclical programs and macroeconomic situation. To some extent, they are intercepted by a series of fixed effects in the models.

The BvD database treats foreign investors as those with a capital share of at least 25%, which does not correspond to the OECD's FDI benchmark definition. Further research will focus on updating the dataset for 2021 and 2022, which will provide a broader view of the VUCA environment and its impact on firms' performance and resilience, considering not only the pandemic but also turbulence resulting from the Russian invasion of Ukraine, inflation and energy prices increases. Moreover, the research could use alternative financial performance indicators. Regional differences may also be of particular interest when it comes to the response of FOEs and domestic entities to crises.

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Annex

Table 1. List of countries in the firm-level dataset

Country	Observations	%
AL	212	0.01
BA	25559	1.30
BG	273121	13.89
CZ	141040	7.17
DE	87157	4.43
DK	1855	0.09
EE	10693	0.54
ES	89070	4.53
FI	7982	0.41
FR	23231	1.18
GB	59875	3.04
GR	47843	2.43
HR	38946	1.98
HU	74169	3.77
IE	2532	0.13
IT	355142	18.06
LT	42172	2.14
LV	74102	3.77
ME	4362	0.22
MK	35672	1.81
NL	3492	0.18
PL	131473	6.69
RO	390336	19.85
SE	10176	0.52
SI	34839	1.77
SK	1435	0.07
Total	1966486	100.00

Table 2. Sector composition of the firm-level dataset

NACE section	N	%
A	54355	2.76
B	7169	0.36
C	958120	48.72
D	8927	0.45
E	21590	1.10
F	147147	7.48
G	325404	16.55
H	101749	5.17
I	80952	4.12
J	46355	2.36
K	12133	0.62
L	20844	1.06
M	64582	3.28
N	51004	2.59
O	521	0.03
P	8956	0.46
Q	34452	1.75
R	12251	0.62
S	9951	0.51
T	24	0.00
Total	1966486	100.00

Table 3. Descriptive statistics of variables used in the study

Variable	Description	Type	N	Mean	Std. Dev.	Min	Max
Rev_growth	Rate of changes in operating revenue	Ratio	1690171	0.158	0.557	-0.697	4.392
DIG	Digital industry	Dummy	1966486	0.06	0.237	0	1
FOE	Foreign-owned entities*	Dummy	1966486	0.149	0.357	0	1
Leverage	Gearing ratio**	Ratio	1365534	95.762	150.09	0	796.529
HT	High-tech firms	Dummy	1966486	0.023	0.15	0	1
Intangibility	Intangible assets to total assets	Ratio	1949344	0.013	0.04	0	0.298
Age	Age of the firm	Log	1929021	2.584	0.877	0	4.382
Size	Total assets	Log	1966486	7.351	1.947	2.601	12.532
Pandemic	2020 dummy	Dummy	1966486	0.092	0.289	0	1

Note: * GUO's minimum 25.01% ownership threshold applies. ** Gearing ratio = (non-current liabilities + loans) / shareholders funds *100.

Table 4. Covid-19 pandemic and firm performance – baseline estimations

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Size (lag)	-0.016***	-0.016***	-0.016***	-0.016***	-0.016***	-0.016***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intang (lag)	0.098***	0.098***	0.088***	0.090***	0.088***	0.089***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Leverage (lag)	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	-0.135***	-0.135***	-0.135***	-0.135***	-0.135***	-0.135***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
FOE	0.019***	0.018***	0.018***	0.019***	0.017***	0.019***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Pandemic		-0.114***	-0.114***	-0.114***	-0.116***	-0.115***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Pandemic * FOE		0.010***			0.008***	0.009***
		(0.003)			(0.003)	(0.003)
DIG			0.012***		0.011***	
			(0.002)		(0.002)	
Pandemic * DIG			0.025***		0.024***	
			(0.004)		(0.005)	
FOE * DIG					0.007	
					(0.004)	
Pandemic * FOE * DIG					-0.001	
					(0.009)	
HT				0.024***		0.030***
				(0.003)		(0.003)
Pandemic * HT				0.041***		0.042***
				(0.006)		(0.008)
FOE * HT						-0.019***
						(0.005)
Pandemic * FOE * HT						-0.008
						(0.013)
Constant	0.620***	0.621***	0.620***	0.622***	0.621***	0.622***
	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
Observations	1,132,624	1,132,624	1,132,624	1,132,624	1,132,624	1,132,624
No. of firms	194869	194869	194869	194869	194869	194869
R-squared	0.086	0.086	0.086	0.086	0.086	0.086

Note: The table presents estimations (obtained in STATA) with an operating revenue change as a dependent variable. In each of the estimations, country, sector and year fixed effects were included. Robust standard errors (clustered at the firm level) are reported in parentheses. ***, **, * denote significance level at 1%, 5% and 10%, respectively.

Table 5. Covid-19 pandemic and firm performance – System GMM estimations

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Rev_growth (lag)	-0.131***	-0.131***	-0.131***	-0.131***	-0.119***	-0.116***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.003)	(0.008)
Size (lag)	-0.023***	-0.023***	-0.023***	-0.023***	-0.021***	-0.023***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Intang (lag)	0.408***	0.408***	0.400***	0.400***	0.351***	0.372***
	(0.027)	(0.027)	(0.027)	(0.027)	(0.015)	(0.026)
Leverage (lag)	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	0.016***	0.016***	0.016***	0.016***	0.012***	0.010**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.001)	(0.004)
FOE	0.012***	-0.020***	0.012***	0.012***	0.011***	0.011***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)
Pandemic		-0.233***	-0.214***	-0.205***	-0.208***	-0.200***
		(0.015)	(0.014)	(0.014)	(0.012)	(0.013)
Pandemic * FOE		0.073***			0.008***	0.005
		(0.008)			(0.003)	(0.003)
DIG			0.023***		0.013***	
			(0.004)		(0.002)	
Pandemic * DIG			0.027***		0.022***	
			(0.017)		(0.005)	
FOE * DIG					0.003	
					(0.004)	
Pandemic * FOE * DIG					-0.007	
					(0.009)	
HT				0.015***		0.016***
				(0.005)		(0.005)
Pandemic * HT				0.085***		0.051***
				(0.018)		(0.008)
FOE * HT						0.015*
						(0.008)
Pandemic * FOE * HT						-0.011
						(0.013)
Constant	0.249***	0.258***	0.246***	0.247***	0.277***	0.220***
	(0.051)	(0.049)	(0.051)	(0.051)	(0.050)	(0.050)
Observations	970,845	970,845	970,845	970,845	970,845	970,845
Number of firms	182,468	182,468	182,468	182,468	182,468	182,468
AR(1) p-val	0.000	0.000	0.000	0.000	0.000	0.000
AR(2) p-val	0.414	0.399	0.475	0.432	0.571	0.188
No. of instruments	42	43	44	44	47	47
Hansen J-test p-val	0.693	0.705	0.657	0.673	0.728	0.731

Note: The table presents estimations (obtained in STATA) with an operating revenue change as a dependent variable. In each of the estimations, country, sector and year fixed effects were included. Robust standard errors (clustered at the firm level) are reported in parentheses. ***, **, * denote significance level at 1%, 5% and 10%, respectively. AR stands for the Arellano-Bond test verifying the existence of first or second-order autocorrelation. Hansen J-test verifies instruments' validity.