PRODUCTIVITY ANALYSIS OF LATVIAN COMPANIES USING ORBIS DATABASE

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Abstract. This research study uses ORBIS microdata at the company level to analyse productivity of 167 thousand economically active Latvian companies over 2011-2018. The aim of the study is twofold - to find factors consistently associated with productivity at the company level; and to recommend possible criteria for companies to receive a state support (from the view of enhancing aggregate productivity in the long term). Our research results show that productivity of Latvian companies is positively related to their size, age, as well as location closer to Riga and other big cities. However, there is a substantial within-group variation in productivity between companies. Multivariate regression results show that location, size, age and economic sector explain only up to 19% of productivity differences between companies. In addition, distribution of companies by productivity has a positive skewness. This suggests that there is a small number of highly productive companies, while for most companies the productivity is lower than the average. Finally, we propose three criteria for companies to receive a state support: (1) high relative productivity given size, age, sector and location; (2) belonging to a group of companies with a higher probability of survival; (3) carrying out a significant part of economic activity in areas with a high unemployment rate.

Keywords: *productivity, micro data, ORBIS, company size, company age, company location.*

JEL code: C31, L60, R32

Introduction

Economic slowdown resulted from the Covid-19 pandemics has increased the scale and scope of state support not only to households, but also to companies worldwide. In case of short-run lockdown, even a non-targeted broad support measures to companies are not likely to alter a medium term fiscal sustainability of the country. However, if the disease will appear persistent, there might be an increasing tension towards targeting support measures. Moreover, short-run state support to companies should ideally also enhance productivity developments in the longer term. State support should not be targeted to zombie companies which cannot function without a permanent state intervention, as income redistribution from productive companies to unproductive ones would negatively affect aggregate productivity of the economy. With this in mind we began analysing micro data of Latvian companies, aiming to propose such criteria for receiving a state support, which would be beneficial for longer term productivity developments.

In recent years, micro data has been increasingly used in scientific research, which is driven by both the increased availability of such databases and the increased computer capacity. Micro data provide an opportunity for in-depth research on topics for which only aggregated data were previously available. For instance, although aggregated data on productivity by economic sector are available, it is the micro data of particular companies that allow to analyze the productivity variance within a particular sector. Moreover, the use of company micro data allows analysing productivity in dimensions where aggregated data are not available – by company size, age and location. In addition, micro data allows the simultaneous assessment of the impact of all these factors on productivity of the company.

This research study employs company-level micro data from the ORBIS database. ORBIS is the world's largest company-level database maintained by Bureau Van Dijk, a subsidiary of Moody's Analytics. As of autumn 2020, it included about 375 million company data from several countries around the world. The main advantage of the database is that it collects information both on large listed companies and on small limited liability companies with only a few employees. ORBIS includes information on companies' financial indicators, number of employees, capital structure and many other indicators. ORBIS data are widely used in academic research. For example, Alviarez et.al. (2020) assess the role of firm productivity in cross-country income disparities. Ahmad et.al. (2020) examine whether the productivity of firms with foreign capital is higher compared to firms with local owners. OECD (2019) assesses the extent to which the digital transformation of EU countries has affected firm productivity. Opazo-Basáez et.al. (2018) found that car manufacturers that purposefully reduce emissions achieve higher productivity growth. Kancs and Siliverstovs (2016) show that research and development (R&D) investments have a positive but nonlinear impact on firm productivity.

After checking ORBIS data representativity by sectors and regions for the case of Latvia, this research study estimates the links between the productivity of the company and its age, size, sector and location. The link between these factors and productivity is often examined in academic research. For example, De Kok et.al. (2006) assess the non-linear relationship between firm age and productivity. Coad et.al. (2016) examine whether younger firms are more focused on productivity-enhancing innovative solutions. Cucculelli and Mannarino (2019) study the effects of age and ownership on productivity. Biesebroeck (2005) concludes that firms with more employees also have higher productivity. Diaz and Sanchez

(2008) explore the relationship between firm size and technical progress (and productivity). Aiello et.al. (2014) determine whether there is a close correlation between firm location, R&D spending and productivity level. Yang (2020) compares the productivity and viability of firms located in large and small cities. Rizov and Walsh (2010) analyze productivity levels as a function of a firm's distance from the capital.

Based on established links between company productivity and its observable characteristics, we propose criteria which should be fulfilled by companies to receive a state support. When developing these criteria, we perform an additional analysis estimating the persistency of productivity at the company level over time, as well as estimating the probability of survival in different groups of companies (subject to size, age, sector, location and productivity level). Our proposed criteria target state support to companies which are able to achieve high relative productivity and have high probability of survival. Furthermore, these criteria not discriminate companies which have relatively low productivity due to objective reasons. Criteria also allow policy makers to prioritize job retention in areas with the highest unemployment prevalence.

It should be acknowledged that our proposed list of criteria is not exhaustive. First, criteria reflecting the short-term decrease of economic activity in the company (such as the magnitude of turnover decrease) are beyond the scope of this study. Second, incorporation of some important company indicators into criteria is precluded by the respective micro data unavailability. For instance, although export potential of the company and its engagement in R&D activities are also important for maintaining the long-run potential of the economy, ORBIS database does not have export and R&D data for Latvian companies; thus, analysis of these indicators is left for further research.

Research results and discussion

1. Data description

The ORBIS database contains information on 418 thousand Latvian companies in the period from 2011 to 2018/19 (some companies still do not have 2019 data). We narrow the sample of companies to those in which economic activity was observed for at least one year during 2011-2018 (about 167 thousand companies).

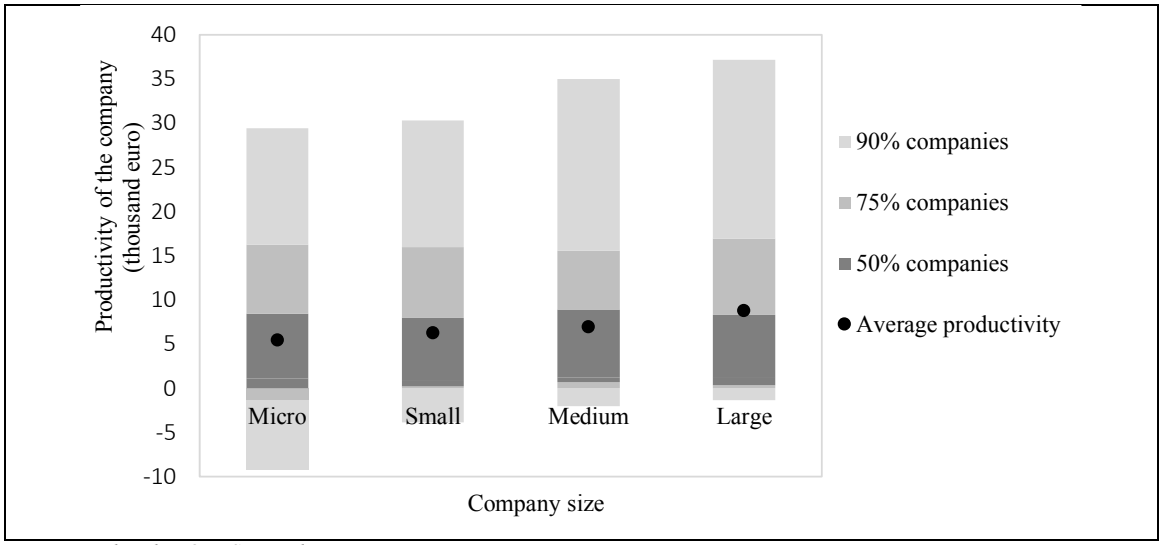
Economically active companies, information on which can be found in the ORBIS database, in 2018 covered more than 714 thousand workplaces, which is 79% of the total number of workplaces in the country. Most of these companies (covering about 630 thousand workplaces) also have data necessary to calculate productivity. In most sectors of the economy, the data on workplaces in the ORBIS database almost coincide with the respective data from Central Statistical Bureau of Latvia (CSB), with the exception of public administration and education (almost not covered by ORBIS). The ORBIS database is also representative in a regional breakdown, covering from two thirds of workplaces in Latgale, up to almost 90% in Pieriga.

In this study, productivity is defined as value added per employee. In turn, value added was calculated as a sum of corporate profits and personnel costs (companies, for which personnel costs were not available, these were considered to be 70% of the company's administrative costs; data on administrative costs come from Lursoft database). In order to obtain real productivity values (at 2015 prices), the nominal indicators (at current prices) were divided by gross domestic product deflator. Such productivity calculations are widely used in academic literature (e.g., Chevalier et al. (2012), Hadengue and Warrin (2013), Barnett et al. (2014)).

2. Productivity of the company and its relation with size, age, location and sector

Our research results imply that in Latvia productivity is positively related to the size of the company. For example, large companies (more than 250 employees) on average have by half higher productivity than the small ones (11-50 employees; Figure 1).

However, there is a significant variation in productivity within each group of companies. Particularly, productivity level in some micro companies (10 employees or less) is higher than in the majority of large companies. In addition, the distribution of productivity by companies is not symmetric. Instead, there is a positive asymmetry (i.e., the median productivity is lower than the average). A small number of companies have very high productivity, which significantly increases the average productivity level. For most of the companies, however, productivity is below the average. This is especially true in the group of large companies, where three quarters of employees are employed in companies with below-average productivity.

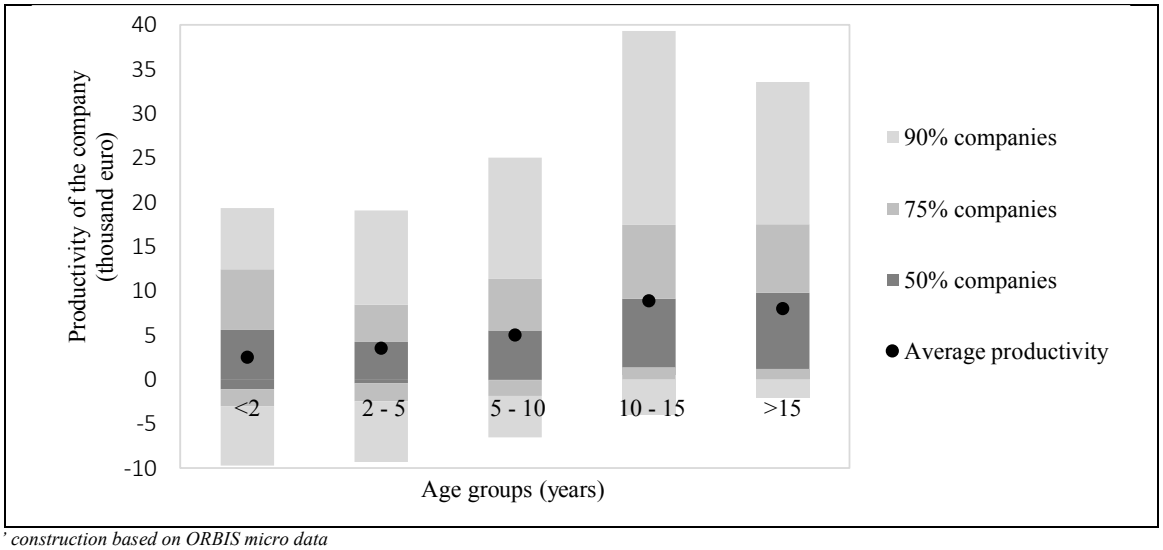


Source: authors' construction based on ORBIS micro data

Note. Companies are divided into four groups according to the number of employees: micro (10 employees or less), small (11 - 50 employees), medium (51 - 250 employees), large (more than 250 employees). Companies are weighted by the number of workplaces.

Fig. 1. **Productivity variation subject to company size (during 2015-2019 on average)**

Next, the relationship between productivity and the age of companies was examined. Our results show that the productivity of companies tends to increase with age, but the relation is not linear. In the first years of a company's operation, the level of productivity is usually relatively low, while it is the highest for companies aged 10-15 years (Figure 2). However, even in this case, there is a large variation in productivity in each group of companies, as well as a positive asymmetry in the distribution of companies (especially for companies older than 10 years). Thus, it can be concluded that although larger and older companies have higher productivity on average, age and size are not crucial productivity factors.



Source: authors' construction based on ORBIS micro data

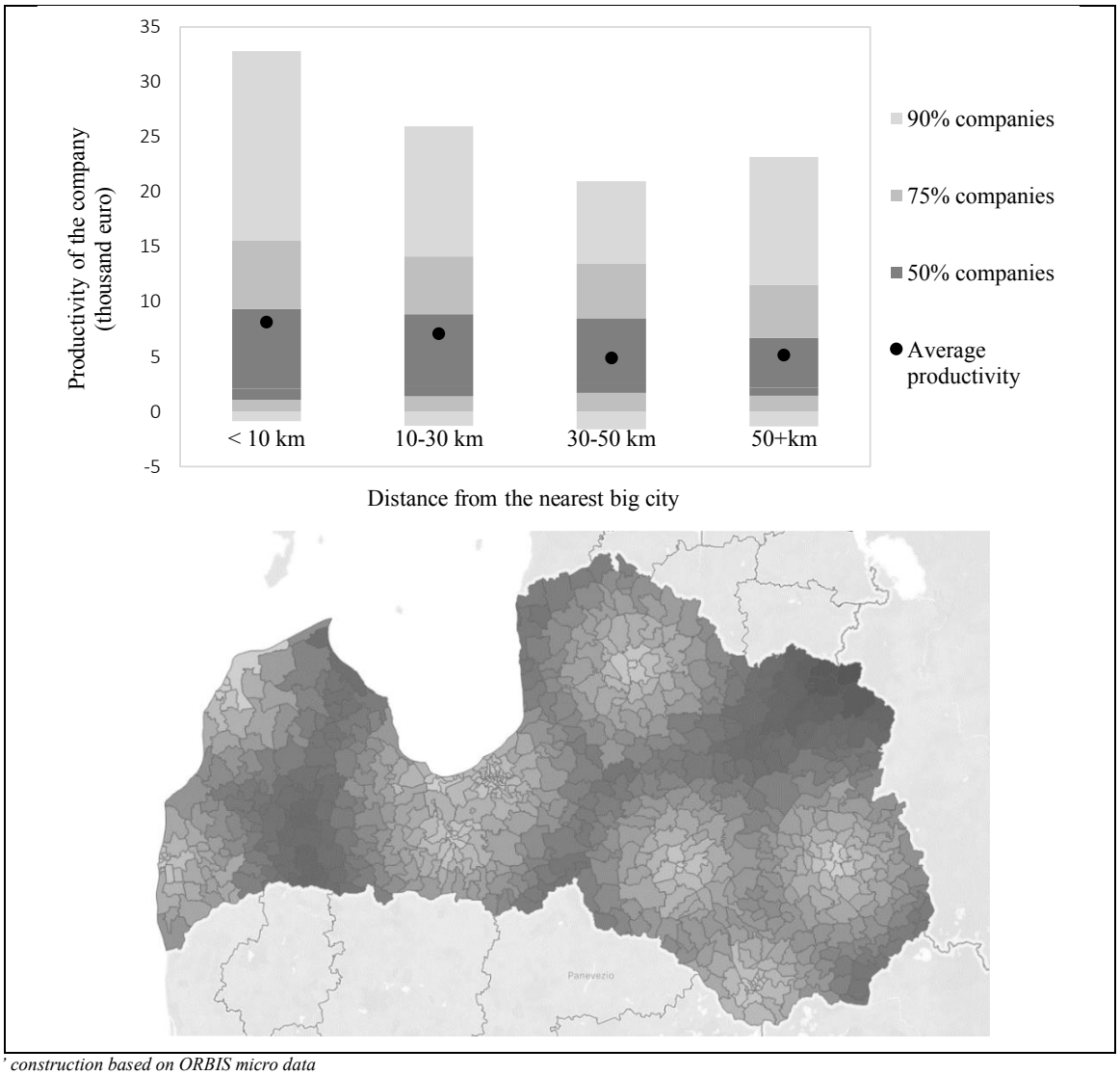
Note. Companies are weighted by the number of workplaces.

Fig. 2. **Productivity variation subject to company age (during 2015-2019 on average)**

When analysing the relationship between productivity and the location of the company, the location was determined by the geographical coordinates of the postal code of the company's legal address. Although the legal address may not always reflect the place where economic activity is implemented (especially for large companies), the relation between the company's legal address and place of economic activity is also obvious. To determine the distance between the coordinate point for each of the 709 Latvian postal codes to Riga and to the nearest other big city (Daugavpils, Jekabpils, Jelgava, Jurmala, Liepaja, Rezekne, Valmiera, Ventspils) latitudes and longitudes were obtained with the Google Cloud Geocoding API service function. Then, the distance in kilometers was calculated using the Haversine formula.

Our research results imply that the productivity of companies is positively related to the location closer to Riga and other big cities. For example, the average level of productivity for a company located within a ten-kilometer radius from Riga center is almost twice higher than for a company

located a hundred kilometers away from Riga. Also, a company located closer than ten kilometers from any big city is on average 1.6 times more productive than a company located more than 50 kilometers from a big city (Figure 3). However, also in these cases there is a significant variation of productivity (and a pronounced positive asymmetry) in each group of companies. Namely, both in Riga and in other regions, the productivity of most companies is lower than the average of respective group.

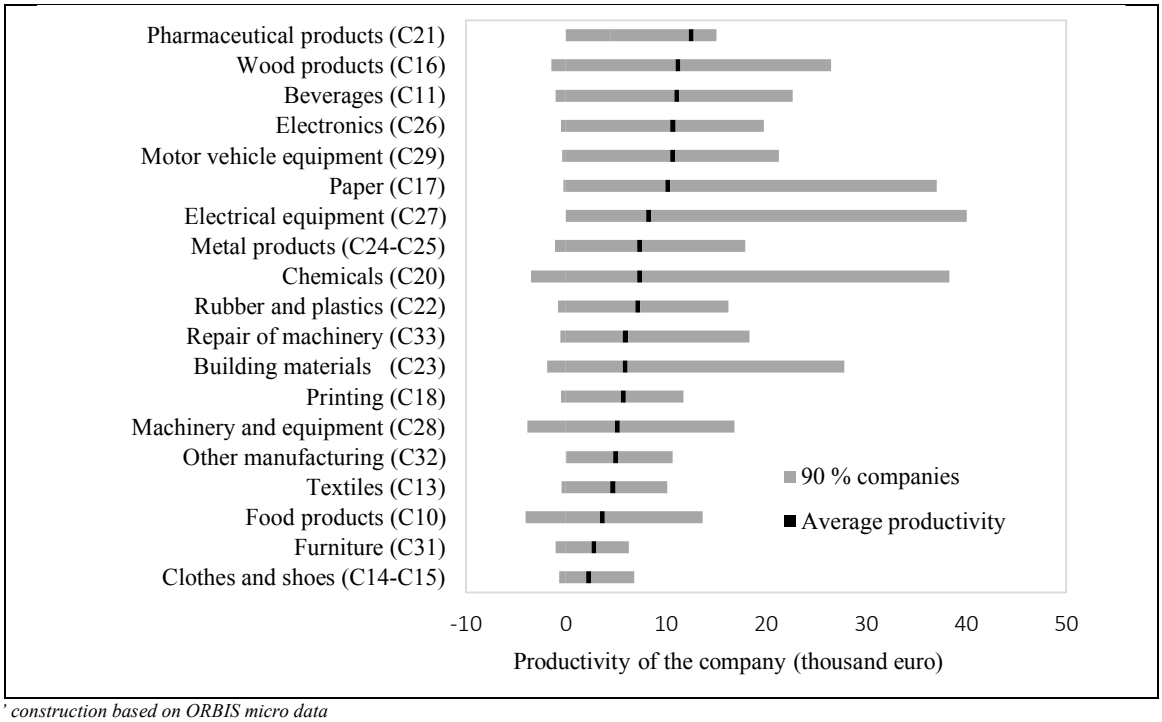


Source: authors' construction based on ORBIS micro data

Notes. The upper panel shows the productivity variation in different groups of companies subject to distance from a big city. The lower panel shows map with 709 separate postal codes and their distance to big cities (lighter colour reflets closer distance to big city). Companies are weighted by the number of workplaces.

Fig. 3. **Productivity variation subject to company distance from a big city (during 2015-2019 on average)**

ORBIS data also confirm that company productivity differs significantly even within a single economic sub-sector. For example, although the manufacturing of food products has, on average, a relatively modest level of productivity, some companies from this sub-sector are more productive than a typical company in pharmaceutical or wood sub-sectors (Figure 4).



Source: authors' construction based on ORBIS micro data

Notes. Companies are weighted by the number of workplaces. The following companies were excluded (outliers, which significantly affected the average productivity): Elme Messer Metalurgs LLC, I.S.D. LLC (chemicals C20), SCHWENK Latvija LLC, Valmieras Stikla Skiedra JSC (building materials C23), KVV Liepajas Metalurgs JSC (metal products C24-25), EUROLCDS LLC, Mikrotikls LLC (electronics C26).

Fig. 4. **Productivity variation of manufacturing companies by sub-sectors (during 2015-2018 on average)**

Next, we analyse the simultaneous impact of all the above mentioned factors on productivity at the company level. Multifactor regression results confirm the negative correlation between productivity of the company and its distance from economic centres. For example, 1% additional distance from Riga is associated with lower productivity by about 0.12 -0.15% (other factors holding unchanged; see Table 1). In turn, the size and age of a company have a positive but non-linear relationship with productivity. Particularly, the larger is the company, the less further increase in workforce is associated with higher productivity. The model assessment also took into account that companies in different sectors tend to have different productivity.

Results of multifactor regression model show that all the above factors together can explain only a small part of productivity differentials between the companies. When controlling by economic sectors, the model explains 10% of the differences in productivity (coefficient of determination; model 2), but without controlling economic sectors - only 2% (model 1). In models where companies were weighted by the number of workplaces (i.e., big companies have a greater impact on model results), the explanatory power is slightly higher - 4% without control of economic sector (model 3) and 19% with control of economic sector (model 4). The use of a weighted regression is justified by the fact that in small companies productivity tends to be more affected by one-off factors. However, even in case of a weighted regression, largest part of productivity difference between companies remains unexplained.

Table 1

Factors associated with company productivity: multifactor regression model

Dependent variable: log (productivity of the company; average level over 2015 – 2018)
Companies are not weighted by the number of workplaces:

	Model 1	Model 2
log (kilometres from Riga)	-0.123 *** (-21.1)	-0.153 *** (-25.6)
Number of workplaces	0.000 (1.0)	0.001 *** (4.3)
Number of workplaces squared	-0.000 (-1.1)	-0.000 *** (-3.8)
Company age (years)	0.026 *** (6.6)	0.018 *** (4.7)
Company age squared	-0.001 *** (-4.9)	-0.001 *** (-5.4)
Constant	8.216 *** (248.6)	7.908 *** (150.7)
Economic sector		Included
Coefficient of determination (R2)	0.02	0.10
Number of companies	28 271	28 256

Companies are weighted by the number of workplaces:

	Model 3	Model 4
log (kilometres from Riga)	-0.121 *** (-23.1)	-0.136 *** (-26.2)
Number of workplaces	-0.000 *** (-13.6)	-0.000 *** (-10.9)
Number of workplaces squared	0.000 *** (9.2)	0.000 *** (6.5)
Company age (years)	0.031 *** (18.6)	0.028 *** (18.0)
Company age squared	-0.000 *** (-5.1)	-0.000 *** (-5.8)
Constant	8.036 *** (291.3)	7.182 *** (196.9)
Economic sector		Included
Coefficient of determination (R2)	0.04	0.19
Number of companies	28 271	28 256

Source: authors' calculations based on ORBIS micro data

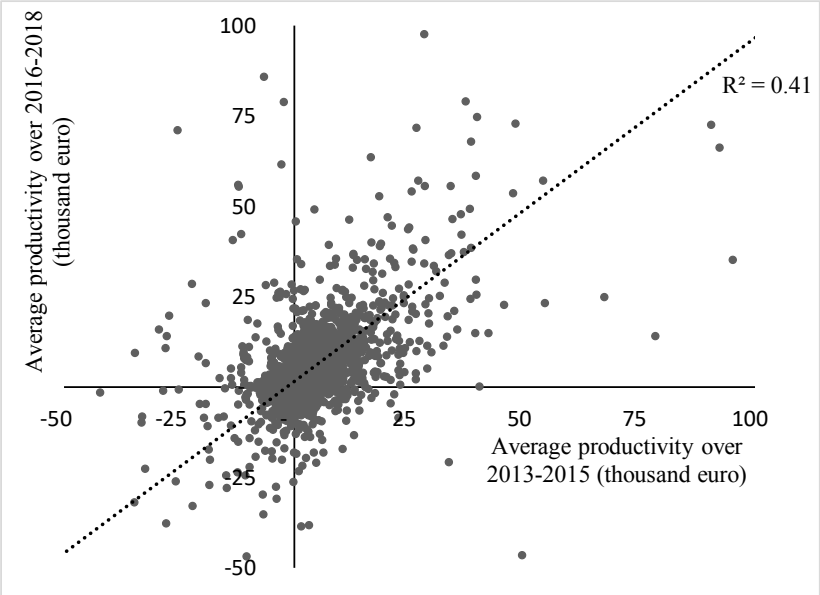
Notes: table contains multifactor regression coefficient values (and t-values in parentheses).
Models exclude firms with missing value added or number of workplaces data over 2015-2018, firms with negative productivity, firms for which the year of establishment or legal address was not indicated. The economic sector is included at the NACE letter level.
, ** and * defines statistical significance at 10%, 5% and 1% level respectively.*

Therefore, it can be concluded that company productivity is positively related to the size and age of the company, as well as its location closer to Riga and other big cities. However, these factors are not crucial to firm productivity. Even when controlled by the economic sector, these factors can explain 10 to 19% of productivity differences between companies.

3. Defining criteria for companies to receive a state support

Our research results show that the level of productivity at the company level is persistent over time. This means that companies that were productive yesterday (with rare exceptions) are productive today; and the same companies are likely to show high productivity also tomorrow. For example, there is a positive and statistically significant correlation between the productivity of manufacturing companies during 2016–2018 and 2013–2015 (Figure 5).

This can also be seen when selecting 15 most productive manufacturing companies in 2018 and analysing the relative productivity of these companies during the previous years. Those manufacturing companies that were the most productive in 2018 also showed relatively high productivity over 2013-2017 (Table 2). For instance, LLC "Technics SA" (aircraft repair and maintenance) - the company with the highest productivity in 2018, has never fallen below the 3rd place in the productivity rating over 2013-2017. LLC "Kronospan Riga" (production of veneer sheets and wood panels) with the 2nd highest productivity in 2018, in the previous five years was never lower than the 8th place, but LLC "Mikrotikls" (production of communication equipment) with the 3rd place in 2018 – was never below the 6th place. It should be noted that the total number of manufacturing enterprises for which it was possible to calculate the level of productivity for each of the years from 2013 to 2018 is almost four thousand. Thus, even the rank of 200 or 400 reflects a very high relative productivity (higher than 95% and 90% of all manufacturing companies for which data were available, respectively).



Source: authors' construction based on ORBIS micro data

Fig. 5. **Productivity of manufacturing companies over 2013–2015 and 2016–2018**

Table 2

Productivity rank of Latvian manufacturing companies during 2013 – 2018

(sample: 15 most productive companies in 2018)

Company	NACE sub-sector	Rank					
		2018	2017	2016	2015	2014	2013
Technics SA LLC	aircraft repair and maintenance	1	1	3	2	3	1
Kronospan Riga LLC	manufacture of veneer sheets and wood panels	2	3	4	8	7	5
Mikrotikls LLC	manufacture of communication equipment	3	5	1	1	2	3
BSI Import LLC	repair of equipment	4	31	75	107	45	299
Embedded Systems LLC	manufacture of electricity distribution and control apparatus	5	6	9	15	22	48
Tibnor LLC	metal structures	6	12	6	4	12	9
BMS Tehnologija LLC	repair of electronic and optical equipment	7	8	8	12	34	19
Severstal Distribution LLC	metal surface treatment and coating	8	10	24	75	193	45
Evolution Print LLC	printing of other publications	9	52	20	17	28	61
Burlat LLC	repair of electronic and optical equipment	10	173	201	215	287	80
Wonderwood LLC	manufacture of other products of wood	11	21	27	55	76	201
Vilomix Baltic LLC	manufacture of prepared feeds for farm animals	12	15	36	31	33	78
JI Tehnologijas LLC	repair of other equipment	13	14	81	120	14	397
Hansa Timber Trade LLC	sawing, planing and impregnation	14	9	45	38	35	89
Ilstone LLC	manufacture nec	15	93	87	206	373	347

Source: authors' calculations based on ORBIS micro data

Note: manufacturing companies that were economically active every year from 2013 to 2018 were ranked in descending order of productivity (3998 companies in total).

Thus, our first proposed criterion for companies to receive a state support is that **in the medium term the company has been able to achieve higher productivity than other similar companies (in the same size and age group, industry and location** (distance from Riga and other large cities)).

This criterion ensures that state support is received mainly by those companies that are likely to show high productivity in the future (i.e., their financial difficulties are a short-term phenomenon). State support is not spent on preserving companies that are unproductive in the long term – these companies are allowed to close down quickly; thus, to free up production factors (labour, capital and land) for more productive businesses. Thus, state support may not increase the share of zombie companies in the economy and does not support companies that cannot function without the state intervention in the long run.

Zombie companies and their detrimental impact on productivity are considered to be one of the causes of Japan's economic stagnation during the 1990s (Caballero et al., 2008). There is also evidence that the share of zombie companies in EU countries has increased significantly since the global financial crisis (Storz et al., 2017; Andrews and Petroulakis, 2019). The presence of zombie companies not only reduces the average level of productivity in the economy, but also slows down the development of productive companies, reducing their opportunities to invest, innovate and recruit new employees (Peek and Rosengren, 2005; Caballero et al., 2008).

At the same time, this criterion takes into account objective reasons why a given company's productivity is high or low. For example, this criterion stipulates that the threshold for granting state support (in terms of productivity) to small companies located far from Riga should be lower than to large companies located close to Riga. Similarly, beverage manufacturers should have a higher productivity threshold (to qualify for state support) than food manufacturers.

There has been a long academic discussion on whether state industrial policy should adapt to the existing comparative advantage of the economy or try to develop it in the desired direction (Lin and Chang, 2009). This criterion does not support one or another approach. Instead of supporting sectors in which Latvia already has a comparative advantage, or high-productivity sectors in which Latvia has the potential to develop its comparative advantage, this criterion offers support to companies that have already proven their high productivity. There are two reasons for this criterion, which result from the analysis of ORBIS micro data. First, the level of productivity at the company level is persistent over time. Second, the economic sector (as well as any factor by which companies can be divided into groups - size, age, location) tends to unite both companies with

high productivity and companies with low productivity; thus, belonging to a certain group of companies does not yet guarantee high productivity in a particular company.

An additional criteria should include a possibility that the company will go out of business soon after receiving a state support. The analysis of the ORBIS database shows that different companies have quite different probabilities of survival - depending on the industry, age, size, sector or even productivity level. For instance, across sectors, manufacturing companies have the highest probability of survival. Regarding company breakdown by size and age group, probability of survival is the highest for larger and older companies. Particularly, of all micro companies (ten employees and less) that were economically active in 2011, only 86% remained economically active until 2018, while in other size groups the rate of survival was at least 95%. Of those companies that were less than two years old in 2011, 82% remained until 2018 (compared to 91% of enterprises aged 15 and over). **Thus, the second (additional) criterion for receiving state support is that the company belongs to a group of companies with a higher probability of survival**. It should be noted that the probability of survival is positively and systematically related to the level of productivity, ensuring the consistency with the first (main) criterion. In particular, among the active companies in 2011 which showed negative productivity in the medium term, 81% remained until 2018 (compared to 90% with positive productivity).

When granting state support to companies, significant differences in the labour market situation in different regions of Latvia must also be taken into account. In high unemployment areas maintaining jobs is as important priority as promoting productivity. Latgale traditionally stands out with high unemployment - in several municipalities the number of unemployed registered with the State Employment Agency varies around 20% of the working age population (corresponding to about 30% of the economically active population). Although during the Covid-19 outbreak the fastest unemployment increase was observed in large cities, the highest unemployment rate still remains in the municipalities located in the eastern part of the country. **Thus, the third (additional) criterion for receiving state support is that a significant part of the company's economic activity is carried out in areas with a high unemployment rate.**

Third criterion will allow companies operating in municipalities with a high unemployment rate to be eligible for state support even if their productivity is below a certain threshold. Note that this criterion includes precisely the place of the economic activity and not the legal address of the company, since the latter can be easily changed if such criterion will be introduced.

It should be noted also that the relative importance of the criteria may vary depending on the phase of the economic cycle. For example, the relevance of job retention increases during the economic crisis - this can be taken into account by increasing the weight of the unemployment criterion. In turn, in the expansion phase of the economic cycle, ensuring the long-term pace of economic development becomes more important, which can be promoted by redistributing the factors of production in favour of more productive companies (i.e., increasing the weight of the productivity criterion).

Conclusions, proposals, recommendations

Conclusions:

1. Productivity of Latvian companies is positively related to their size, age, as well as location closer to Riga and other big cities. For example, in large companies (more than 250 employees) productivity is by half higher than in small companies (11 - 50 employees). In the first years of a company's operation, the level of productivity is usually relatively low, while it is the highest for 10-15 years aged companies. Also, in a company located within a ten-kilometres radius from the center of Riga, productivity is almost twice higher than in a company located further than hundred kilometres from Riga.
2. There is a significant variation in productivity in all the above groups of companies. Multivariate regression results show that location, size, age and economic sector explain only up to 19% of productivity differences between companies in the medium term.
3. Productivity distribution of companies has a positive skewness. This suggests that there is a small number of highly productive companies, while for most companies the productivity is lower than the average. For example, in the group of large companies, three quarters of employees are employed in companies with productivity lower than the average.

Proposals and recommendations:

Based on this study, three criteria for companies to receive a state support (from the point of view of enhancing aggregate productivity) are defined:
1. First (main) criterion - in the medium term the company has been able to achieve higher productivity than other similar companies (in the same size and age group, industry and location (distance from Riga and other Republican cities)). This criterion is justified both by the fact that belonging to a certain group of companies does not guarantee high productivity, as well as given that company productivity level is persistent over time. This

main criterion ensures that state support is received by the companies which are highly likely to show high productivity in the future. State support is not spent on companies that are unproductive in the long term. At the same time, objective reasons for differences in productivity are taken into account - receipt of state support does not discriminate, for instance, small and young companies located far from Riga.

2. Second (additional) criterion - the company belongs to a group of companies with a higher probability of survival. The results of this study show that survival probability is higher for manufacturing companies, as well as older companies with more than ten employees.

3. Third (additional) criterion – a significant part of economic activity in the company is carried out in areas with high unemployment rate. The third criterion takes into account significant labour market differences between Latvian municipalities and allows policy makers to prioritize job retention in areas with the highest unemployment prevalence.

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