Harnessing the productivity benefits of online platforms: Background paper

An OECD contribution to the G20 Italian Presidency 2021

2021

This document was prepared by the Organisation for Economic Co-operation and Development as an input for the discussions in the Framework Working Group in 2021 (under the G20 Italian Presidency).

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Please cite this publication as: OECD (2021), "Harnessing the productivity benefits of online platforms: Background paper", OECD Publishing, Paris.

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An OECD contribution to the G20 Italian Presidency 2021[1]

1. Introduction

In the past decade, online platforms have become ubiquitous. People and firms use them for many purposes, such as entertainment, information, advertisement, and for the purchase and sale of goods and services. A companion study to this report (OECD, 2021[1]) provides new evidence of the rapid diffusion in G20 countries of multisided online platforms that facilitate interactions among firms or individuals for the exchange goods or services via the Internet. This OECD contribution to the Framework Working Group of the 2021 G20 presidency focuses on the impact of these platforms on the productivity growth of incumbent firms.

The fast diffusion of online platforms over the past decade is attributable to the large economic benefits and opportunities they engender. Large network effects and low-cost transactions allow online platforms to connect more individuals and businesses than physical marketplaces, facilitating market exchanges, while internet openness and global trade enable them to reach users globally. By reducing transaction costs, improving matching of buyers and sellers and boosting capacity utilisation, platforms can increase market efficiency (OECD, 2019[2]; Cramer and Krueger, 2016[3]). The numerous services some online platforms provide to their users (e.g., advanced low-cost logistics and payment services, tailored advertising, better communications with suppliers and easier dispute resolutions) can be especially beneficial for SMEs.

The COVID-19 shock has further accelerated the take up of online platforms. During lockdowns, economic activity has shifted towards online marketplaces – at least in those sectors, such as retail sales, mobile payments and restaurant delivery, requiring no or minimal physical contact – helping economies to weather the economic shock (OECD, 2020[5]).

At the same time, the rapid rise of online platforms has disrupted well-established industries and business models, and calls for a review of existing regulations across many policy areas, such as competition, labour market, taxation and consumer protection. For instance, large network effects can generate winner-take-

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[1] The report was prepared by a team from the OECD Economics Department including Mauro Pisu, Hélia Costa, and Christina von Rüden, under the supervision of Giuseppe Nicoletti. Editorial support was provided by Sarah Michelson. The report benefited from inputs from the following OECD directorates: Centre for Entrepreneurship, SMEs, Regions and Cities, Directorate for Financial and Enterprise Affairs, Directorate for Employment, Labour and Social Affairs, Statistics and Data Directorate, Directorate for Science, Technology and Innovation and the Sherpa Office. The report also greatly benefited from interactions with the Italian G20 team.

all dynamics that can result in the emergence of just few large players and lead to rent extraction from users.

Estimating online platforms' impact on the productivity growth of incumbent firms can shed light on how digital technologies can contribute to revive aggregate productivity growth, as platforms are one of the most prominent and visible embodiment of the ongoing digital transformation. This is a topical issue given the productivity slowdown G20 countries have experienced over the past 20 years (OECD, 2021 forthcoming[5]) and key to understanding the contribution of online platforms to raising long-term growth prospects. Raising productivity growth is crucial to deal with the fiscal challenges ahead without recurring to drastic tax increases and spending cuts (OECD, 2021 forthcoming[7]).

Online platforms could affect the productivity growth of incumbent firms through many channels. First, platforms that are in direct competition with incumbent firms (i.e. disruptor platforms) can encourage them to innovate, rising their productivity, or force the exit of the less productive ones. Second, platforms that connect existing service providers with consumers (i.e. aggregator platforms) can raise incumbent firms' productivity growth by increasing market transparency (through for instance review systems and price comparisons), and allowing firms to improve some of their production processes, such as booking systems and logistics. However, platforms could also contribute to lower the productivity of incumbent businesses by weakening the selection process and allowing low productivity workers and firms to stay in business.[2] For instance, by facilitating market access, aggregator platforms may make it easier for small and less productive firms to enter the market or continue to operate (Schwellnus et al., 2019[7]).

Previous analyses of the effect of online platforms on firms' economic performance are limited and consist mostly of case studies focusing on specific platforms and settings (see Box 1). As detailed in Section 2, this study overcomes these limits by measuring online platforms activity in a consistent way across countries and sectors relying on new data on the number of visits to platforms' websites. The data cover seven activity areas (accommodation, business-to-consumer and consumer-to-consumer marketplace, business-to-business marketplace, personal services, professional services, restaurant booking and delivery, and transport). Information on online platform activity were then merged with information on firm-level performance from a cross-country data set based on a correspondence table between platforms' activity areas and firms' industrial classification.

The results presented in Section 3 indicate that online platform diffusion is associated with higher productivity growth of incumbent businesses. These results are in line with previous OECD work (Bailin Rivares et al., 2019[4]).[3] Results also show that productivity gains are due to increases in value added rather than reductions in employment, pointing to the expansion of business opportunities online platforms generate. Moreover, productivity gains are greater for small firms and firms in the middle of the productivity distribution, suggesting that online platforms can play an important role in levelling the competitive playing field between SMEs and large companies and in narrowing productivity gaps among firms. Finally, productivity gains are stronger in areas of platform activity with a higher degree of reshuffling among the

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[2] In addition to these channels, online platforms can contribute to increase aggregate productivity by improving allocative efficiency. Increased competition and more transparency may force the least efficient firms to exit and promote the reallocation of market shares towards the most productive ones, a channel that was explored in Bailin Rivares et al. (2019).

[3] This report however differs in several key dimensions. Most importantly, it covers a vastly more comprehensive list of platforms built using different sources, including also smaller and purely local platforms, and measuring platform activity in absolute (rather than purely relative) terms. The larger set of countries covers economies at different stages of development. Additional sectors are included, notably personal and professional services, where online platforms are playing an increasingly important role. This study focuses on the past decade, when platform diffusion has been most rapid.

largest online platforms, underlining the importance of online-platform market contestability for productivity gains.

The productivity benefits of online platforms on incumbent companies should not diminish the urgency to address the challenges that can still limit the adoption and effective use of online platforms, especially by small firms, reduce competitive pressures among platforms and worsen working conditions for platform workers. Tackling these challenges is key to perpetuating online platforms' positive contribution to productivity growth.

As Section 4 discusses, issues relating to competition policy and enforcement, and the labour market deserve special attention. That the productivity benefits arising from online platforms tend to rise with the degree of reshuffling among top platforms calls for ensuring that online-platform markets remain open and contestable. In addition, online platforms' reliance on huge amounts of personal and business data raises concerns over data privacy, concentration of power, and unfair competition against third party sellers. Finally, because of their reliance on "gig-economy" or "on-demand" workers, online platforms create new challenges for the labour market and social protection systems (OECD, 2019[8]; Schwellnus et al., 2019[7]), which – if left unaddressed – may lessen the productivity benefits of online platforms and abet rent extraction. Addressing these requires action to diminish the labour market monopsony (i.e. buyer' power) of online platforms, adjust collective bargaining arrangements and improve training opportunities and the social protection of platform workers.

Box 1. Research on the economic effects of online platforms

Despite the vast and growing interest in the development of online platforms and their interactions with economic outcomes, such as prices, profits, and consumer welfare, empirical literature in this area is still relatively scarce, and consists mostly of case studies of specific settings.

In the transport sector, research has mostly focused on the quality of services. Examples are Athey, Castillo and Chandar (2019[9]), who study which characteristics of Uber services improve their quality, and Wallsten (2015[10]), who investigates the impact of the uptake of uber in certain United States cities on the ratings of traditional taxi drivers. Similarly, Cramer and Krueger (2015[11]) compare the efficiency of Uber with that of traditional taxis by measuring capacity utilization in both and find that uber drivers in five U.S. cities have higher capacity utilization rates. Other studies reach similar conclusions (e.g. Rayle et al. (2016[12])).

In the accommodation sector, studies have focused mostly on the welfare effects of platforms. For example, Zervas, Proserpio and Byers (2017[13]) quantify the impact of Airbnb on hotel revenues, Barron, Kung and Proserpio (2020[14]) the increases in rental rates and hotel prices from Airbnb entrance, and Farronato and Fradkin (2018[15]) the changes and distribution of surpluses of consumers, entrants, and incumbents, from Airbnb use, all using United States data.

Again for the United States, Farronato et al. (2020[16]) study whether ex-ante (in the form of occupational licencing) or ex-post (in the form of online reviews) quality control matters the most to consumers. They use a professional services platform as an example, and find that consumers value mostly the latter.

A considerable amount of work has also focused on job market impacts of online platforms, for example on participation Hall and Krueger (2018[18]) or on wages Schwellnus et al. (2019[7]), both for U.S. platforms.

The lack of cross-sector and cross-country empirical studies has to do with the difficulty of measuring platform uptake in a comparable way. Bailin Rivares e a. (2019[4]) get around the problem by using search data from Google Trends to measure platform uptake across four sectors and ten countries and find a positive relationship between platform uptake and firm-level productivity growth. They find that that aggregator platforms drive this positive effect, lending some support to the second channel described above, and that the positive effect declines with persistent market dominance by a few platforms.

2. Platform diffusion and productivity growth: data

The focus of this analysis is on multisided online platforms, defined as those that facilitate interactions between two or more distinct but interdependent sets of users (firms or individuals) who interact to exchange goods or services via the Internet.[4] This includes both platforms that are in direct competition with incumbent firms (i.e. disruptor platforms) and platforms that connect existing service providers with consumers (i.e. aggregator platforms). The analysis encompasses seven service areas of activity (marketplace to consumers, including consumer-to-consumer and business-to-consumer, marketplace business-to-business, restaurant, both booking and delivery, transport, accommodation, personal services, and professional services) where the diffusion of online platforms has been relevant in recent years. The study uses yearly data on platform diffusion (proxied by number of visits to online platforms' websites as explained below), and yearly firm-level data on value added, labour input, productivity and total assets. Website traffic is just a proxy of the actual volume of activity of online platforms but it has the advantage of being consistent across platforms, countries, and years. More details on the data and their limitations are in OECD (2021[1]) and Box 2.

Box 2. Measuring online-platform activity

The measurement of online-platform activity is not straightforward, as comparable data across platforms and countries are not available. For this reason, many studies focus on single-platform data. This study instead uses the estimated number of visits to a platform's website (i.e. traffic) as a proxy for the diffusion of the platform as detailed in OECD (2021[1]). The assumption is that the number of visits to an online platform's website is correlated with the volume of activity of the platform, either because the platform is accessed directly through the website or because users are looking for information or tips when using the platform through mobile apps.[5] Unlike data sourced from Google Trends and employed in previous studies, the measure used in this report is not standardised by the total number of Google searches in a country (thus it is not affected by the rising numbers of internet users and

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[4] This definition excludes online activities that do not involve online marketplaces, such as e-commerce (direct online sale of own products to customers without third parties) and social media, but it includes third-party business-to-consumers and business-to-business activities.

[5] The data does not allow to discern the number of users with mobile apps or how much they use them. Accessing platforms through apps is likely to have surged in recent years, which implies that the data may underestimate the increase in the use of platforms. This also means that the suitability of website traffic as proxy of platform use may vary across activity areas. In some areas (e.g., accommodation) users may be more likely to access online platform services through the website than in others (e.g., taxi).

changes in the number of Google searches over time) and excludes searches for platforms that did not result in website visits and "false positives" (OECD, 2021[1]).

Each online platform area of activity is then mapped into the standard classification (2-digit level in the NACE Rev 2) of services industries (Table 1). The exception was mobile payments sector, as it does not clearly map into any specific standard service industry. For this reason, it was excluded from the analysis.

Table 1. Correspondence of online platforms' areas into service sectors industrial classification

Online platforms' activity area	Service sectors (2-dgit NACE Rev 2)	
Marketplace X2C (Consumer-to-consumer and Business-to-consumer)	47	Retail trade
Marketplace B2B (Business-to-business)	46	Wholesale trade
Restaurants booking; restaurant delivery	56	Food and beverage service activities
Transport	49	Land transport and transport pipelines
Accommodation	55	Accommodation
Professional services	62	Computer programming, consultancy and related activities
	69	Legal and accounting activities
	71	Architectural and engineering activities; technical testing and analysis
	73	Advertising and market research
	74	Other professional, scientific and technical activities
Personal services	43	Specialised construction activities
	81	Services to buildings and landscape activities
	95	Repair of computers and personal and household goods
	96	Other personal service activities

Source: OECD (2021[1]).

Firm level data for the same sectors are retrieved from Orbis, a harmonised cross-country firm-level longitudinal dataset commercialised by Bureau Van Dijk. Orbis provided annual firm-level data until 2018 at the time this study was completed. The process described in Gal (2013[18]) is used to clean the data and ensure comparability across countries.

The study estimates the link between yearly productivity growth of incumbent firms and the activity of online platforms operating in the same country and activity area. The focus is primarily on labour productivity, which is measured as the ratio between real value added and the number of employees.[6] The empirical analysis covers 28 countries for between two and six years (between 2013 and 2018) depending on the availability of platform and labour productivity data. The cleaned dataset has nearly 2 600 000 observations in total, with a large variation across countries (see Table B.1 in Annex B).[7]

Over the period of analysis, the number of platforms operating in the 28 countries increased markedly, from 541 in 2013 to 1 096 in 2018. For the 16 countries for which data are available for all years between 2013 and to 2018, the average traffic per capita increased more than threefold (Figure 1, Panel A). The number of platforms also varies widely across countries. For example, the number of active platforms in the United States in 2018 was 773 while it was 114 in Slovenia (Figure 1, Panel B). OECD (2021[1]) provides further information on the diffusion of platforms across counties and over time.

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[6] As alternatives, two measures of multifactor productivity growth are used. These are detailed in Annex A along with the empirical specification.

[7] The main results are robust to restricting the focus on the eight countries with the best coverage.

Figure 1. The number of online platforms and their activity have been increasing

Panel A: Number of platforms and average of traffic per capita across countries, 2013-2018

Number of platforms   Traffic per capita

——Total number of platforms (left axis)   ——Website visits per capita (right axis)
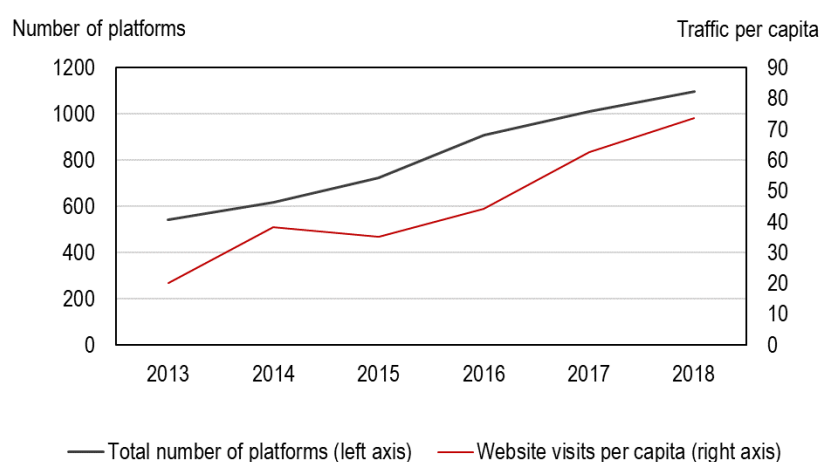
Panel B: Number of platforms in each country in the sample, 2018
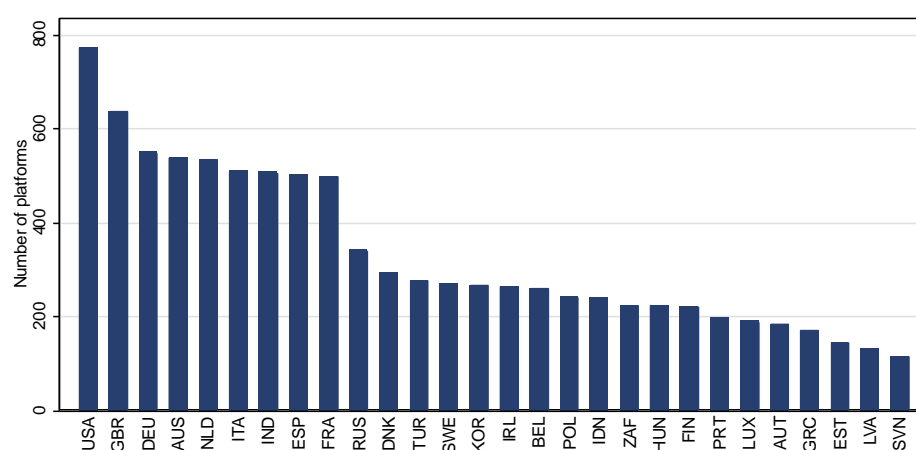

Note: Panel A: The number of platforms refers to the total number of unique online platforms present on the data across all 28 countries used in the analysis; traffic per capita refers to the average of platform website visits per capita across all 16 countries in the database for which data is available from 2013. See Table B.1 in Annex B for a list of countries and the years available. Panel B: the number of platforms is the total number of online platforms present in each of the countries in the sample, in 2018.
Source: Author's calculations using data from OECD (2021[1]).

3. Platform diffusion and productivity growth: results

3.1. Platform diffusion tends to boost firm-level productivity growth

Overall, results suggest that online platform activity has a positive association with labour productivity growth (Figure 2). According to these estimates, doubling online platform activity would increase labour productivity growth of traditional companies by 2 percentage points on average.8 Importantly, the results

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8 Equivalently, increasing online platform activity by one standard deviation is associated with an increase of labour productivity growth by around 5.3 percentage points. The impact of platform activity on multifactor productivity growth

also suggest that the labour productivity gains associated with higher online-platform activity are attributable to increases in value added and not reduction in employment. Access to services provided by online platforms, such as logistics, marketing, tailored advertising, dispute resolutions and others, could make it easier to reach new clients and improve service quality, boosting firms' revenues and value added at unchanged labour input. These results are consistent, for instance, with recent findings that a rising share of value added in German industry and industry-related services depends on the use of online platforms (vbw, 2019[19]).

Figure 2. Online-platform activity increases firms' labour productivity growth by boosting value added

Changes to firm-level growth of labour productivity, value added, and employment attributable to a three-fold increase in online platform activity in the same sector
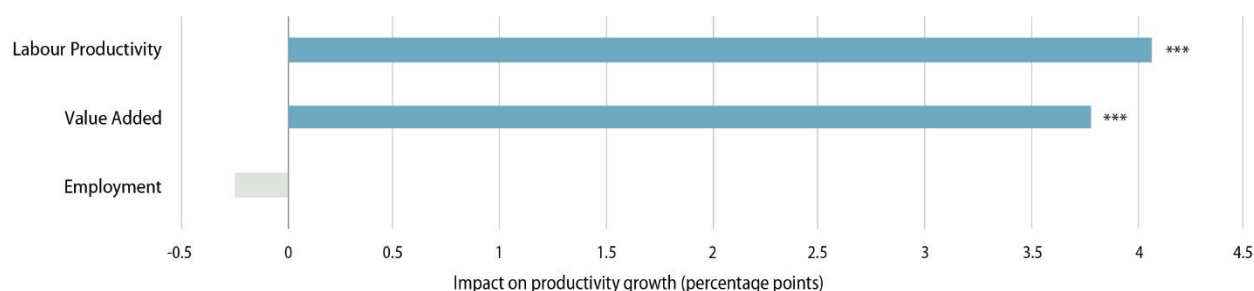
Note: Bars' colour and stars indicate statistical significance level:***1%, **5%, *10%. Results come from estimation of equation (1) in Annex A, where the dependent variables are the log change in each of the variables. Bars measure marginal effects in percentage points. Platform activity is measured by the number of visits to a platform's website. Full results in Table C.1 in Annex C.
Source: OECD estimations with data from Orbis, Semrush, and Crunchbase.

Sector-by-sector results however (see Table C.2 in Annex C) show that the positive association of productivity with platforms' activity mainly concerns consumer-to-consumer marketplaces and transport. In other areas, the association is not statistically significant at conventional levels. This strong sectoral heterogeneity result in an inverted U-shaped link between platform activity and productivity at the aggregate level, whereby the productivity impact first increases and decreases.[9] The sectoral heterogeneity of the diffusion-productivity nexus likely reflects differences in platform penetration (with consumer-to-consumer marketplace dwarfing all the other areas), differences in platform maturity (e.g. business-to-business platforms are still small but growing fast)[10] and differences in platform characteristics (with disruptors and aggregators being unequally distributed across platform activity areas).

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is similar to that on labour productivity. The size of the effect is smaller however as part of the improvement in labour productivity could be attributable to higher investment.

[9] The results considering all sectors combined point to a non-linear (concave) association between online platform activity and firm-level productivity growth, although this non-linear relationship can be ascribed to sector heterogeneity. The non-linearity is absent in sector-by-sector regressions. Thus, the concavity of overall traffic is mostly driven by cross-sectoral heterogeneity in the association of traffic with firms' productivity growth.

[10] Online platforms operating in the business-to-business markets are considerably less developed than in the retail and consumer markets but are developing fast. They cover a variety of businesses processes, including the purchase and sale of components and goods that are usually intermediated by wholesalers as well as logistics, management of inventories, cloud computing and other IT and non IT related services for corporates. By facilitating connections and market transactions between companies, B2B online platforms can disrupt traditional wholesale business models by undermining their intermediator role.

3.2. Productivity gains tend to be larger for micro enterprises and SMEs as well as for lowly productive firms

The positive association of online platform diffusion with incumbent firms' productivity growth may differ across firms based on their management and employee skills, organizational capital, intangible assets and in general the capacity of firms to innovate and thrive in a digital-oriented environment. However, comparable cross-country information on these firm characteristics is lacking at the cross-country level. Therefore, the study focuses on two variables – size and productivity levels – that likely correlate with these unobserved firm-level characteristics, by exploring how the link between platform activity and productivity varies across firms of different size and productivity levels.

The results suggest that the productivity benefits of platform activity are strongest for small-sized and medium productive firms. As for size, the association between online platform activity and productivity growth is positive and significant for firms with up to 100 employees (Figure 3).[11] In firms with less than ten employees, doubling average platform activity in the same sector is associated with a boost of more than 10 percentage points to their labour productivity growth. For instance, going from the average platform activity level of Spain to that of France would raise the average productivity growth of a small incumbent firm (less than 10 employees) operating in the same activity area by 5.5 percentage points.

Figure 3. Online-platform activity benefits mostly productivity of small firms

Change in firm-level labour productivity growth attributable to a one standard deviation in online-platform activity in the same sector, by firm size (number of employees)
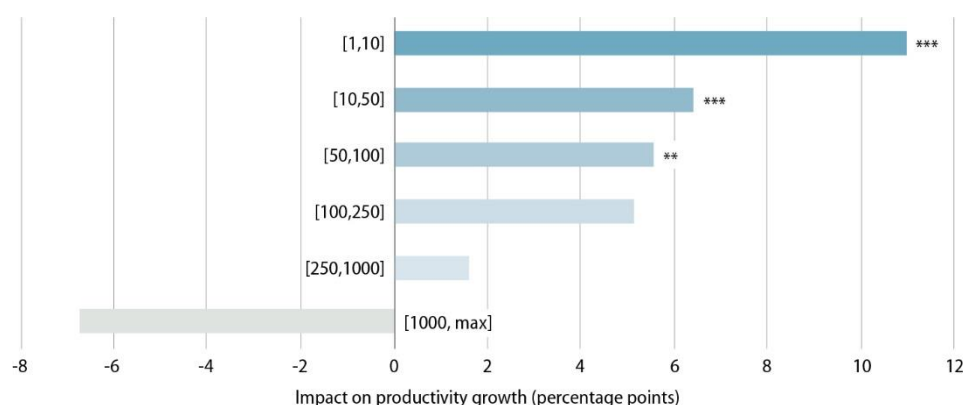
Note: Bars' colour and stars indicate statistical significance level:*** 1%, **5%, *10%. Marginal effects come from estimation of equation (1) in Annex A separately for firms within each bracket. Bars measure marginal effects of increasing activity by one standard deviation in percentage points, by size category (number of employees). Platform activity is measured by the number of visits to a platform's website. Full results in Table C.3 Annex B.
Source: OECD estimations with data from Orbis, Semrush, and Crunchbase.

The large estimated impact of online platforms' activity on small and medium sized firms' productivity growth may result from small firms deriving larger benefits from the network effects and access to larger markets and services that online platforms offer, as well as from being more incentivized by the tougher competition that online platforms generate. Easy access to additional customers and services provided by online platforms (such as logistics services by platforms operating in consumer-to-consumer marketplaces) could for instance have a large positive impact on the sales and value added of small companies (without reducing employment) as either they would not have had access to these services otherwise or it would have been more costly to access them in the absence of platforms. Results on the effect on online-platform activity on value added and employment growth corroborate this hypothesis, as small firms' value added increases as online-platform use rises. Additional regressions disaggregated by sector show this is true

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[11] While the lack of significance might be partly due to smaller sample sizes for larger firms.

for the activity areas of sectors of consumer-to-consumer marketplaces, professional services, and transport.

Overall, these findings indicate that online platforms can play an important role in helping SMEs to overcome barriers hampering their growth. Again, this is in line with some specific findings for Germany showing that the share of value added in industry and industry-related services connected with online platform activity is larger for SMEs (8.3%) than for the average firm (6.8%) (vbw, 2019[19]).

As regards productivity, results point to a positive association between online-platform activity and labour productivity growth across the whole firm-level productivity distribution except for the least productive firms, with the strength of the effect declining in productivity levels (Figure 4). Productivity gains are particularly large for firms whose productivity level is around the median. Conversely, effects for the least and most productive firms are weaker and not precisely estimated. The least productive firms may not benefit from online platform activity as they might lack the absorptive capacity (e.g. in terms of organisational capital or skills) to improve efficiency in response to increased competition (Berlingieri et al., 2020[20]). The most productive firms may have less scope to further improve productivity by means of online platforms' operations; for them product and process innovation, R&D spending and investment in other intangibles are more important drivers of productivity growth. All in all, these results suggest that platform diffusion can be a powerful lever for facilitating the productivity catch up of laggard firms to the levels of productivity prevailing at the technological frontier.

Figure 4. Online-platform activity can help lower-productive firms to catch up to the technological frontier

Change in firm-level labour productivity growth attributable to a one standard deviation increase in online platform activity in the same sector, by firm labour productivity level
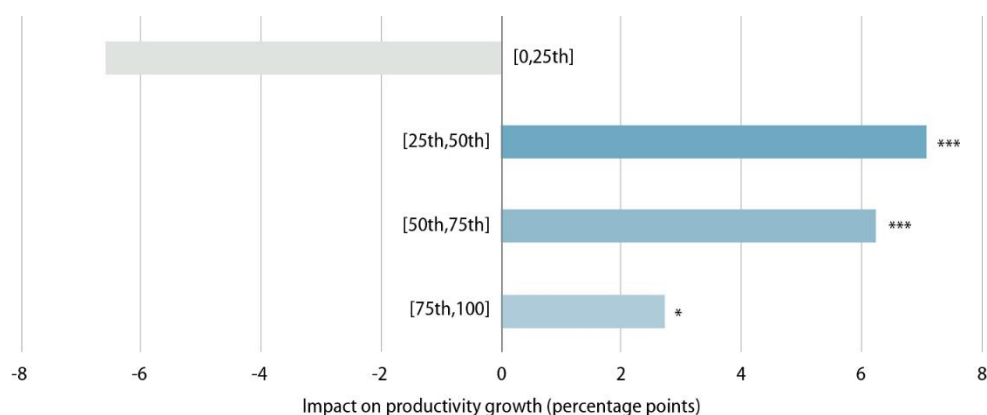
Note: Bars' colour and stars indicate statistical significance level:*** 1%, **5%, *10%. Marginal effects come from estimation of equation (1) in Annex A separately for firms within each bracket. Bars measure marginal effects in percentage points by size category. Labour productivity classes are defined for each sector and year and labour productivity is lagged by two years to diminish the risk of endogeneity bias. Results using once-lagged productivity remain similar. Platform activity is measured by the number of visits to a platform's website. Full results in Table C.4 in Annex C.
Source: OECD estimations with data from Orbis, Semrush, and Crunchbase.

3.3. Productivity gains tend to rise with the degree of online-platform markets' contestability

Across sectors, a few platforms account for a large share of total online platform website activity (OECD, 2021[1]). Some aspects of online platform activity –such as network effects, winner-take-all dynamics, acquisitions of smaller platforms – lead to concentrated markets and the COVID-19 shock may have exacerbated this. At the same time, while most platforms operate simultaneously in many countries, platform activity tends to be less concentrated in those countries and sectors with a higher share of global

platforms (OECD, 2021[1]). Therefore, the link between platform activity and competition among platforms is complex and global platforms do necessarily lower competition in online platform markets.

A priori, it is not clear whether a more concentrated online-platform markets would generate higher productivity benefits for incumbent firms. On the one hand, large platforms could yield larger productivity benefits because of larger network effects, which would result in better supply-demand matches. On the other hand, more concentration could lead dominant platforms to abuse their market power and to rent extraction, which could lower observed productivity of incumbent firms. For instance, dominant online platforms can increase the prices advertisers (many of the small businesses) pay, thereby increasing costs, reducing output, and diverting income towards platforms. Or they could be in a position to impose unilaterally changes to contractual conditions regulating the access to and use of the platform that are onerous to users (Stigler Committee on Digital Platforms, 2019[21]). In addition, dominant online platforms selling goods or services in competition with third party sellers on the platform may benefit from what has been labelled a "kill zone". This is the combination of two platform advantages. First, their ability to use the information they collect as platform operators to identify and copy (at low cost) the best performing products/services. Second, their capacity to steer consumers towards their products/services and away from the original ones through tailored ads and ranking results of searches on the platform (OECD, 2020[22]). Factors potentially leading to lower productivity outcomes for incumbents are likely to gain importance in markets where the dominance of large platforms remains unchallenged over time.

The results in this study suggest that, when the same platforms persistently hold the largest shares of activity levels, the positive association of platform activity with firm-level productivity growth is weaker. There is no evidence however that high concentration of activity per se lowers this positive association. Figure 5 reports the changes in the relationship between platform activity and productivity by degree of online platforms' persistence at the top (Panel A) and traffic concentration (Panel B).

Figure 5. The positive association of platform activity with incumbent forms' productivity growth is lower for higher persistence of the same platforms at the top

A. Association of productivity growth and platform activity by degree of persistence of the largest eight platforms (in terms of traffic) in the sector
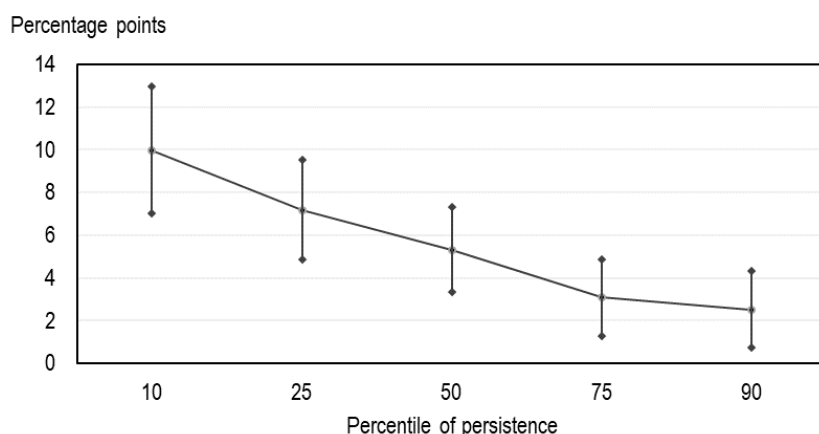
B. Association of productivity growth and platform activity by percentiles of the traffic share concentration of largest eight platforms

Percentage points
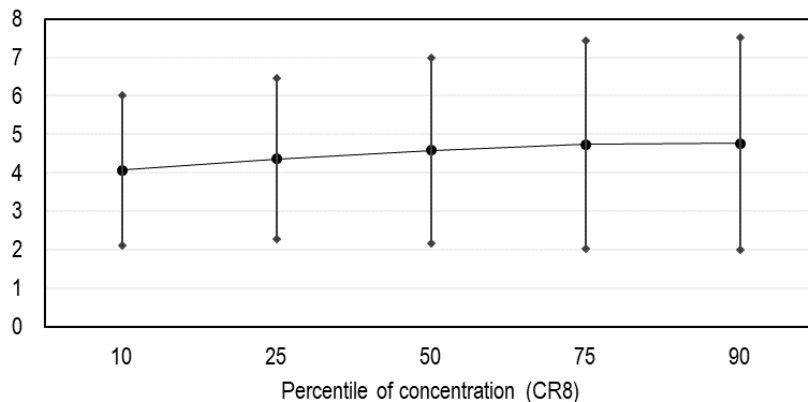
Note: The middle dots show the estimated marginal effects of an increase in platform activity of one billion website visits on the productivity growth of incumbent firms (in percentage points) evaluated at the average activity. Lines represent 95% confidence intervals. Marginal effects from estimating equation (1) in Annex A. The degree of persistence is measured as the amount of top 8 firms that were already in the top 8 in the previous year, in each sector, country, and year and the degree of concentration in platform markets is measured as the share of traffic of top 8 platforms in each sector, country, and year. Full regression in columns (1) and (3) of Table C.5 of Annex C.
Source: OECD estimations with data from Orbis, Semrush, and Crunchbase.

According to these estimates, lack of turnover among the largest online platforms weakens the positive association between traffic and productivity while traffic concentration per se does not significantly affect the association of online platform activity with productivity growth. These results are robust to different measures of concentration and persistence (see Table C.5. in Annex C). However, the measure of concentration used in this study (online platforms' website traffic) is only a proxy of actual platforms' market shares. Based on this proxy, the results indicate that in a more dynamic activity area (one with less persistence and more reshuffling of platforms at the top) incumbent firms stand to benefit more in terms of productivity growth from platform diffusion. This further highlights the need for policies to ensure online platform markets remain open and contestable.

4. Conclusion and policy discussion

The evidence reported above points to the positive effect of online-platform diffusion on incumbent firms' productivity growth. This effect tends to be larger for micro and SMEs, and firms that are far from the productivity frontier. As such, online platforms can help to level the playing field between small and large firms and contribute to aggregate productivity growth by lifting the productivity of firms that lag behind. The productivity gains arising from online platforms seem to be depend on the online-platform market structure, as they tend to be larger the higher the market contestability (i.e. degree of reshuffling) among the largest platforms.

Policies can play an important role in ensuring that incumbent companies take maximum advantage of online platforms. Securing these productivity benefits can boost online platforms' contribution to long-term growth prospects in addition to accelerating the post-COVID-19 recovery. During COVID-19, many G20 governments have implemented initiatives to encourage the use of online platforms through, for instance, awareness campaigns, consultancy vouchers, self-assessment tools or training, often with a focus on SMEs (OECD, 2021[23]). For example, the French government has built an inventory of online platforms

offering their services to small businesses at a preferential rate, while the Chinese government has introduced "online operations" programmes to help SMEs use major Chinese online platforms (OECD, 2020[24]). Similarly, Australia has provided businesses with information on how to make the best use of social media platforms (Australian Government, 2020[25]). Denmark, France, Korea and New Zealand have launched specific initiatives to increase the use of online platforms targeting SMEs (OECD, 2021[23])

These initiatives are useful responses to the economic emergency but a more coordinated policy approach is needed to overcome the fundamental hurdles hampering the diffusion of online platforms and their effective use among a wider share of companies, especially small ones. Two of the most important obstacles concern the lack of digital skills and insufficient access to communication infrastructure. These issues are discussed in OECD (2021[1]) and are not repeated here. The discussion below focuses on areas that are salient for productivity growth, namely competition policy and the labour market.

4.1. Competition policy and enforcement

Network effects are a crucial feature of online platforms (Rochet and Tirole, 2003[26]; Parker and Van Alstyne, 2005[27]; Armstrong, 2006[28]). They imply that new users tend to use platforms that are already large, thus increasing their size further. In principle, network effects are welfare enhancing, as they allow for connecting more individuals and businesses than physical marketplaces, and facilitate market exchanges, thus increasing the efficiency of market matching and growth. At the same time network effects can give rise to winner-take-all dynamics that can result in the emergence of few dominant players, weakening competition and leading to rent extraction.

Policy then needs to ensure that the welfare gains arising from network effects – generated by activity concentrating in few large platforms – go hand in hand with those arising from strong competition among online platforms. This is all the more important given that online-platform market dynamism, particularly among the largest online platforms, enhances productivity gains of incumbent companies. Provisions to limit lock-in effects could strengthen market contestability without undermining the large benefits of network effects of successful online platforms (OECD, 2019[29]).

To this end, removing barriers hampering the ability of users to switch platforms or use multiple platforms at the same time (multihoming) could avoid lock-in effects. This would involve supporting user data (e.g., information, reputation, ratings) portability and interoperability of platforms (e.g. through open application programming interfaces), and prohibiting contractual clauses limiting multihoming. In this sense, the General Data Protection Regulation (GDPR), which formally introduced the right to data portability for individuals in the European Union, could be a powerful tool to strengthen competition. Singapore also introduced data portability obligation in legislation with the 2019 Personal Data Protection Commission (OECD, 2020[29]).

The proliferation of different data-privacy regulations across countries however risks fragmenting the international regulatory landscape, raising costs for companies, generating uncertainty and undermining trust in the digital economy. This is particularly relevant for SMEs, which often lack the skills to assess the risks from their sharing of data (OECD, 2021[24]). This calls for more international coordination (OECD, 2020[29]). The common adoption of advanced privacy-enhancing solutions, like homomorphic encryption, which enables the processing of encrypted data without revealing its embedded information, can help share data while ensuring privacy (OECD, 2019[30]). Given the global nature of many platforms, the G20 could support international efforts to agree on common standards needed to facilitate data portability and interoperability across platforms while ensuring data privacy and security.

Specific aspects of online platforms' business model warrant the review of competition policies and their enforcement mechanisms. These aspects concern, for instance, the collection of large quantity of data and the use of algorithms to exploit them, the acquisition of smaller platforms to ward off potential threats (i.e. killer acquisitions), direct competition with the third party sellers using the platform (OECD, 2018[30]).

Several G20 countries (such as France, Germany, Italy, Japan and the United Kingdom) have commissioned studies of existing competition policy frameworks to determine which changes are needed (if any). Although the exact findings of each of these studies vary, countries agreed that digital markets represent a unique challenge for competition policy, and that other policy areas, such as consumer protection and data privacy, also have a role to play to preserve competition (OECD, 2016[31]; OECD, 2020[32]). Other concerns regard the opportunity of regulating algorithms and what effects such regulations could have on competition and innovation (OECD, 2017[33]).

There is a need to ensure a level-playing field between online platforms and their users. In this respect the European Commission has recently put forward, after thorough stakeholder consultations, the Digital Markets Act and the Digital Services Act to reset the digital regulatory framework and to support SMEs in their scaling-up process through better access to customers and lower compliance costs (European Commission, 2020[34]). These proposals are currently being discussed within the EU. Other concrete changes currently being mooted (although more controversial) include the introduction of a new digital regulator, new enforcement approaches (e.g. a greater use of interim measures to enable more timely responses to potentially anticompetitive conduct) and new merger notification requirements (Mancini, 2019[35]; Mancini, 2019[36]).

4.2. Labour market regulation and social protection

Online platforms' reliance on "on-demand" own-account workers (self-employed workers without employees) raises challenges for labour markets and social protection systems. Flexible own-account workers allow platforms to adjust supply to fluctuations in demand more rapidly than traditional companies with dependent employees. In principle, this allows for the sharing of the benefits of flexibility between platforms and workers as for instance many platforms provide mechanisms to adjust prices according to demand and supply conditions. Yet, these workers can be subject to poor working conditions and have few skill-upgrading opportunities, weighing on their professional development and productivity improvements. In addition, they are usually outside social protection systems and do not have access to collective bargaining mechanisms, leaving them exposed to shocks and the labour market monopsony of online platforms (as in certain geographical and professional areas a single platform can intermediate most of the job opportunities).

Without remedial action, labour market monopsony abets low pay and poor working conditions while insufficient social protection can deter the accumulation of productive assets and human capital in addition to retarding the emergence of higher productivity jobs (OECD, 2019[37]; Mathers and Slater, 2014[38]; Barrientos, 2012[39]). The challenge for labour market policies and social protection systems is thus to preserve sufficient flexibility in working arrangements to allow innovative business models to emerge and succeed while ensuring skill-upgrading opportunities and good working conditions for platform workers.

As regards training opportunities, in many countries platform workers' status as own-account workers prevents them from accessing existing training schemes. Moreover, platforms have also limited incentives to offer training because of the high likelihood of workers changing jobs. Making access to training schemes independent of employment status would go a long way towards promoting training and skill acquisition of platform workers. (Schwellnus et al., 2019[7]; OECD, 2019[8]). For instance, in France, online platforms that set workers' pay and other working conditions have to reimburse, under certain circumstances, workers' costs of validating acquired experience. Given that the digital skills of platform workers tend to be better than those of the general population, capitalising on the opportunities offered by digital technologies, such as with massive open online courses, would be a cost-effective way of providing training to these workers.

The emergence of online platforms also calls into question the rationale for market regulation of specific services, such as occupational licences. Occupational licences are usually justified on the grounds of consumer protection as it may be difficult for consumers to evaluate a provider before buying the service. However, such licencing requirements have become increasingly obsolete as gig economy platforms have

developed mechanisms to reduce the extent of information asymmetries through reputation rating mechanisms and have strong incentives to establish trust between providers and clients by establishing minimum standards (Bambalaite, Nicoletti and von Rueden, 2020[43]). However, private incentives might not suffice to stave off misleading or deceptive practices relating to customer ratings (e.g. fake reviews, undisclosed incentivises to post positive reviews, suppression of negative feedback). In this respect, governments can intervene to ensure that businesses are aware of current legislation and best practices developed by international consumer networks, and to encourage cooperation between consumer protection authorities and businesses to take action against fake ratings and reviews (OECD, 2019[43]).

Addressing the labour market monopsony of platforms would require revising rules preventing platform workers from bargaining collectively. In a number of OECD countries antitrust rules prohibit the self-employed to bargain collectively since associations of self-employed workers are considered as a cartel. Such rules may warrant review especially in those cases where platform workers have limited autonomy, including over setting fees. OECD countries provide successful examples of collective bargaining in the temporary work agency sector (which emerged as an innovative form of employment service decades ago) or in industries (such as the cultural and creative industries) where nonstandard work is pervasive. In addition, a handful of OECD countries have extended collective bargaining rights to certain groups of self-employed workers. These examples show the capacity of bargaining systems to adjust and cover different and new forms of work without unduly hampering sectors' development and innovation.

Setting minimum standards for the removal of workers from platforms and limiting the cases in which the platform can change unilaterally the terms and conditions of its relationship with online platform workers would protect them against rent extraction from the platform. Clarifying what constitutes abusive contractual terms, including those limiting workers' mobility by preventing for instance multi-homing, would limit the bargaining power of the platforms, in addition to enhancing competition among online platforms as highlighted above. Moreover, clarifying and assigning employers' duties and responsibilities in the case of triangular employment relationships, such as those intermediated by platforms, could strengthen platform workers' position in cases of disputes. One possibility involves spreading responsibility across the different parties involved – for example holding platforms (more generally intermediaries) and clients jointly liable, or by imposing liability first on platforms and only subsidiary liability on clients (OECD, 2019[8]).

In emerging economies, new forms of work in the platform economy may offer opportunities for formalisation of own-account workers. This may contribute to economic development as the formal sector is more productive than the informal one and its expansion is associated with faster productivity growth and higher wages (La Porta and Shleifer, 2014[40]). In countries with a large incidence of informality, platform work can represent a route to formalisation as it can reduce its costs and improve monitoring of economic activity through the digitalisation of transactions. In Indonesia for instance, some delivery platforms have facilitated access to social protection for workers by helping platform workers to subscribe to the government's health insurance program or enrolling them into the professional insurance programme. However, to exploit these opportunities, emerging economies need to further develop effective tax and social protection systems (Alonso Soto, 2020[43]).

At the same time, the rise of online platforms makes the need to tackle false self-employment more pressing. Self-employment working arrangements can mask dependent working relationships with the aim of avoiding burdensome regulations, higher taxes and unionisation. This is also true in many cases for online platform workers as they often have limited control over their work (e.g., they cannot fix prices, they are required to wear uniforms, they cannot choose the order of their tasks…) despite working as own-account workers. In some countries, these issues are currently being discussed and reviewed. In February 2021, the United Kingdom Supreme Court ruled that Uber drivers be treated as dependent employees and not as own-account workers, thus being entitled to minimum wage and benefits (BBC News, 2021[45]). In California, in November 2020, a ballot vote gave gig economy platforms the right to treat their workers as self-employed, reversing the decision of a 2018 State Supreme Court ruling (The New York Times, 2020[46]).

To avoid misclassification, there is a need to clarify and enforce better existing regulations and make it easier for workers to challenge their employment status. Reducing differences in the tax treatment of different forms of employment would contribute to lower incentives for misclassification of workers. In several countries, the rapid growth in non-standard forms of work is attributable to a large extent to fiscal and regulatory differences between employment forms (OECD, 2019[8]).

Some workers will be genuinely difficult to classify as they share some characteristics with employees but also some characteristics with the self-employed. Examples of such workers include self-employed workers without employees who depend for most if not all of their income on a single employer or platform. These workers find themselves in a "grey zone" and, in most cases, will be treated like self-employed workers. In reality, these workers are more vulnerable to shocks and abusive contractual terms than "real" self-employed and governments should consider ways of strengthening their rights and protections, for example by extending collective bargaining rights, improving pension arrangements, or allowing access to some form of unemployment insurance.

Finally, improving the social protection of platform workers requires reforms of social protection systems that largely overlap with those aiming at extending coverage to workers in non-standard forms of employment (i.e. part-time, temporary or self-employed workers). In this area, policy action includes: 1) making parametric changes to raise the effective coverage of social insurance and benefit schemes (such as for work accidents, parental benefits, health and pensions); 2) boosting the portability of entitlements between social insurance programmes of different labour market groups; 3) complementing targeted social protection measures with more universal and unconditional support.

The design of effective policies tackling the challenges highlighted above hinges on a better understanding of how policies and institutions affect the working conditions of platform workers. For instance, the OECD is entering in a research partnership with Uber to set up a survey of Uber drivers. Drivers will be contacted twice a year for three years to get information on their career aspirations, training participation, challenges encountered, etc. This information will be matched to administrative data to build a rich picture of the careers of this important group of platform workers. The survey will be carried out in a number of countries to map driver outcomes to differences in country policies and institutions.

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Annex A. Empirical specification

To investigate the link between digital-platform uptake and firm-level productivity growth, the following model is estimated:

$$\Delta Productivity_{f,s,c,t} = \alpha_1 + \alpha_2 Traffic_{s,c,t-1} +$$

$$\alpha_3 Traffic^2_{s,c,t-1} + \gamma_f + \theta_{ct} + \delta_{st} + \varepsilon_{f,s,c,t} \tag{1}$$

where $\Delta Productivity_{f,s,c,t}$ is the log change in labour productivity of firm *f*, in sector *s*, country *c* and in year *t*. Labour productivity is measured as the ratio between real value added and the number of employees. For more detail on the computation of productivity see Gal (2013[18]). Value added and employment are also used as separate dependent variables to identify the source of the productivity changes induced by platform developments.

$Traffic_{s,c,t-1}$ is the main variable of interest. It measures platform activity, as proxied by the total number of visits, in billions, to all platform websites operating in sector *s*, country *c*, in year *t-1*. Table B.2 in Annex B presents the summary statistics for the main variables of interest. The square of *Traffic* is also included to account for possible non-linearities. These could arise as platforms could initially have large positive effects on productivity growth as firms access new markets more easily and invest in digitalization, but these may have decreasing marginal returns. It can additionally capture possible cross-sector heterogeneity of the association between online platform traffic and productivity growth. Finally, γ_f, θ_{ct} , and δ_{st} are, respectively, firm, country-year, and sector-year fixed effects; and $\varepsilon_{f,s,c,t}$ is the error term.[12]

The rich set of fixed effects is included to control for time-invariant firm-specific characteristics (like management characteristics or country and industry specific characteristics), time-varying country-specific trends (such as trends in internet use or smartphone penetration), and global sectoral changes (for example driven by technological innovation).

Despite these controls, some possible endogeneity issues remain. First, excluded variables that are sector and country specific (such as demand shocks or sectoral policies/regulations) could affect both traffic and productivity. However, as traffic is lagged by one year, this shock would need to be persistent over time to introduce endogeneity biases. Second, there could be a problem of reverse causality, if platforms tend to enter sectors and grow more easily either when firms in these sectors are more productive or when they are less productive. The first instance would introduce a downward bias in the estimates, the second an upward bias. However, the focus on within-firm changes lowers the likelihood of this problem.

In order to understand how dynamism in the platform market affects the relationship between platform use and productivity growth of incumbent firms, equation (1) is augmented with a term $C_{t-1,c,s}$. The variable $C_{t-1,c,s}$ is in turn the degree of concentration (measured as the share of traffic of top 8 platforms in each sector, country, and year), and the degree of persistence (measured as the amount of top 8 firms that were already in the top 8 in the previous year, in each sector, country, and year). The equation to be estimated thus becomes:

$$\begin{aligned}\Delta Productivity_{f,s,c,t} \\ = \alpha_1 + \alpha_2 Traffic_{s,c,t-1} + \alpha_3 Traffic^2_{s,c,t-1} + \alpha_3 C_{t-1,c,s} + \alpha_4 C_{t-1,c,s} \\ * Traffic_{s,c,t-1} + \alpha_5 C_{t-1,c,s} * Traffic^2_{s,c,t-1} + \gamma_f + \theta_{ct} + \delta_{st} \\ + \varepsilon_{f,s,c,t}\end{aligned} \tag{2}$$

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[12] The results are unchanged when controlling for firm-level characteristics, such as the level of total assets.

Model (1) and its extension (2) are estimated through OLS using the methodology for linear models with multi-way fixed effects developed by Correia (2016[42]). Standard errors are adjusted by two-way clustering, at the firm level and at the country-industry-year level.

Annex B. Data description

Table B.1. Summary statistics

	Observations	Average	Standard deviation	Min	Max
Traffic	2,405,271	0.56	1.283	6.93e-06	20.3
Labour Productivity	2,588,185	10.4	0.765	2.6	20.2
Value Added	2,588,185	2274979	1.02E+08	22	4.20E+10
Employment	2,433,383	14.6	299.854	1	100000

Note: All the variables except for traffic are in logarithms. Traffic is in billion visits.

Annex C. Full results

Table C.1. Traffic to online platforms and firm-level productivity growth

Dependent variable	(1) Labour productivity	(2) Value Added	(3) Labour
$Traffic_{t-1}$	0.04435***	0.04118***	-0.00264
	(0.011)	(0.010)	(0.006)
$Traffic^2_{t-1}$	-0.00326***	-0.00301***	0.00021
	(0.001)	(0.001)	(0.000)
Constant	0.01156***	0.04141***	0.02898***
	(0.004)	(0.004)	(0.002)
Observations	2,321,795	2,326,966	2,248,277
R-squared	0.211	0.302	0.267
F	8.467	8.249	0.149

Note: The dependent variables are the log change in each of the variables. All estimations include firm, country-year, and sector-year fixed effects. Standard errors clustered at the firm and country-sector-year. Traffic is platform activity measured in billion visits to all platforms' website in a given sector.
Source: OECD estimations with data from Orbis, Semrush, and Crunchbase.

Table C.2. Traffic to online platforms and firm-level productivity growth by sector

Dependent variable:	(1) Labour productivity	(2) Value Added	(3) Labour
Accommodation	0.15832	0.20057	0.05467
	(0.123)	(0.126)	(0.061)
Marketplace B2B	-0.18330	-0.35723*	-0.16797*
	(0.138)	(0.201)	(0.089)
Marketplace X2C	0.00830**	0.01010**	0.00192
	(0.004)	(0.004)	(0.002)
Personal Services	-0.12217	-0.03914	0.08668*
	(0.089)	(0.095)	(0.047)
Professional Services	1.57519	4.09560***	2.91015***
	(1.311)	(1.256)	(0.665)
Restaurant	0.15450	0.29089	0.11448
	(0.303)	(0.310)	(0.171)
Transport/Taxi	1.81757***	2.41098***	0.27717
	(0.627)	(0.740)	(0.963)
Constant	0.02366***	0.04950***	0.02370***
	(0.003)	(0.003)	(0.002)
Observations	2,321,795	2,321,795	2,173,109
R-squared	0.211	0.301	0.263
F	3.414	4.701	3.695

Note: The dependent variables are the log change in each of the variables. Sectors indicate traffic in each sector in year t-1. All estimations include firm, country-year, and sector-year fixed effects. Standard errors clustered at the firm and country-sector-year. Traffic is platform activity measured in billion visits to all platforms' website in a given sector.
Source: OECD calculations with data from Orbis, Semrush and Crunchbase.

Table C.3. Platform traffic and productivity firms-level growth by firms' size

	(1)	(2)	(3)	(4)	(5)	(6)
Size	[1,10[	[10,50[	[50,100[	[100,250[	[250,1000[	[1000, max]
$Traffic_{t-1}$	0.12095***	0.07083***	0.06061**	0.05686	0.01870	-0.07368
	(0.025)	(0.018)	(0.027)	(0.041)	(0.022)	(0.063)
$Traffic^2_{t-1}$	-0.01125***	-0.00758***	-0.00404**	-0.00429	-0.00180	0.00187
	(0.003)	(0.002)	(0.002)	(0.003)	(0.001)	(0.002)
Constant	-0.02979***	-0.00185	-0.02149*	-0.02261	-0.00144	0.12081*
	(0.009)	(0.006)	(0.012)	(0.018)	(0.012)	(0.073)
Observations	1,369,918	330,666	24,661	15,122	6,569	1,074
R-squared	0.200	0.227	0.279	0.292	0.308	0.418
F	14.56	10.33	2.912	0.983	1.117	1.647

Note: The dependent variable is the log change of labour productivity. All estimations include firm, country-year, and sector-year fixed effects. Standard errors clustered at the firm and country-sector-year. Traffic is platform activity measured in billion visits to all platforms' website in a given sector.
Source: OECD calculations with data from Orbis, Semrush and Crunchbase.

Table C.4. Platform traffic and firm-level productivity growth by past productivity levels

	(1)	(2)	(3)	(4)
Productivity percentile	[0,25th[	[25th,50th[	[50th,75th[	[75th,100]
$Traffic_{t-1}$	-0.06478	0.07509***	0.06843***	0.02952*
	(0.063)	(0.023)	(0.020)	(0.016)
$Traffic^2_{t-1}$	-0.00189	-0.00498***	-0.00552***	-0.00212
	(0.005)	(0.002)	(0.002)	(0.001)
Constant	0.12720***	0.00411	-0.02654***	-0.04522***
	(0.011)	(0.008)	(0.009)	(0.006)
Observations	127,122	190,464	257,963	351,606
R-squared	0.271	0.254	0.249	0.231
F	3.700	5.519	6.066	1.793

Note: The dependent variable is the log change of labour productivity. All estimations include firm, country-year, and sector-year fixed effects. Standard errors clustered at the firm and country-sector-year. Traffic is platform activity measured in billion visits to all platforms' website in a given sector.
Source: OECD calculations with data from Orbis, Semrush and Crunchbase.

Table C.5. Concentration in the platform market and productivity

Concentration measure:	(1) CR8	(2) CR4	(3) Persistence	(4) Reshuffling
Traffic_{t-1}	-0.02738	0.04793	0.30105***	0.04730***
	(0.107)	(0.036)	(0.045)	(0.017)
Concentration measure	-0.02439	0.13230***	0.00301	0.05516**
	(0.078)	(0.045)	(0.005)	(0.026)
Traffic_{t-1} x Concentration	0.07893	-0.01203	-0.04388***	0.08538**
	(0.117)	(0.040)	(0.007)	(0.036)
Traffic2_{t-1}	0.00512	0.00140	-0.04332***	-0.00351***
	(0.011)	(0.004)	(0.008)	(0.001)
Traffic2_{t-1} x Concentration	-0.00910	-0.00533	0.00668***	-0.02510***
	(0.011)	(0.004)	(0.001)	(0.008)
Constant	0.03383	-0.10234***	0.00115	0.00038
	(0.076)	(0.039)	(0.026)	(0.007)
Observations	2,321,795	2,321,795	2,321,795	1,891,009
R-squared	0.211	0.211	0.211	0.236
F	3.653	6.510	9.640	5.769

Note: The dependent variable is the log change in labour productivity. All estimations include firm, country-year, and sector-year fixed effects. Standard errors clustered at the firm and country-sector-year. The degree of concentration, CR4 (CR8), measures the share of traffic of top 4 (8) platforms in each sector-country-year, Persistence at the top measures the amount of top 8 firms that were already in the top 8 in the previous year, in each sector-country- year, and Reshuffling is the overall change in ranking of top eight platforms in each sector-country-year. Traffic is platform activity measured in billion visits to all platforms' website in a given sector.

Source: OECD calculations with data from Orbis, Semrush and Crunchbase.