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Post-Covid Telework and Productivity: A Large Scale Analysis

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Abstract

This paper studies the causal impact of post-Covid telework on firm productivity in France, where hybrid work has become the dominant form of telework. Using matched survey and administrative data on over 6,500 firms employing three million workers, we test whether telework in 2022 relates to productivity growth from 2019 to 2022 excluding agriculture, finance and insurance, and real estate. OLS estimates show a modest positive link: a 10-percentage-point rise in telework share correlates with a 0.7–1.0 percentage-point productivity gain. To address endogeneity, we use an instrumental variable based on pre-pandemic office surface per employee in rented separate office spaces, which likely facilitated telework adoption and cost reductions. The instrument is strong, and 2SLS results indicate a sizeable LATE: a 10-point increase in telework raises productivity by about 2.7 points. Firms with separate offices also reduce obsolete space and slightly increase office equipment, suggesting additional productivity channels beyond real-estate adjustments.

JEL classification

L23, J52, J81

Keywords

telework, productivity, office

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1 Introduction

The rapid expansion of telework following the COVID-19 pandemic represents one of the most significant organizational changes in modern labour markets. What began as an emergency response in early 2020 has persisted well beyond lockdowns, raising a fundamental question: does telework enhance or hinder firm labour productivity? Answering this question is crucial for firms designing work arrangements and for policymakers evaluating the broader implications of technological and organizational change.

The implications of telework for firm-level productive performance remain unsettled. Some studies report gains driven by reduced commuting time, improved focus, or lower job turnover. Others emphasize coordination frictions, selection effects, or diminishing returns at high telework intensity. Moreover, much of the current evidence relies on specific occupations, single firms, or experimental settings, raising concerns about external validity. Establishing credible causal effects at large scale remains challenging.

This paper provides new evidence on the causal impact of post-COVID telework adoption on firm-level labour productivity growth. We focus on France, where telework expanded rapidly during the pandemic and subsequently stabilized as a major work arrangement. Unlike several international studies that examine intensive telework arrangements, including fully remote or high-frequency telework, we study the productivity effects of hybrid work organization. In France, hybrid telework, typically two days per week, overwhelmingly dominates: fewer than 3% of private-sector employees are fully remote, whereas roughly 20% engage in hybrid telework. France is not exceptional in this regard. According to the Living and Working in the EU e-survey (Eurofound, 2026), hybrid arrangements constitute the predominant form of telework across Europe. Even in the United States, where fully remote work remains relatively common, BLS data indicate a steady shift toward hybrid arrangements since 2022.

We combine employer-level telework data from the Dares ACEMO-Covid survey with firm-level value-added data from Insee's FARE fiscal records. Our analysis covers a large sample of private-sector firms (excluding agriculture, finance, and real estate) and relates the telework share in 2022 to productivity growth between 2019 and 2022.

Our baseline OLS estimates reveal a moderate but robust positive association: a 10-percentage-point increase in telework adoption is associated with a 0.7 to 1.0-point increase in labour productivity growth between 2019 and 2022. The relationship is non-linear: productivity gains are concentrated at moderate levels of telework adoption and flatten once the telework share exceeds roughly 22% of the workforce.

To address endogeneity concerns, including reverse causality and omitted firm characteristics, we develop an instrumental-variable strategy exploiting the pre-COVID configuration of firms' premises. Using exhaustive administrative records on business premises, we construct an instrument capturing whether office spaces were physically separated from production or retail areas in December 2019. Firms operating distinct office lots were organizationally bet-

ter positioned to adopt telework and had stronger incentives to reduce real estate costs. This pre-existing spatial configuration strongly predicts post-pandemic telework adoption. Placebo tests show no association between office separation and pre-pandemic productivity dynamics, nor with productivity growth among firms that did not adopt telework, supporting the exclusion restriction.

Our IV estimates indicate a sizeable causal effect: a 10-percentage-point increase in telework raises labour productivity by approximately 2.5 percent. The larger IV magnitude suggests that telework particularly benefits firms whose adoption decisions are sensitive to organizational structure and real-estate costs. Additional evidence indicates modest reductions in separated office space and increases in office equipment investment following telework adoption. However, these adjustments appear too small to account for the magnitude of the estimated productivity gains.

Our findings contribute to the literature on telework and productivity in three ways. First, we provide large-scale causal evidence on the productivity effects of telework. Second, by focusing on hybrid telework, the dominant form of remote work, we estimate the impact of moderate telework adoption rather than full telework arrangements. Third, we exploit variation in firms' pre-pandemic office premises to identify the causal effect of telework on productivity.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 presents the empirical strategy. Section 4 describes the data. Section 5 reports OLS results. Section 6 examines the validity of the instrumental variable. Section 7 presents IV estimates and robustness checks. Section 8 discusses broader macroeconomic implications. The final section concludes.

2 Literature Review: Remote Work/Telework and Productivity

Understanding how telework affects productivity is challenging because empirical studies differ widely in how they define telework, measure output, and often rely on natural experiments or Covid-era settings with limited external validity. A further difficulty comes from the endogeneity between productivity and telework adoption, as more productive or better-managed firms may be both more inclined and more able to implement remote work. This section reviews the main strands of the literature, emphasising conceptual issues, identification challenges, and the mechanisms most relevant for our empirical strategy.

2.1 Measurement Considerations

Productivity metrics. The empirical literature on telework and productivity predominantly focuses on individual labour productivity—typically measured as output per worker or per hour worked—rather than aggregate or firm-level productivity metrics. This focus is evident

in experimental and survey-based studies that evaluate telework in terms of time saved, worker self-reported performance, or specific task efficiency. Exceptions are relatively rare and include, notably, recent studies by Bergeaud et al. (2023a), who adopt broader measures at the firm or sector level, such as total factor productivity (TFP).

In contrast, the present paper uses a firm-level definition of productivity, calculated as value added divided by full-time equivalent (FTE) employment. This measure captures the apparent labour productivity of firms, offering a more structural and aggregate perspective. Our analysis therefore contributes to filling a gap in the literature by linking telework adoption to this macro-organizational measure, rather than to individual or task-based output.

Definition of telework. In addition, the definition of teleworking is not straightforward, as it may encompass a variety of organizational practices, work arrangements, and technological setups. In order to ensure consistency with the data at hand, we rely on the definition adopted by Eurostat, which is also the one applied in the Dares *ACEMO-Covid* survey used in this study (see Section 4).[1] This choice allows us to construct a measure of the share of teleworkers within each firm. Consequently, we obtain an operational definition of the extensive margin of telework as perceived and reported by the firm's manager. Other studies, however, can rely on different definitions: some measure telework as reported by employees and aggregate individual responses at the firm level (Barrero et al., 2023; Jauneau, 2022); others focus on the intensive margin, that is the number of days worked remotely (Asmussen et al., 2024; Bloom et al., 2015); while still others adopt a binary definition of whether telework is used at all (Eurofound and International Labour Organization, 2017; OECD, 2021). Finally, telework can also be defined in institutional terms, based on the existence of formal company-level agreements and labour law rather than actual practices (Favaro and Thiounn, 2025; Pesenti, 2022). In the case of France where telework is clearly defined and regulated in the labour code, we can expect that most employers and workers stick to this definition when they are surveyed; instructions in the French labour force survey are also consistent with this definition.

2.2 Pre-Covid studies

Empirical evidence on the effects of telework on productivity before the Covid-19 pandemic reveals heterogeneous results, largely influenced by the context, methodology, definition of telework or remote work[2] and type of work considered. Positive productivity effects were more likely to be observed in voluntary telework settings and in specific task environments.

[1] Telework consists in working outside the employer's premises during one's usual working hours. It requires the ability to connect to the establishment's IT system. Telework is formalised in writing with the employer. Bringing work home, working while on business trips, at a client's premises or in a mobile way (during commutes, between meetings), or working at a remote site is not considered telework.

[2] The International Labour Organization has clarified the differences between remote work and telework since the health crisis (Eurofound and International Labour Organization, 2017)

Evidence from natural experiments. Several studies used quasi-experimental methods to identify causal effects. Bloom et al. (2015) found a 13% increase in labour productivity in a Chinese call centre, attributing gains to reduced noise and fewer breaks. Conversely, Battiston et al. (2020) reported labour productivity losses of 2% to 4% in UK police call centres, citing coordination challenges as a primary factor.

Other studies highlighted task-dependence. For instance, Dutcher (2012) and Golden and Gajendran (2019) found that telework benefits creative or complex tasks, but impairs performance on routine work. Coenen and Kok (2014) proposed an inverted-U relationship, suggesting peak labour productivity at around two days of remote work per week. Environmental factors may also distort productivity comparisons: poor office conditions such as open-plan layouts can bias against in-office productivity measures (Bernstein and Turban, 2018; Smith-Jackson and Klein, 2009).

These results suggest that productivity effects may depend less on telework itself than on the complementarities between remote work and organisational context.

In addition to individual productivity, firm-level outcomes can amplify the perceived benefits of telework. Bloom et al. (2015) report that lower real estate costs and reduced employee turnover may lead to total factor productivity (TFP) improvements of up to 20%.

Evidence from administrative data. Quantitative studies using administrative records further support the non-linear nature of effects of the telework intensive margin. Both Kazekami (2020) and Behrens et al. (2024) find labour productivity follows an inverted-U pattern relative to the intensity of remote work.

2.3 Covid and Post-Covid Insights: Conditional Gains and Selection Effects

Since the onset of the Covid-19 pandemic, the literature has expanded significantly, often leveraging new datasets and institutional experiments. Results remain mixed, with conditional and context-dependent productivity effects.

Evidence from experiments and case studies. Comparing the individual productivity of workers in a Fortune 500 firm before and during the Covid-19, Emanuel and Harrington (2024) highlight potential adverse selection, as remote jobs tend to attract less experienced or lower-performing workers. According to their cost-benefit analysis, savings from reduced turnover and office rents can compensate for the productivity losses of remote work, but not for the cost of hiring less productive workers. Gibbs et al. (2023) find no overall productivity gain during lockdown periods: although employees worked longer hours, their hourly productivity declined.

In contrast, Bloom et al. (2024) conducted a large-scale randomized control trial at Trip.com (n = 1,612), revealing that hybrid arrangements (two remote days per week) reduced attrition

by 33% without harming output or career progression.

Evidence from survey data. Surveys of workers and firms also suggest modest productivity improvements. Barrero et al. (2021, 2023) estimate an average 5% productivity gain, primarily from reduced commuting time. However, studies such as Criscuolo et al. (2023) and Lewis et al. (2021) caution against overuse of remote work, as benefits diminish with intensity.

Evidence from administrative data. Recent administrative datasets provide macro-level insights. Using French data Bergeaud et al. (2023a) estimate that a one percentage point increase in telework share is associated with a 0.6% rise in TFP, with potential for up to 10% long-term gains. Other findings suggest that telework benefits are non-linear (OECD, 2020), and that firms require time to adapt in order to fully realize these gains (Bergeaud, 2024).

Bergeaud et al. (2023b) further document how telework impacts firms' use of office space. They show a sustained decline in office occupancy following the spread of telework in France, consistent with a structural shift in spatial organization. However, despite this drop in demand, office-to-residential conversions remain rare due to legal and technical constraints. These findings suggest that some productivity gains from telework may be linked to real estate optimization, although these are shaped by strong institutional frictions.

Cross-industry correlations. In the United States, the BLS (Pabilonia and Redmond, 2024) correlates sector-level data from the Current Population Survey and the Bureau of Labor Statistics. The findings suggest a positive correlation between the rise in remote work and productivity gains between 2019 and 2021, particularly in the information and professional services industries. In France, replicating this suggestive exercise yields a similar pattern: data from the 2019 French Working Conditions Survey (Dares), the 2023 French Labour Force Survey (Insee), and the national accounts show that sectors with greater increases in the share of teleworkers between 2019 and 2023 also experienced stronger labour productivity growth (Appendix Figure A8); the coefficient is relatively large (around 0.26).

To sum up, the current literature provides conflicting results, ranging from negative impacts of telework on productivity to substantial positive ones. One exception is the common finding that telework is likely to reduce office costs. In addition, the empirical analyses suffer, on the one hand, a potential lack of external validity and, on the other hand, a risk of endogeneity. The short/medium/long-term effect of telework on productivity is thus still largely discussed.

Despite valuable insights from case studies and survey-based analyses, there is still no credible large-scale causal estimate of the effect of post-Covid telework adoption on firm-level productivity. Our contribution aims to overcome these limitations through large-scale firm-level data, a context where telework varies on the extensive rather than intensive margin, and an instrument derived from pre-pandemic office configurations.

3 Empirical strategy

3.1 OLS baseline

Post-Covid Telework can be understood as a collective organizational arrangement rather than an individual labour supply decision. It modifies the implicit and explicit contracts that govern the employment relationship, affecting not only working conditions and monitoring but also cooperation, information flows, and the balance of bargaining power within the firm. The extent of telework thus reflects firm-level negotiations and managerial choices regarding work organization, technology adoption, and employee autonomy. This interpretation is particularly salient in the context of French labour law, where telework arrangements are typically formalised through collective agreements or employer charters (Askenazy et al., 2025a), and where individual discretion over telework remains limited. Estimating telework effects at the firm level is therefore consistent with this theoretical view: productivity outcomes emerge from collective practices, shared norms, and coordination mechanisms rather than isolated individual decisions.

Our baseline firm-level Ordinary Least Squares (OLS) specification relates productivity growth between 2019 and 2022 to the share of teleworkers in April 2022 and to initial productivity. Specifically, we estimate a standard β-convergence equation in productivity (see Chevalier et al. (2012)), according to which initially more (less) productive firms tend to experience relatively slower (higher) subsequent productivity growth ($\beta_2 < 0$):

$$\Delta \log(\text{Prod})_{2019-22} = \beta_0 + \beta_1 \, \text{TW}_{2022} + \beta_2 \, \log\big(\text{Prod}_{2019}\big) + \mathbf{X}'\boldsymbol{\gamma} + \varepsilon, \tag{1}$$

where TW_{2022} is the share of teleworkers in April 2022 and $\mathbf{X}$ contains sector and enterprise-type fixed effects (and further controls -spatial location of employment, pre-trend...- in some specifications). We assume that the level of telework in France in 2019 was negligible, which is consistent with the 2019 DARES Working Conditions data estimating that about 1% of employees teleworked (Beatriz and Erb (2024)). Note that since the productivity is in log and the model is a β-convergence equation, the estimated coefficient for telework is the same when the interest variable is the level of productivity in 2022 rather than the productivity growth between 2019 and 2022.[3] The coefficient β_1 can be thus interpreted as a correlate of telework with the growth of productivity between 2019 and 2022 or alternatively as a correlate with the level of productivity in 2022 (controlling by its initial level in 2019).

However, OLS estimates are likely endogenous. More productive or better-managed firms may have been more able to adopt telework, biasing estimates upward, while firms hit by adverse shocks may have turned to telework as an adjustment margin, biasing them downward. Telework adoption is also correlated with workforce composition, which independently influ-

[3] $\Delta \log(\text{Prod})_{2019-22} = \beta_0 + \beta_1 \, \text{TW}_{2022} + \beta_2 \, \log\big(\text{Prod}_{2019}\big) + \mathbf{X}'\boldsymbol{\gamma} + \varepsilon \implies \log\big(\text{Prod}_{2022}\big) = \beta_0 + \beta_1 \, \text{TW}_{2022} + (1 + \beta_2) \, \log\big(\text{Prod}_{2019}\big) + \mathbf{X}'\boldsymbol{\gamma} + \varepsilon'$.

ences productivity. These issues motivate the instrumental-variable strategy introduced in the next section.

3.2 IV strategy

The correlation between telework and productivity may suffer from endogeneity bias or omitted variables. For example, a better quality of industrial relations may be reflected in the signing of telework agreements and the use of this practice. Increased productivity, especially in the Covid and post-Covid periods, could then reflect this quality rather than telework per-se. Moreover, reverse causality may also arise if more productive firms are both more likely and better equipped to implement telework, further motivating the use of an instrumental variable approach (see Figure A5). To provide a causal estimate, we propose to mobilize the ante-Covid structure of the company's real estate. Basically, we consider two main configurations, with and without separate office lots:

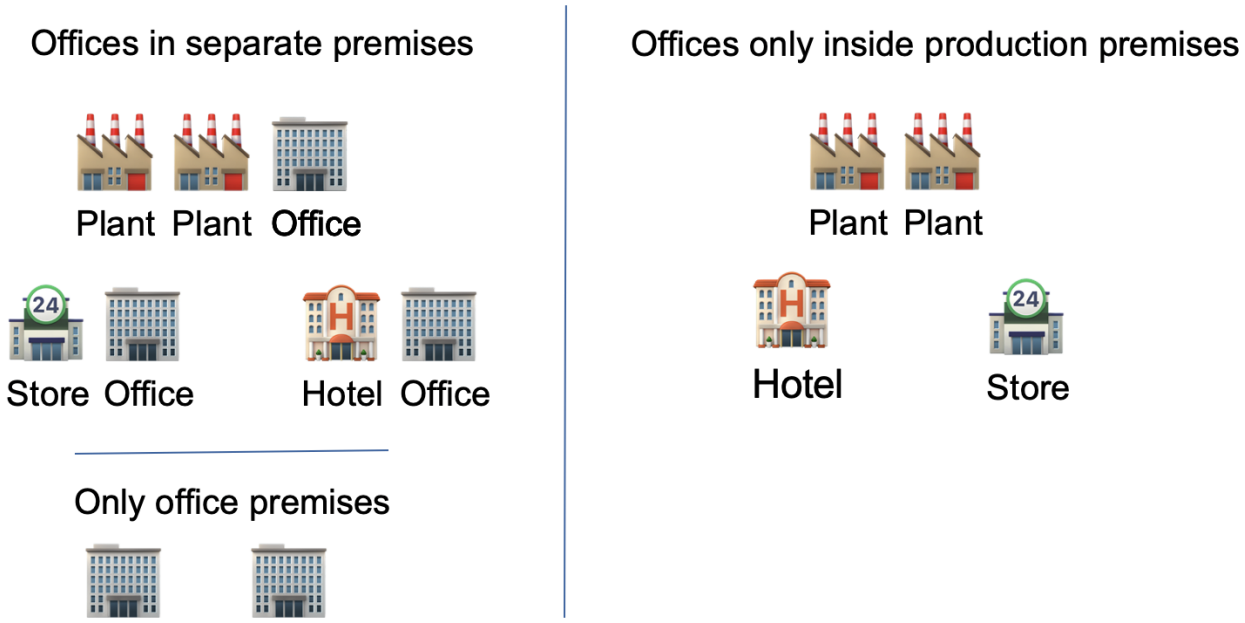

Figure 1: Real estate configurations of firms

In the sample of firms used for the empirical analysis, the two configurations each account for roughly half of the observations (see Table A14). Two complementary lines of argument — one based on cost-saving considerations and the other on organisational factors — support the assumption that a configuration with separate offices is more conducive to adopting telework. Our identification strategy exploits the fact that this real-estate configuration was fully predetermined as of December 2019, well before any anticipation of the pandemic or the subsequent boom in telework.

A first argument relates to the cost of this real estate. The use of telework reduces the company's need for offices and related surfaces, both inside (meeting rooms, corridors, etc.)

and outside (parking spaces, etc.). This office real estate generates costs: rental if the company does not own it, opportunity cost if it does, running costs (electricity, maintenance, caretaking, etc.), and in France in particular, increased taxation —such as the *taxe foncière* (TF) for owners and the *cotisation foncière des entreprises* (CFE) for occupiers. Before the pandemic crisis, rents represented a growing share of firms' value added, rising from 6.6% in 2001 to 8.3% in 2017 (Bergeaud and Ray, 2020). However, offices are not necessarily divisible. For example, a company will not be able to sell or stop renting an office in a shop or within a factory. It is therefore the abandonment of offices in lots separate from other activities that can enable a significant reduction in direct and indirect property costs. From this cost perspective, it is companies that use such premises ex-ante that would favour teleworking. This is also the case for firms in pure tertiary activities with only office premises.

The separation of offices from the company's other production premises makes it possible to put forward a second argument. With this building structure, the company already has an organisation that physically separates employees on the one hand in production sites such as shops, factories or laboratories, and on the other hand in tertiary offices in other sites. In this context, there is little risk that teleworking by employees in tertiary offices will alter relations between these employees and those in other activities and significantly raise coordination costs. On the other hand, a company whose premises encouraged physical interaction between office staff and employees in other activities may be exposed to a loss of cohesion in case of telework and potential coordination failures.

In both cases, the ex-ante use of offices in separate lots should encourage the use of teleworking. As a corollary, the signing of teleworking agreements would be fuelled. At the same time, there is no obvious argument that this organization of firm premises should impact directly the dynamics of firms' productivity. Crucially, while pre-Covid office configuration affects the cost and organisational feasibility of telework, it has no direct reason to influence post-pandemic productivity conditional on pre-Covid productivity. This provides the core exclusion restriction underlying our IV strategy.

Following these two lines of argument, we propose to mobilise the structure of the company's real estate as an instrument for the use of post-Covid telework. However, we need to distinguish between companies that own offices and those that rent them: it is easier to leave rented premises than owner-occupied premises. In France, in most cases[4], firms can break a commercial property lease every 3 years with a six-month notice period. So firms can quickly adjust their portfolio of rented premises. In addition, selling is costly, so if the firm has no immediate need for cash, it has little incentive to sell its premises, which constitute part of its capital and collateral. In that case, the firm would prefer to keep its employees working on-site.

The depressed state of the commercial property market at the end of the Covid crisis, particularly in France, would reinforce this heterogeneity. Indeed, office vacancies in France

[4]After nine years, the contract can be tacitly extended. In this case, it may be terminated at any time with notice.

have increased dramatically since 2019. Real estate professionals blame the rise of remote work as the main cause of this phenomenon. The last section will test this channel.

We will consequently use the surface area of office space used as a tenant and as an owner by the company at the end of 2019, just before the pandemic, as instruments for the proportion of teleworkers in 2022. Therefore, we instrument TW_{2022} with the *pre-Covid office surface in December 2019 per full-time equivalent* (FTE) in 2019. More precisely, we separate rented offices and owned offices and use classes of surface rather than the continuous variable, and estimate a two-stage least squares (2SLS) model[5]:

$$\text{(First stage)} \quad \text{TW}_{2022} = \alpha_0 + \alpha_1 \,\text{ClassesRentedOfficeSurf}_{2019} +$$

$$\alpha_2 \,\text{ClassesOwnedOfficeSurf}_{2019} + \alpha_3 \,\log\big(\text{Prod}_{2019}\big) + \mathbf{X}'\boldsymbol{\delta} + \nu, \tag{2}$$

$$\text{(Second stage)} \quad \Delta \log\big(\text{Prod}\big)_{2019\text{–}22} = \beta_0 + \beta_1 \,\widehat{\text{TW}}_{2022} + \beta_2 \,\log\big(\text{Prod}_{2019}\big) + \mathbf{X}'\boldsymbol{\gamma} + \varepsilon. \tag{3}$$

4 Data

4.1 Main sources

To assess the impact of telework on the organization and performance of French firms during and after the pandemic, we combine three complementary data sources. The first directly records the diffusion and modalities of telework at the establishment level; the second captures firms' economic and structural characteristics; and the third provides granular information on the use and ownership of business premises. Linking these datasets via common SIRET/SIREN identifiers and cadastral references allows us to trace—across a wide spectrum of companies—the joint evolution of telework adoption, output, and workspace occupation over the 2016-2022 period.

ACEMO-Covid Survey. Conducted by Dares, the purpose of this establishment-level monthly survey was to analyse how companies responded to the health and economic consequences of Covid-19 between March 2020 and April 2022. This survey was a key statistical source to monitor the crisis. In particular, it asks employers about the proportion of teleworkers and the number of telework days by teleworker. ACEMO-Covid is a monthly survey sent to managers. Only establishments of firms with at least 10 salaried workers are surveyed. It is stratified by establishment size, all establishments with 250 or more workers were surveyed.

[5] As for the OLS, since the model is a β-convergence equation, the estimated coefficient for telework is the same in the alternative specification for the second stage replacing the productivity growth, by the log level of productivity in 2022.

The response rate was about 40%, which is reasonable, with approximately 15,000 respondents per wave[6]. Larger legal units and enterprises are overrepresented in the sample in terms of counts compared to the universe of firms (see Appendix A and Section 4.2)[7]. A unique establishment/legal unit identifier (SIRET/SIREN) is available for the observations. We use the last wave in April 2022: as shown in Askenazy et al. (2025b), by spring 2022 telework had moved beyond a temporary post-pandemic adjustment and become a stabilised, structural practice in French private firms.[8]. We do not use survey weights in the estimations; this implies that larger legal units are mechanically overrepresented in the sample in terms of counts.

FARE. The FARE database is a key source for compiling industry statistics and national accounts in France. Developed by Insee, it combines tax records from French legal units with various other sources, including employment data from the FLORES database, which is itself derived from the BTS (see below). FARE covers the entire universe of non-financial, non-agricultural firms. In this study, FARE provides firm-level (see Appendix A.1) variables such as value added, full-time equivalent (FTE) employment, industry sector, and enterprise size category. It also gives the rental costs and real estate charges of firms' premises. It should be noted that these costs constitute intermediate consumption and are therefore deducted from value added.

CFE and TF (Majic). Two different taxes are paid by French firms on their premises. The *Cotisation Foncière des Entreprises* (CFE) is based in principle on the occupation as an owner or a tenant of a premise at the end of the year-2. However, if a change of occupant for a given premise has occurred in year-1, the CFE is paid by the new occupant. Using different vintages, we have been able to reconstruct the actual occupation at the end of a given year. The *Taxe Foncière* (TF) is paid by the owner of a business premise the first January of the current year. Each separate lot has a unique identifier. The related fiscal databases can be merged. We can thus identify if a premise is occupied by the owner or a tenant (an usufructuary is considered as an owner) (see Appendix A.2). The CFE database provides the size of the lot in square meters and the nature of the lot: office, store, plant... The size of the lot includes all the different surface: for example, in an office premise, offices, meeting rooms, archive or technical rooms. Offices within a plant or a store are not a separate lot. We are thus able to identify the surface per worker of separate offices.

[6]The survey was mandatory; however, given the circumstances, Dares did not impose sanctions on non-responding firms.

[7]Firms in the final sample are treated as individual observations. Instead of building and applying weights, all estimates control for enterprise size categories and 1- or 2-digit industry classifications, and we analyse heterogeneity across firm sizes.

[8]Telework information is reported at the legal-unit level (SIREN) or at the establishment level (SIRET); when we have the information at the establishment level only, we take the mean of the telework share on all establishments for a given SIREN.

BTS-Postes. The Base Tous Salariés (BTS) database is derived from the *Déclarations Sociales Nominatives* (DSN), which is shared between tax and social security authorities. Employers are required to report information annually, both at the establishment level and for each individual employee. For each employee, the following relevant details are declared: detailed occupation (at the 4-digit level), the start and end dates of the pay period, the number of hours worked, employment status (full-time or part-time), remuneration paid... The BTS-Postes dataset, which focuses on job positions, compiles initial variables and processing secondary variables from this information, including the calculation of full-time equivalent (FTE) measures for each job.

D@ccord. The D@ccord database of company collective agreements is based on information provided in a deposit slip and in texts transmitted to the labour administration. Pursuant to the French Labour Code, in order to be valid, a company collective agreement must be filed. The services of the Ministry of Labour then identify and record certain characteristics of company agreements. About 75% of the agreements are signed at the firm (legal unit) level, 12% cover two or more firms, and 12% only some establishments in a given firm (Favaro and Thiounn, 2025). This distribution supports the view that the firm level is the most relevant level for appraising the impact of the adoption of telework.

EEC. The Continuous Employment Survey EEC is the French version of the European LFS. It is the reference for labour force statistics. Conducted by Insee, this survey has been enhanced with a comprehensive telework component. EEC is a rotating panel survey conducted in six consecutive waves. Since 2021, the first-round questionnaire includes questions on both the proportion of teleworkers and the number of telework days by teleworker. From July 2022, additional questions have been introduced regarding the feasibility of telework for a given job. The definition of telework is consistent with ILO recommendations. Telework consists in working outside the employer's premises during one's usual working hours. It requires the ability to connect to the establishment's IT system. Telework is formalised in writing or via a dedicated electronic application, with the employer. Bringing work home, working while on business trips, at a client's premises or in a mobile way (during commutes, between meetings), or working at a remote site is not considered telework. We use a question on teleworkability to build for each 4-digit occupation a teleworkability index (see Appendix A.3).

Except for Majic, which is in open data, these databases are accessible remotely to researchers via the CASD (French Secure Data Access Centre). They have first to apply for an authorization by the French statistical secret committee.

4.2 Main variables and descriptive statistics

Sample. After linking ACEMO-Covid, FARE and BTS, we obtain 6,593 firms (legal units) representing about 3 million FTE (see Table 1). Comparing with the Insee business statis-

tics universe (Table A11), large enterprises are overrepresented, which is consistent with the ACEMO-Covid survey covering only establishments with more than 10 FTE. Nevertheless, our sample covers 20% of total employment in market sectors excluding agriculture, finance, and real estate. Table A12 shows that all sectors are represented, although coverage in terms of observations and employment is not uniform. Compared with the population of firms, observations in manufacturing, transportation and storage services, information and communication, and administrative support account for around 30% of total employment, whereas they represent less than 10% in accommodation and food services and in the extractive industries.

Coverage is slightly lower when data are also matched with CFE and TF sources, and the number of observations decreases to 6,427 – a level that we nonetheless consider very satisfactory given the number of datasets that had to be linked.

Table 1: Sample summary by enterprise size: employment and telework prevalence with 2019 productivity

Enterprise size	Count	Employment	Mean TW Share	Med. TW Share	Mean Prod. 19.	Med. Prod. 19
SME (excl. micro)	3,069	191,215	0.17	0.00	4.08	4.05
Mid-cap	2,483	875,676	0.25	0.07	4.24	4.20
Large enterprises	1,041	1,928,890	0.30	0.10	4.31	4.22
Total	6,593	2,995,781	0.22	0.04	4.17	4.14

Reading note: Telework is more prevalent in larger enterprises: the mean telework share rises from 0.17 in SMEs (excluding micro enterprises) to 0.30 in large enterprises, while median telework remains low (0.00 for SMEs), indicating a sizeable fraction of non-teleworking firms even among larger size groups. Mean productivity in 2019 is reported in logs and increases with enterprise size (from 4.08 for SMEs to 4.31 for large enterprises). Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate.
Source: Dares ACEMO-Covid, Insee FARE, authors' calculations.

Productivity. Productivity for year t refers to the natural log of the ratio of the current value-added (in 1000s EUR) to the number of FTE workers year t. By construction, about 2% of the observations which exhibit negative value-added are excluded. Productivity measures are also winsorised at the 1st and 99th percentiles, so as to limit the influence of extreme values. Initial productivity in 2019 is centred around a log value of 4.17, implying a median labour productivity on the order of €60–65k per FTE in 2019. Importantly, these levels are in line with the full-scope population: among firms with value added > 0 and FTE > 10, average value added per FTE is €69k per FTE and the median is €54k per FTE in 2019. Productivity growth between 2019 and 2022 averages 6% (log change = 0.06) in nominal terms, with marked dispersion (SD = 0.33; IQR from -0.05 to 0.18) and a wide range from -2.3 to 2.8.

Telework. Telework refers to the share of teleworkers. Its distribution in 2022 is uneven: the mean share is 22% while the median is 4% (1st quartile = 0%, 3rd quartile = 30%, SD = 0.33), with many firms reporting no telework and some reporting full telework (100%). This

dispersion provides useful variation for identifying the link between telework share in firms and productivity dynamics (see Figure A4).

Correlations. Initial productivity is positively correlated with telework intensity in 2022 ($\rho = 0.40$), suggesting that more productive firms are more likely to adopt telework. However, telework is essentially uncorrelated with productivity growth over 2019–2022 ($\rho = -0.01$), indicating no simple mechanical link. Initial productivity and subsequent growth are mildly negatively correlated ($\rho = -0.19$), consistent with mean-reversion dynamics.

Separate office space per FTE. This variable is computed as the firm's total office floor area (in square metres) divided by its total number of full-time equivalent employees (FTEs). The distribution reflects the fact that only a minority of firms occupy office spaces registered as separate lots, distinct from other premises such as factories or warehouses (see Table 2 and Appendix A.2). As a result, most firms report zero square meters per full-time equivalent (FTE), both for owned and rented offices. For owned office space, in 2019, 90 % of firms are at zero, and the mean of 0.5 m^2 per FTE is driven by a small number of firms with significant property holdings (C95 = 1.9). Rented office space is more prevalent and more unequally distributed: the mean reaches 4.5 m^2 per FTE, with a third quartile at 4.2 and a 95th percentile exceeding 25. This suggests that when firms rent separate office lots, they often do so at scale relative to their workforce. About 166 firms lack matched cadastral data, resulting in missing values for both indicators; these observations are excluded from regressions using office-space variables. Because of the distribution of these variables (see also Figure A6), we use in this study categorical variables rather than the continuous ones. Precisely, for both owned and rented separate offices, we consider 4 categories: no office, less than 5 m^2 per FTE, 5 to 15 m^2 and more than 15 m^2.

Table 2: Distribution of rented and owned separate offices. 2016 and 2019

	Rented (%)		Owned (%)		TW Share 2022 in offices 2019 (%)	
Space	2019	2016	2019	2016	Rented	Owned
0 m^2	53.4	51.7	91.0	86.5	10.1	21.3
> 0–5 m^2	21.8	18.5	3.9	3.4	25.7	24.0
> 5–15 m^2	12.8	12.3	1.6	1.6	43.9	33.6
> 15 m^2	9.5	10.2	1.1	1.2	49.4	44.4
No premise	2.5	7.4	2.5	7.4	28.5	28.5

Reading note: In 2019, 53% of firms have no rented separate office space per FTE, while 10% rent more than 15 m^2 per FTE; owned separate offices are much rarer, with 91% of firms reporting 0 m^2 per FTE. We did not find any premise for 2.5% of the firms in 2019.
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity in 2019 and 2022, excluding finance, insurance and real estate.
Source: TF, CFE, authors' calculations.

5 OLS estimates

Baseline results. In 2022, higher telework intensity is consistently associated with faster productivity growth: moving from 0 to 100 % telework corresponds to a cumulative gain of about 7 % in model (1), which rises slightly once fixed effects —enterprise-size and sector/subsector[9]— are included (coefficients between 0.09 and 0.10 in models (2) and (3); see Table 3). Initial productivity in 2019 is negatively correlated with subsequent growth, in line with *β-convergence* across firms. Note that, when we separate the correlations for employment change on the one hand, and for value-added on the other hand, the former is slightly negative and not statistically significant and the latter is clearly positive. These results suggest that the positive correlation between telework and productivity growth is driven by an increase in firms' value added rather than by a reduction in their workforce. Results remain robust to controlling for firms' *pre-Covid productivity trend* (growth 2016–2019): despite a smaller sample, the telework coefficient is still significant and above 0.06 and not statistically lower than the estimates without pre-trend (see Table A16). Overall, the evidence suggests a moderate yet robust association between telework adoption and productivity gains.

Non-linear returns to the extensive margin of telework. As we have already emphasized, the literature points to the risk of increasing coordination costs as telework expands, potentially generating adverse effects on productivity. This issue echoes the standard autonomy–coordination dilemma within firms (e.g. in Mintzberg's or Williamson's frameworks). In the French case, the dominant hybrid arrangement –implying around three days of physical presence at the workplace per week– should limit coordination costs on the intensive margin of telework. However, on the extensive margin, a too large share of teleworkers may increase such costs or coordination failures, leading to decreasing returns of this share in terms of productivity.

A grid-search piecewise-linear model (with sector/section FE), where the breakpoint is moved from 5% to 50% telework, suggests clear diminishing returns (see Figure A9). Specifically, we estimate a two-slope (kinked) linear specification and select the breakpoint by iterating over a grid of candidate thresholds and choosing the value that yields the best fit. For low thresholds (5–10%), the slope *below* the kink is about 0.25–0.30 (so an extra 10 pp of telework is associated with roughly 2.5–3.0 log-points higher productivity), while the slope *above* the kink is only about 0.08–0.09 (i.e., 0.8–0.9 log-points per 10 pp). As the breakpoint rises, both slopes decline: by 20–30% telework, the below-kink slope falls to about 0.21–0.24 and the above-kink slope to roughly 0.045–0.06; beyond one-third telework, the above-kink slope drops below 0.04 (i.e., < 0.4 log-points per 10 pp). In terms of precision, the above-kink effect is statistically distinguishable from zero at the 5% conventional level up to about 22% and becomes non-significant yet positive from ∼23% onward; the below-kink slope is generally significant once the threshold exceeds ∼10%.

[9]Precisely, a sector refers to a section in the NACE/NAF classification (2-digit-like NAICS). See for the full list Table A12. A subsector refers to a division (3-digit-like NAICS).

Table 3: OLS Estimates of Productivity Growth (2019–2022)

Dependent Variable:	Productivity Growth 2019-2022		
Model:	(1)	(2)	(3)
Variables			
TW Share 2022	0.073***	0.096***	0.088***
	(0.015)	(0.020)	(0.020)
Prod. 2019	-0.129***	-0.151***	-0.181***
	(0.011)	(0.012)	(0.014)
Fixed-effects			
Sector/Section		Yes	
Enterprise size		Yes	Yes
Subsector/Division			Yes
Fit statistics			
Observations	6,593	6,593	6,593
R^2	0.042	0.058	0.096

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reading note: In column (2), the coefficient 0.096 *implies that a 10 percentage-point increase in the telework share in 2022 is associated with about 1.0pp higher productivity growth over 2019–2022, conditional on subsector/section and enterprise-size fixed effects.*
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate.
Source: Dares ACEMO-Covid, Insee FARE, authors' calculations.

These non-linearities likely reflect the staggered activation of different productivity channels. On the capital side, while IT investments often represent front-loaded fixed costs, gains from real estate optimization—such as reducing office floor space—typically exhibit a step-function behaviour. Indeed, significant savings on rent and energy only materialize once a specific threshold of telework is reached, allowing for structural reorganizations. On the labour side, the levers also operate at different scales: the initial productivity boost driven by improved working conditions and reduced commuting time may be progressively offset by the non-linear rise in coordination costs. As the "physical" density of the firm falls, the depletion of spontaneous knowledge spillovers and the complexity of synchronous management may explain why the marginal gain of adding more teleworkers eventually vanishes.

Overall, these correlates suggest that the productivity payoff of telework peaks at moderate adoption and then fades as telework becomes widespread, a finding consistent with coordination mechanisms. The distribution of the telework share provides complementary insights to interpret these results. A majority of firms in our sample practising telework have a proportion of teleworkers below or close to the kink (see Figure A4). Only a few firms -about 10% of the observations- have between 30% and 75% of their workforce engaged in telework. The 15% of

observations with a very high proportion of teleworkers tend to concentrate mainly teleworkable occupations.

Composition gains and alignment. Building on the grid-search, the linear FE models of Table A19 in Appendix clarify *where* gains lie and *how* to reach them. In Column (2), augmenting the specification with the occupation-based *predicted* teleworkable share in 2019 (see Appendix A.3 for the construction's details) indicates that composition is the main margin: a 10 pp increase in the predicted share is associated with about +1.8% higher productivity growth. The partial return to the *observed* telework share is mechanically lower than in the baseline OLS (column 1)—a part of the potential effect of telework on productivity is absorbed by the predicted teleworkable share— but still statistically significant +0.5% per 10 pp. Column (3) proposes a similar exercise with the managerial share in 2019. The telework coefficient is still significant ($\approx 0.6\%$) per 10 pp. A 10 pp higher managerial share is linked to about +1.1% faster growth, consistent with organizational capacity facilitating the alignment of telework with task composition.

Taken together with the 22 % threshold from the grid search, these estimates suggest that firms reap most gains by aligning observed telework with the level implied by their occupational mix—rather than pushing far beyond it. However, the fact that the coefficient on *observed telework* remains positive and highly significant across all specifications, even after controlling for workforce composition, suggests that the decision to adopt telework is influenced by additional factors beyond workforce characteristics — factors that could, in turn, serve as valid instruments for an IV analysis.

Enterprise-size and sectoral heterogeneity. We further examine whether the productivity gains from telework vary across firm characteristics. First, our sample includes firms belonging to enterprises of very different sizes. Because larger companies may have greater opportunities to implement organizational changes and to learn how to extract productivity gains from innovation, we might expect them to achieve higher performance than smaller firms when adopting telework. We thus estimate a specification that interacts telework share with enterprise-size categories, controlling for sector/section fixed effects. This allows the marginal return to telework to differ systematically across enterprise sizes.

Second, we estimate a complementary model where telework intensity is interacted with sector dummies, controlling for enterprise-size categories and subsectors. This specification highlights potential sectoral asymmetries in the productivity effects of telework. Taken together, these models provide a first pass at identifying which types of firms benefit most from telework adoption.

The heterogeneous specifications suggest that productivity gains from telework are not uniform across firms. The estimated coefficient increases modestly with enterprise size; however, the differences across small, medium, and large enterprises are not statistically significant (see

Heterogeneity of telework-productivity effects by enterprise size and by sector.

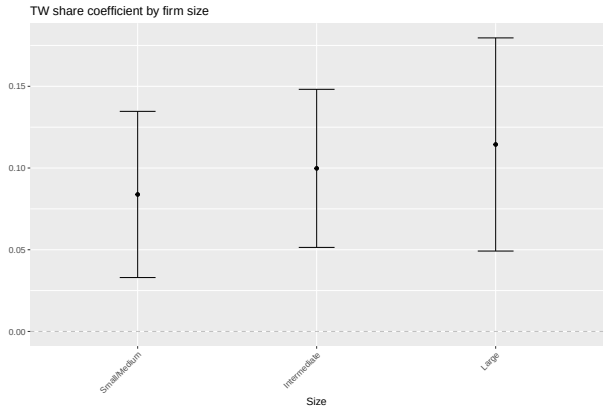

Figure 2: By enterprise size

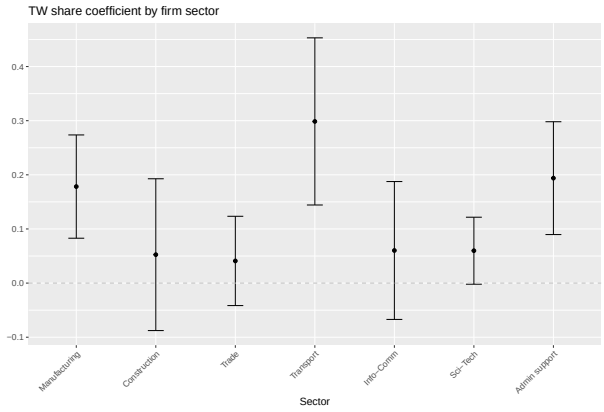

Figure 3: By sector

Reading note: Each dot reports the estimated coefficient on the 2022 telework share from separate regressions run by enterprise-size category (left panel) and by sector/division (right panel); vertical bars show 95% robust confidence intervals. A coefficient of 0.10*, for instance, means that a 10 percentage-point increase in the telework share is associated with a 1.0pp higher productivity growth over 2019–2022 in the corresponding group.*
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate.
Source: Dares ACEMO-Covid, Insee FARE, authors' calculations.

Figure 2). These results suggest that enterprise size does not systematically condition the telework–productivity relationship. By contrast, Figure 3 reveals substantial sectoral heterogeneity. Only sectors with at least 400 observations are reported. All sectors exhibit positive coefficients but two groups emerge. The correlations are the largest for *Manufacturing* (0.18), *Transport and warehousing* (0.30) and *Administrative support* (0.19). For the other sectors, the coefficients are much lower ranging from 0.04 to 0.06 and statistically different from 0 only for *Scientific–Technical activities*.

The result for the information and communication sector should be interpreted with caution. Almost all firms have adopted teleworking, and most of them report a very high share of teleworkers (see Table A15); consequently, the low coefficient may reflect the scarcity of non-treated firms. Its high dispersion also suggests contrasting impacts of telework on firm performance in this sector, resulting, for example, from the non-linearity of the relationship between the share of teleworkers and productivity.

For the construction sector, the estimate is likewise very dispersed, pointing to substantial within-sector heterogeneity. The comparison with the transport sector is suggestive. Both sectors display a low share of teleworkers, about 7% (Table A15), yet the correlation between telework and productivity is positive and large within the transport sector. This may reflect the interaction between telework and the physical organization of production: in the construction sector, production is mainly carried out by teams supervised on site at fixed brick-and-mortar locations, whereas in large parts of the transport sector, the activity is mobile and spatially dis-

persed, involving individual drivers and delivery workers or small crews electronically connected to their supervisors.

Crucially, these sectoral discrepancies are unlikely to be driven by variations in the intensive margin of telework. Analysis of the French Labour Force Survey reveals no substantial differences in the average number of teleworking days across enterprise sizes or sectors, which consistently hover around 1.8 days per week; only the Information and Communication sector stands slightly higher at 2.3 days (Askenazy et al., 2025b).

A Paris effect? According to the Labour Force Survey, telework is very unevenly distributed (Askenazy et al., 2025b). In particular, the share of teleworkers is much larger in the Paris region -Île-de-France-. Consistently, in our sample, firms that are present in Île-de-France report a telework share of 40% in 2022, compared to roughly 10% for firms with no workplace in this region (see Table A17). Geography also matters for productivity, notably through agglomeration economies, sectoral composition, and labour-market pooling, which raises the concern that spatial sorting might confound the estimated relationship between telework and productivity.

To monitor a potential source of spatial confounding, we begin by constructing, at the firm level, the proportion of employees by region NUTS 1 and by category of AAV *aire d'attraction des villes* (cities) plus outside a city, according to the Base Tous Salariés in 2019. This allows us to control not only for the presence in Île-de-France but also for finer-grained spatial composition differences across firms. We then augment our baseline OLS specification by adding these spatial composition controls to the regression, as reported in Appendix Table A18, Models (2) & (3). The estimated coefficient on telework is virtually unchanged when these controls are included, both in magnitude and in statistical significance. This stability suggests that our estimated effect of telework on productivity is not primarily driven by differences in the spatial distribution of firms' workplaces or by the spatial sorting of more productive firms into high-telework areas.

Table A18 - model (4) - in Appendix also presents the differences in estimate of the correlation between telework and productivity for firms with employees working only in the French capital region and for firms with no workers in this region, compared to firms with workers in Ile-de-France and at least another French region. The coefficient is slightly larger for firms located exclusively in Île-de-France and somewhat lower for firms outside the capital region, but the differences are small and statistically insignificant at conventional levels.

Taken together, these spatial robustness checks provide no evidence that the estimated productivity effect of telework is concentrated in the Paris region. Instead, the relationship appears remarkably stable across distinct geographic settings, suggesting that our findings capture a general organisational mechanism rather than a region-specific phenomenon.

6 IV relevance and validity

To study the relevance and validity of our instruments built on rented and owned separate offices in 2019 (see Appendix A.2) and possibly select some, we will proceed step by step by studying the correlations between

- **First-stage relevance (telework take-up in 2022).** We test whether the instruments are positively correlated with the use of telework in 2022. A significant positive correlation would show the relevance of the instrument.
- **Predicting telework agreements (pre- vs post-Covid).** We examine whether the instruments predict coverage by telework agreements in late 2019 and late 2023. If having separate offices boosts the implementation of telework it should also push firms to reach a telework agreement after but also before the Covid crisis.
- **Reduced form (instrument and productivity growth, 2019–2022).** We test the correlation between the instruments and productivity growth over 2019–2022. A possible correlation does not necessarily mean that the instrument is not valid, since it may be mediated precisely by the use of telework.
- **Placebo: reduced form among non-teleworking firms.** We test whether the instruments are correlated with productivity growth over 2019–2022 within the subsample of firms that do not use telework. If it is mediated by telework, we should expect no correlation. On the contrary, the persistence of a correlation in this falsification test would undermine the validity of the instrument.
- **Pre-period placebo (2016 instrument and productivity growth, 2016–2019).** We test whether separate offices in 2016 predict productivity growth over 2016–2019. Since telework was marginal in 2019, it can hardly mediate a positive correlation between separate offices in 2016 and the productivity growth. On the contrary, a significant correlation in this second falsification test would suggest that the instrument itself has an effect on productivity dynamics.

6.1 Separate offices in December 2019 predict telework practices

First-stage estimates. The instrument strongly predicts telework intensity in 2022. Firms renting separate office space exhibit significantly higher telework shares, with coefficients ranging from 0.08 (i.e. 8% more teleworkers) to 0.17 depending on the surface per FTE. The relationship is particularly steep between 0 and 15 m^2/FTE, then slightly attenuates beyond that.[10] In contrast, owned office space predicts less well: coefficients become positive only for

[10]Note that the relationship remains when controlling by the proportion of employees by region or AAV: this reassures that it is not driven by confounding geographical mechanisms.

surface areas above 5 m^2/FTE, and their magnitudes are smaller. These results could be explained by the small number of observations with owned separate office but are consistent with the idea that rented offices, being more flexible and less asset-specific, facilitate the organisational changes needed to implement telework. Initial productivity is also positively associated with telework uptake, and the inclusion of sector and size fixed effects brings the model's R^2 to 0.45, indicating substantial explanatory power. These patterns validate the instrument's relevance and motivate the use of rented surface per FTE in the second stage.

Table 4: First-stage estimates: rented office space per FTE predicts higher telework adoption.

Dependent Variable:		TW Share 2022	
Model:		(1)	(2)
Variables			
Office lots (rented) per FTE	0 m^2 (ref.)	–	–
	> 0–5 m^2	0.083*** (0.009)	0.082*** (0.009)
	> 5–15 m^2	0.173*** (0.013)	0.173*** (0.013)
	> 15 m^2	0.167*** (0.016)	0.169*** (0.016)
Office lots (owned) per FTE	0 m^2 (ref.)	–	–
	> 0–5 m^2	–	−0.002 (0.016)
	> 5–15 m^2	–	0.094*** (0.027)
	> 15 m^2	–	0.108** (0.043)
Prod. 2019		0.155*** (0.008)	0.151*** (0.008)
Fixed effects			
Sector/Section		Yes	Yes
Enterprise size		Yes	Yes
Fit statistics			
Observations		6 427	6 427
R^2		0.453	0.456

Heteroskedasticity-robust standard errors in parentheses
*Signif. Codes: *** 0.01, ** 0.05, * 0.1*

Reading note: In column (1), firms renting > 5–15 m^2 of separate office space per FTE have a telework share in 2022 that is higher by 0.173 (i.e., 17.3 percentage points) compared with firms with no rented separate office space (reference category).
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2019 and 2022 and at least one premise in 2019, excluding finance, insurance and real estate.
Source: Dares ACEMO-Covid, Insee FARE, authors' calculations.

In the same spirit we can expect that having ex-ante separate offices should incite firm to reach telework agreements. We thus ran probit estimates of the relation between separate offices in 2019 and the coverage by a specific firm-level collective agreement on telework in

2023 (see Table A20 in Appendix). Separate offices and telework collective agreements are significantly correlated. The magnitude of the coefficients is rather large: a separate office owned or rented in 2019 is associated with about a 10 percentage-point higher probability of being covered by an agreement in 2023. The same exercise can be done on the eve of the development of telework in France in 2019. Only 4% of firms in the sample were covered by such agreements in 2019. Average marginal effects from the probit model indicate that, relative to firms with no separate office lot, having separate offices in 2019 is associated with a 4–8 percentage-point higher probability of being covered by a telework agreement, consistent with earlier adoption. Note that Goux and Maurin (2025) use collective agreements signed before Covid as an instrument for remote work during and post-Covid. Since our instrument, separate office, can explain the signature of agreements, it is likely stronger and more relevant.

6.2 Office space and productivity in 2022: comparing teleworking and non-teleworking firms

The use of separate offices, particularly rented ones, may influence productivity dynamics either directly or through unobserved factors. For instance, using separate offices may make firms more agile to innovate and develop activities. In such cases, the exclusion restriction that the instrument must affect the dependent variable solely through its impact on the endogenous explanatory variable, and not through any other channel, could be violated.

To probe whether it is the case, we perform two tests. First, we regress productivity in 2022 on the telework share while keeping the same controls and fixed effects. Second, we rerun this level specification on the subsample of firms that report *no telework in 2022*. If a correlation between separated offices and productivity disappears in this restricted sample, it suggests that the association captured in the full sample indeed operates through telework and not through pre-existing productivity differences or location-specific shocks.

Full sample. Regressing 2022 productivity levels on the office–space variables for the full sample reveals a *statistically significant yet modest* link: firms that rent more than 5 m^2 per FTE are, on average, 4 to 5 % more productive than those with no separate rented offices (see Table A21 in Appendix). The coefficient drops to 2 %, for smaller separate office spaces but is still significant at the 10% level. These results show a statistically significant but modest association between rented office surface and productivity levels in the full sample. Again this correlation can mirror an effect of telework rather than a direct effect of having separate offices on productivity. The key question is therefore whether this association persists when telework is absent, which motivates the placebo analysis on non-teleworking firms. Then, a first way to disentangle between these two interpretations is to restrict our analysis for firms with no telework and so no mediating effects.

Non-telework firms. When the analysis is restricted to the 2 545 firms that report a teleworker share below 1% in 2022, the relationship between *rented* office space and productivity disappears: coefficients are near zero and statistically insignificant across all rental categories (see Table A22 in Appendix). Note that if these firms have on average less separate office spaces than the rest of the sample, still more than a quarter of them have such lots. Only *owned* space between 5 and 15 m^2 per FTE display a significant coefficient, likely reflecting capital intensity rather than telework readiness; but we can not reject that large owned office space improves productivity.

The absence of any correlation for rented offices—the component used as the instrument—among non-teleworking firms supports the exclusion restriction: rented office surface matters for productivity *only* in firms that actually use telework. Taken together, the two reduced forms suggest that while rented office space is mildly correlated with productivity in the full sample, this correlation is mediated through telework rather than reflecting a direct productivity channel.

6.3 Placebo test: separate offices in 2016 and productivity 2016-2019

To support this interpretation, we ran a second test for exclusion condition. We assume that telework was marginal before the Covid crisis, except for firms that were already covered in 2019 by a collective agreement on telework.[11] Under this assumption, telework could not mediate higher productivity. We thus regress for firms not covered by a telework agreement in 2019, the productivity growth between 2016 and 2019 on the separate office spaces in 2016 following the same categories that we use for offices in 2019. Table 5 reports the OLS results.

For rented separate offices, the estimated coefficients are positive, but their magnitudes are much lower than those for the "telework" period 2019-2022. For the first category, the estimated coefficients are essentially close to zero. Only the coefficient associated with the 15+m^2 group of rented separate offices in column (1) is statistically significant at the 10% level. But here again, a quite large positive correlation remains between the 5-15 m^2 per FTE class of owned separate offices and the productivity dynamics in 2016-2019.

To sum up, the three classes of rented offices per FTE appear as a likely determinant of the use and spread of telework among firms in 2022. Falsification tests are consistent with the exclusion assumption: renting separate offices is unlikely a significant source per-se of a productivity dynamic. Findings are less clear-cut for owned offices. The first class (<5m^2) is uncorrelated with the share of teleworkers in 2022. But, we cannot reject an impact of large owned separate offices on productivity. In addition, only 7% of firms own separate offices.

[11] Only 4% of firms in our sample were covered in 2019, but in 2022, they have on average more than half of their workforce engaged in telework, suggesting that they had already a significant share of teleworkers in 2019.

Table 5: Office spaces in 2016 and productivity growth 2016–2019

Dependent Variable:		Productivity Growth 2016–2019	
Model:		(1)	(2)
Variables			
Office lots (rented) per FTE 2016	0 m^2 (ref.)	–	–
	> 0–5 m^2	0.004	0.003
		(0.010)	(0.011)
	> 5–15 m^2	0.021	0.020
		(0.013)	(0.014)
	> 15 m^2	0.030*	0.028
		(0.018)	(0.018)
Office lots (owned) per FTE 2016	0 m^2 (ref.)	–	–
	> 0–5 m^2	–	0.007
			(0.025)
	> 5–15 m^2	–	0.053**
			(0.025)
	> 15 m^2	–	−0.029
			(0.057)
Prod. 2016		−0.221***	−0.221***
		(0.014)	(0.013)
Fixed effects			
Sector/Section		Yes	Yes
Enterprise size		Yes	Yes
Fit statistics			
Observations		5,601	5,601
R^2		0.136	0.137

Heteroskedasticity-robust standard errors in parentheses
*Signif. Codes: *** 0.01, ** 0.05, * 0.1*

Reading note: In the pre-telework period (2016–2019), separate office space in 2016 should not systematically predict subsequent productivity growth. In practice, most office-space coefficients are small and statistically insignificant, although a few categories display weak significance, so this placebo should be interpreted as largely—but not perfectly—supportive.
Coverage: Firms present in the core sample of Table 4, with 10 or more FTE and positive productivity in 2016 and no pre-Covid telework agreement, excluding finance, insurance and real estate.
Source: Dares ACEMO-Covid, Insee FARE, authors' calculations.

Therefore, we primarily use the surface of rented offices as instruments for the IV second-stage estimates, and also report results based on both rented and owned offices for completeness.

7 IV second-stage estimates and alternative specifications

This section presents the baseline estimates of the second stage of the IV, robustness checks on different samples and specifications, and the IV estimates for an alternative instrument.

7.1 Baseline

Table 6 provides the second stage estimates when instrumenting telework by the categories of rented separated offices only, and for both rented and owned offices.

Diagnostic tests. In both cases, instrument strength is confirmed by the Kleibergen–Paap under-identification test, whose p-values are well below .01, rejecting the null hypothesis of weak instruments. Exogeneity is not contradicted: the Sargan over-identification test fails to reject at conventional levels, suggesting that the office-space instruments are uncorrelated with the error term in the second stage. Finally, the Wu–Hausman test rejects the null that OLS and IV yield the same coefficients, confirming the risk of endogeneity of telework intensity and the need for an IV strategy. Overall, these diagnostics endorse both the relevance and validity of the instruments, lending credibility to the causal interpretation of the second-stage estimates.

Table 6: IV Estimates - Second stage

Dependent Variable:	Productivity Growth 2019-2022	
Model:	(1) IV-rented offices	(2) IV-rented and owned offices
Variables		
TW Share 2022	0.267***	0.272***
	(0.073)	(0.071)
Prod. 2019	-0.185***	-0.185***
	(0.019)	(0.019)
Fixed-effects		
Sector/Section	Yes	Yes
Enterprise size	Yes	Yes
Fit statistics		
Observations	6,427	6,427
R^2	0.043	0.043
Kleibergen-Paap, p-value	0.000	0.000
Sargan, p-value	0.904	0.543
Wu-Hausman, p-value	0.011	0.007

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reading note: In column (1), the coefficient 0.267 *implies that a 10 percentage-point increase in the telework share in 2022 raises productivity growth between 2019 and 2022 by about 2.7pp; column (2) yields a very similar estimate when owned office-space categories are added to the instrument set.*
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2019 and 2022 and at least one premise in 2019, excluding finance, insurance and real estate.
Source: Dares ACEMO-Covid, Insee FARE, authors' calculations.

Estimates. Instrumenting telework intensity with rented office surface per FTE yields with statistically significant positive effects of telework on labour productivity. Specifically, the

coefficients range from 0.26 to 0.27 log points, implying an increase of about 2.7% increases in FTE productivity for one additional teleworker per 10 employees.

These IV estimates of the effect of telework on productivity are markedly larger than the OLS coefficient of about 0.09. This discrepancy suggests that OLS may be biased downwards or that the effect of telework is concentrated on firms using separate offices in 2019. Recall that the IV estimate recovers the local average treatment effect (LATE), that is, the effect of telework on those firms whose adoption status is influenced by having separate office—the compliers. This LATE interpretation relies on the monotonicity assumption, namely that renting separate offices in 2019 does not reduce the probability of adopting telework in 2022 for any firm[12]. In our setting, monotonicity is plausible because renting separate offices in 2019 can be viewed as a signal of organisational readiness for telework rather than as a constraint that would deter adoption; consistently, the first-stage relationship is positive and increasing across rented office-surface categories[13]. They can be more responsive to telework, or they may be marginal adopters with higher potential productivity gains from adoption. The interpretation is therefore local: the estimated impact of 0.27 reflects the productivity gain for the set of firms induced to adopt telework because of renting separate offices in 2019. The smaller OLS coefficient of 0.09 reflects an average of correlations across the sample, combined with possible selection bias, while the IV estimate isolates the causal effect for the subset of compliers.

IV *vs* OLS The structure of the data allows us to comment on the composition of the compliance groups and to clarify the discrepancy between OLS and IV. To simplify the discussion, we consider only binary groups: telework in 2022 (at least 1% of the workforce)[14] or not, and rented separate office or not in 2019. Out of 6,427 firms, 2,908 are observed with rented separate office in 2019. Within this group, 2,207 have also adopted telework in 2022 while 701 do not. In the complementary group (no rented office in 2019), 1,675 firms have implemented telework while the remaining 1,844 have not. This distribution implies the existence of compliers, always-takers (firms that always implement telework), and never-takers (firms that never adopt telework).

More precisely, the 1,675 firms with "rented separate office in 2019 = 0" and "telework in 2022 = 1" represent always-takers, while the 701 firms with "rented separate office = 1" and "telework in 2022 = 0" represent never-takers. Compliers are those firms for which adoption switches with ex-ante renting separate offices. Under the monotonicity assumption, their number can be inferred as the difference in adoption rates between the two instrument groups.

Formally, let $R \in \{0, 1\}$ indicate having *rented separate offices* and $TW \in \{0, 1\}$ indicate

[12]In other words, we rule out *defiers*, i.e. firms that would adopt telework in 2022 if they did not rent separate offices in 2019, but would not adopt telework if they did rent separate offices.

[13]By contrast, owning separate offices may violate the monotonicity assumption. Firms that cannot easily sell or repurpose their office space may have an incentive to make use of this fixed asset and therefore be less likely to implement telework when encouraged to do so. This justifies our focus on rented offices for the instrumentation.

[14]Results are not sensitive to the choice of this threshold in terms of the implied share of compliers: using a 22% cutoff (the sample mean) yields a complier share of 0.32, and using a 50% cutoff yields 0.29.

telework adoption. Define

$$\hat{p}_r \equiv \Pr(TW = 1 \mid R = r) = \frac{\sum_i \mathbf{1}\{TW_i = 1,\, R_i = r\}}{\sum_i \mathbf{1}\{R_i = r\}}, \quad r \in \{0, 1\}.$$

Under monotonicity, the share of *compliers* equals the reduced first stage:

$$\Pr(\widehat{\text{Complier}}) = \hat{p}_1 - \hat{p}_0.$$

From the data,

$$\hat{p}_1 - \hat{p}_0 = \frac{2207}{2908} - \frac{1675}{3519} \approx 0.28.$$

Hence, roughly 28% of firms are compliers (i.e., they switch adoption status when instrumented), while *always-takers* and *never-takers* are differenced out by $\hat{p}_1 - \hat{p}_0$. These compliers are the population to which the IV estimate of 0.27 attaches.

Now note that the IV estimate can be combined with the implied share of compliers to provide a simple contribution exercise. Multiplying the LATE by the complier share yields $0.27 \times 0.28 \approx 0.08$, which is close to the OLS coefficient associated with telework. Therefore, this back-to-the-envelope calculation suggests that most of the positive impact of telework on productivity growth between 2019 and 2022 is driven by firms that were renting separate offices in 2019. Consistently, the mean share of teleworkers among firms with no rented separate office in 2019 is only 10%, and the OLS regression on this subsample gives a positive but smaller and non-statistically significant coefficient 0.05 for the relation between telework share and productivity in 2022. This finding may reflect our hypothesis that these companies could face higher coordination costs, as their employees interacted in the same physical location before the Covid pandemic.

Importantly, this does not imply that telework has no effect among always-takers or never-takers: the IV strategy identifies the causal effect only for compliers, and does not inform counterfactual questions such as what would happen if always-takers stopped teleworking or if never-takers started. Answering these policy-relevant extrapolations would require stronger assumptions on external validity and treatment-effect heterogeneity beyond the LATE framework.

Taken together, the results indicate that telework in 2022 has a substantial causal effect on productivity for those firms whose adoption is triggered by pre-Covid renting of separate offices.

7.2 Robustness checks

This subsection presents a set of robustness checks of the IV findings (using only rented separate offices as instruments, first-stage estimates are presented in Table A23). First, additional controls are included (detailed subsectors, firms' employment location and age). Second, we re-estimate the IV model on the subsample of firms that, in 2019, occupied at least one non-office premise (plant, store, etc.). Third, small and medium-sized enterprises, and intermediate enterprises and large ones may differ substantially in the organisation of their premises[15]. Fourth, on the subsample of firms observed also in 2016, the labour productivity growth 2016-19 is added. To improve comparability (but at the expense of statistical power), we therefore run the IV estimation separately for units belonging to the different enterprise-size categories. Finally, to avoid potential residual distortions in firm performance due to Covid-related disruptions, the impact of telework is assessed using labour productivity in 2023. All IV estimates presented in this subsection use only the categories of rented separate office per FTE as instruments.

Additional controls. The OLS correlation between telework and productivity was similar when detailed industry controls are added. The same exercise in the IV model confirms that dummies for detailed industries do not alter the findings: the estimated impact of telework on productivity in 2022 is almost the same as the baseline (Column 2, table 7).

As already noted in the OLS analysis, the firm's spatial location may constitute a confounding factor, and this may also apply to the first stage. The same may hold for firm age. After including the proportions of employees by AAV category and 4 age groups (created in 2015 or later, 2010-2014, 2000-2009 and older), rented office space remains highly relevant. Moreover, the IV estimated impact of telework on productivity in 2022 is virtually unchanged relative to the baseline specification (Table A24 in Appendix).

Sample of firms with not-only-office premises. The sample initially includes about 1400 firms that occupied only offices in 2019. One can argue that they are therefore not directly comparable with firms operating in different types of premises. To address this point and ensure that the estimation focuses on comparable firms those potentially affected by the use or non-use of separate offices, we re-estimate the IV on the subsample of firms that, in 2019, occupied at least one non-office premise (plant, store, etc.). Here again, the IV estimate effect of telework on labour productivity is unchanged, at 0.26 (Column 4, table 7).

Small and medium *versus* intermediary and large enterprises. Because small and medium-sized enterprises (SMEs) are underrepresented in the sample, the positive impact of telework on productivity may be biased upward by the effects among large firms. To test this hypothesis, we divide the observations into two broadly balanced groups: units belonging to SMEs and units attached to intermediate and large enterprises (ILEs), according to the INSEE

[15]By construction of the database, there are no micro-enterprises in the sample.

Table 7: IV-rented robustness checks

Dependent Variable:	Productivity Growth 2019-2022					
Model:	(1)	(2)	(3)	(4)	(5)	(6)
			Not-only-offices		SME	ILE
Variables						
TW Share 2022	0.267***	0.272***	0.262***			
	(0.073)	(0.084)	(0.085)			
Prod. 2019	-0.185***	-0.214***	-0.171***	-0.177***	-0.222***	-0.153***
	(0.019)	(0.020)	(0.020)	(0.019)	(0.030)	(0.024)
TW Share 2022 in SME				0.280***	0.342**	
				(0.089)	(0.136)	
TW Share 2022 in ILE				0.198***		0.181**
				(0.068)		(0.082)
Fixed-effects						
Sector/Section	Yes		Yes	Yes	Yes	Yes
Enterprise size	Yes	Yes	Yes	Yes	Yes	Yes
Subsector/Division		Yes				
Fit statistics						
Observations	6,427	6,427	5,012	6,427	2,968	3,459
R^2	0.043	0.082	0.046	0.048	0.043	0.049
Sargan, p-value	0.904	0.607	0.985	0.208	0.080	0.411
Wu-Hausman, p-value	0.011	0.016	0.069	0.061	0.042	0.287

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reading note: In column (1), the coefficient 0.267 *implies that a 10 percentage-point increase in the telework share in 2022 raises productivity growth between 2019 and 2022 by about 2.7pp; the remaining columns show that this magnitude is broadly robust across alternative fixed effects, sample restrictions, and heterogeneity specifications.*

Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2019 and 2022 and at least one premise 2019, excluding finance, insurance and real estate.

Source: Dares ACEMO-Covid, Insee FARE, authors' calculations.

classification. For both groups, renting separate offices in 2019 is strongly correlated with the share of teleworkers in 2022 (see Table A23).

The pooled IV estimation uses as instruments the interactions between the categories of rented surface per FTE and the binary variable distinguishing SMEs from ILEs. For both the SME and ILE groups, the IV estimates for telework confirm a significant positive effect on productivity in 2022 (column 4, table 7). The coefficient is higher for units belonging to SMEs, but the difference between the two groups, about 0.08 is not statistically significant at conventional levels. Columns 5 and 6 replicate the IV estimations separately for each group. Once again, the estimated effect is larger for SME units, but the results should be interpreted with caution, as the estimates are more dispersed and the standard diagnostic tests are less

reassuring[16].

Evidence therefore does not support that the impact of telework on productivity is lower in SMEs than in ILEs; it rather suggests the opposite. This finding might be explained by the non-linear relationship between the extensive margin of telework and productivity, as suggested by the OLS regressions: the average share of teleworkers among SMEs is 17%, compared with 26% for units belonging to intermediate and large enterprises.

Productivity pre-trend. To further assess the robustness of the IV analysis, we include productivity growth between 2016 and 2019 as an additional control. This reduces the sample to 5,848 observations. First stages are in Appendix table A25. In this restricted sample, which contains fewer SMEs, the LATE of telework on labour productivity without controlling for the pre-trend is 0.19 —lower, but not significantly different from the estimate obtained for the full sample (Column 1, table A26 in Appendix). When the pre-trend is included (column 2), the estimate remains large and significant (0.15). This coefficient likely provides a lower bound for the IV estimates of the impact of telework.

Productivity in 2023. While the spread of telework practices appeared to reach a steady state in 2022, the French economy was still bearing the scars of the Covid crisis in that year. It is therefore worthwhile to test whether the relationship between telework and productivity persists when considering labour productivity in 2023, a year when GDP had clearly surpassed its 2019 level (and the most recent year for which firm fiscal data are available). The number of observations decreases by about 200 (due to firm mergers, closures, sharp downsizing and missing data). On this sample, the IV estimate for the effect of telework on productivity in 2022 is similar to the full-sample estimate, at 0.27 when using rented separate offices as instruments (column 1, table 8).

The IV estimated effect of telework on productivity in 2023 is slightly larger than in 2022 (column 2, table 8). While telework appears stable in aggregate between 2022 and 2023, we cannot assess whether it is equally stable at the firm level over time; if telework intensity varies across waves for a given firm, this would act as measurement error and induce attenuation bias, potentially leading to underestimate the true coefficient. There is thus no sign of a decline in the estimated effect of telework on productivity in 2023. A learning effect of the new telework practice could explain a higher estimate for 2023, although the difference between the 2022 and 2023 estimates is small and not statistically significant.

[16]While the diagnostics are weaker and the estimates more dispersed than in the baseline, they remain informative for sensitivity checks. By contrast, sectoral splits are harder to interpret: the sample sizes drop and the prevalence of separated offices varies widely (e.g., ∼26% in manufacturing vs. >80% in information–communication), so the mix of compliers differs by sector(see Table A14). We therefore refrain from fine-grained IV by sector.

Table 8: Productivity growth up to 2023

Dependent Variables:	Productivity Growth 2019-2022	Productivity Growth 2019-2023
Model:	(1) IV-rented offices	(2) IV-rented offices
Variables		
TW Share 2022	0.266***	0.313***
	(0.072)	(0.077)
Prod. 2019	-0.178***	-0.226***
	(0.019)	(0.020)
Fixed-effects		
Sector/Section	Yes	Yes
Enterprise size	Yes	Yes
Fit statistics		
Observations	6,230	6,230
R^2	0.041	0.058
Kleibergen-Paap, p-value	0.000	0.000
Sargan, p-value	0.947	0.154
Wu-Hausman, p-value	0.007	0.004

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reading note: In column (2), the coefficient 0.313 *implies that a 10 percentage-point increase in the telework share in 2022 raises productivity growth between 2019 and 2023 by about 3.1pp.*
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2019 and 2022 and at least one premise in 2019, excluding finance, insurance and real estate, and observed in FARE through 2023.
Source: Dares ACEMO-Covid, Insee FARE, authors' calculations.

7.3 Alternative instrument: office surface per teleworkable FTE

Our underlying variable for building instruments is the surface of separate offices per FTE worker. It can reasonably be argued that this surface is small or even null (resp. large) if firms employ very few (resp. many) office jobs that are more likely teleworkable. The correlation between the surface per FTE and the teleworker share may simply reflect differences in workforce teleworkability: firms with more teleworkable jobs are both more likely to have office space and more likely to implement telework arrangements. To address this concern, an alternative approach is to use the surface per FTE teleworkable jobs in 2019 (first-stage estimates are presented in Table A27)[17]. Moreover, the baseline instrument normalizes office surface by total FTEs, while the numerator pertains only to separated offices; using FTE teleworkable jobs as the denominator aligns the numerator and denominator—office area with

[17]Discrepancies for the employment variable between the FARE and BTS sources concern 104 legal units, for which the number of FTEs does not match across the two data sources. We thus excluded these observations as the area per FTE is constructed on FARE and the predicted teleworkable share on BTS.

the subset of workers plausibly using it—and thus mitigates this potential composition bias.

As before, we retain four categories: 0, less than 20 m^2 per teleworkable FTE, between 20 and 60 m^2, and above 60 for both rented and owned separate offices. The number of observations in each category is broadly similar to those based on the surface per total FTE in 2019 (see Appendix A.3 for descriptive statistics).

These alternative instruments especially those based on rented offices, also exhibit good properties. They are strongly correlated with the proportion of teleworkers in 2022 and with the coverage by collective agreements on telework. There is some correlation with productivity growth between 2019 and 2022, but it disappears for rented offices in 2019 when restricting the sample to firms with no or almost no teleworkers in 2022. Diagnostic tests are likewise reassuring.

The second-stage estimates are strikingly similar to those obtained with the initial instruments, around 0.26 and still statistically significant (Table A28). This proximity is partly explained by the fact that the binary characteristic ——whether or not separate offices are used— generates a large common support of compliers for both the initial and the alternative instruments.

8 "General equilibrium" effects and real estate channels

This section first discusses how the micro-findings translate into macro effects of telework on productivity. Then it explores the magnitude of the contribution of the reconfiguration of firm premises in the productivity gains associated with telework.

8.1 From micro to macro

The micro-level estimates can be used to infer potential macroeconomic implications of the expansion of telework. As discussed earlier, the LATE estimate is valid for compliers. If telework has more mixed effects for other firms, the average treatment effect is likely lower and closer to the OLS correlation between telework and labour productivity. Now, according to our OLS results, a 22% share of teleworkers would translate into a non-negligible 1 to 2% increase in FTE productivity. Such an economically meaningful effect is a priori inconsistent with the weak aggregate labour productivity growth in France between 2019 and 2023, but may help to elucidate the clear recovery of productivity observed since 2024.

Actually, the assessment of a macroeconomic impact of telework should be interpreted with caution. First, the empirical analysis covers only about half of the French economy: agriculture, finance, insurance, real estate, and the public sector and micro enterprises are not included in the dataset.[18] Second, the OLS and IV estimates give estimates in "partial

[18] According to the French Labour Force Survey, these sectors exhibited polarised levels of teleworking in 2022, with very few teleworkers in agriculture and in public services (such as the police, the army, and education), while the highest proportion (above 60%) was observed in finance and insurance.

equilibrium". This interpretation implicitly relies on SUTVA (no interference): if telework adoption by some firms affects the productivity of other firms including those in the "control" group, through demand reallocation or competitive spillovers, the estimated effect may overstate private productivity gains relative to the general-equilibrium impact. In the **short run**, the "general equilibrium" impact of telework on productivity is likely to be more ambiguous and even negative. Indeed, like other innovations, telework can distort demand across sectors. For instance, after Covid, the demand and thus productivity dropped in business real estate[19], in service, primarily non-teleworkable activities such as restaurants and stores located in business districts, and in commuting services. In other sectors, telework may also reduce the productivity of non-teleworking competitors through intensified competition on product and labour markets.

In the **medium run**, the potential reduction in rental costs induced by low demand for offices could limit firms' incentives to maintain telework, leading to lower adoption rates.[20] However, in the **long run** several adjustment mechanisms could transform the spread of telework into net productivity gains. These include organizational adaptation within firms, self-selection of workers and firms better suited to telework, and the reallocation of capital towards more efficient uses. Overall, these dynamics suggest that telework may ultimately contribute to sustained improvements in aggregate productivity. It is worth noting that the French Labour Force Survey provides no evidence of a recent decline in telework among private firms. In fact, according to its provisional version, the share of teleworkers may have risen to nearly 25% in 2025, compared with 23% at the end of the pandemic.

8.2 A reconfiguration of office premises

Following the logic of our first argument linking teleworking and real estate structure, firms with separate offices should reduce their floor space and property expenses with the rollout of teleworking. The effect is theoretically ambiguous in the framework of the second, organizational argument. In particular, for firms that did not previously have separated offices, the switch to teleworking may provide an opportunity to move towards an organisation where part of the office and production staff are located in distinct premises. In what follows, we focus on gains for rented offices: owner-occupier firms are much less common, so it seems reasonable to simplify by treating total gains as equal to gains on rented office space.

We rely on two variables to investigate these mechanisms: our measure of office floor space and firms' total real estate expenditures from FARE.[21] The latter mainly covers rental expenses but also includes shared ownership costs borne by both tenants and owners. These costs concern

[19] A reduction in rental costs for a given firm improves its value added, but conversely, lower rents reduce the value added of its landlord. From a purely accounting point of view, this is therefore neutral for the aggregated productivity.

[20] Unfortunately, there are no reliable data on the local evolution of office rental prices. Even web-scraped public listings are unreliable, as landlords often offer substantial unobserved rebates during commercial negotiations. Thus we cannot test empirically this general equilibrium effect by including in the first-stage equation an interaction term between the instrument and changes in rental prices.

[21] Both variables are winsorised at the first and last percentiles.

all the premises: we cannot identify costs specific to separate offices. By construction, we cannot use our IV method based on real estate; we therefore restrict the analysis to OLS regressions of changes in expenditures and office floor space per FTE between 2019 and 2022.

Table 9: Telework and change in separate office spaces

Dependent Variable:	All separate offices		Modern	Old	Modern	Old
	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
TW Share 2022	-0.159		0.168	-0.283**		
	(0.312)		(0.227)	(0.131)		
× no separate office (2019)		2.24***			1.31***	0.596***
		(0.372)			(0.280)	(0.132)
× separate office (2019)		-0.833**			-0.153	-0.529***
		(0.353)			(0.259)	(0.148)
Fixed effects						
Sector/Section	Yes	Yes	Yes	Yes	Yes	Yes
Enterprise size	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics						
Observations	6,291	6,291	6,291	6,291	6,291	6,291
R^2	0.002	0.014	0.003	0.012	0.008	0.019

Heteroskedasticity-robust standard errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reading note: In column (2) (All separate offices), the coefficient on TW Share 2022 × no separate office (2019) *is* 2.24*: a 10 percentage-point increase in the telework share in 2022 is associated with an increase of about* 0.224 m^2 *of separate office space per FTE for firms that had no separate office premises in 2019. By contrast, the coefficient on* TW Share 2022 × separate office (2019) *is* −0.833*, implying a decrease of about* 0.083 m^2 *per FTE for firms that already had separate offices in 2019.*
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate, with non-missing information on separate office premises in 2019 and on office-space changes.
Source: Dares ACEMO-Covid; office real estate administrative sources; Insee FARE; authors' calculations.

Across the full sample, the share of teleworkers in 2022 appears negatively correlated with the evolution of separate office space per FTE (Column 1 Table 9). However, the estimated coefficient is small and non-statistically significant. The interaction with the existence (or absence) of separate offices in 2019 suggests substantial heterogeneity (Column 2). The coefficient associated with the proportion of teleworkers, conditional on the absence of separate offices in 2019, is positive and significant. This suggests that these firms may indeed have shifted towards an organisation with physical separation between production workers and office staff. Conversely, the coefficient for firms that already had separated offices is significantly negative. Quantitatively, a 10-percentage-point increase in the share of teleworkers is associated with a decrease of about 0.08 m^2 in rented office space per employee. Holding firm size constant, this corresponds to approximately 0.8 m^2 less office space for each additional teleworker. Recall,

that the average annual rental cost per square meter in France was about 140 Euros in 2022. There is no significant result regarding owned separate office.

As regards real estate expenditures (for all premises), in both cases the coefficient associated with the share of teleworkers is negative but non-significant at conventional levels (see Table A29 in Appendix). However, here again, the coefficient is larger, about EUR 300 per teleworker for firms initially having separate rented offices. The costs of a workstation include not only real estate expenditures but various direct costs associated with on-site work (such as electricity, security, workplace catering, taxes). The French Association of Workplace Environment Managers estimates that they account for about two-thirds of the real estate expenditures. So the total savings in total workstation costs might reach EUR 500 per teleworker. However, these savings are likely to explain only a limited fraction of the observed average productivity gains in 2022, estimated at approximately EUR 6,000 per teleworker based on OLS estimates (and around EUR 20,000 for IV compliers).

The data allow us to go a step further by breaking down changes in rented office areas according to the quality and age of the office premises: offices located in a recently designed or extensively renovated building with a flexible layout (movable partitions) and modern IT equipment (cabling, etc.) *versus* offices located in an older building without any special facilities and thus obsolete for a hybrid-telework organization.[22] In 2019, firms in our sample occupied separate office space that was almost evenly split between modern and old offices. Columns 3 to 6 of Table 9 show a reallocation from old premises toward more modern ones. Specifically, firms with separate offices in 2019 tend to reduce the area of obsolete premises, whereas firms without separate offices in 2019 mainly rent modern office space. These results are consistent with a reconfiguration and modernization of corporate premises following the expansion of teleworking, that can improve productivity beyond real estate savings. This quality channel can be further explored by looking at the connection between telework and office IT equipment.

8.3 Office IT equipment

Office IT. A complement of the FARE database provides data on gross assets in office equipment (plus a small component reusable packaging).[23] The account groups together all fixed assets related to office and IT equipment: Computers and IT accessories (laptops, desktop computers, peripherals, etc.); Communication devices (phones, etc.); Printers and copiers; Presentation equipment (projectors, projection screens, etc.). Software embedded in the hardware equipment (e.g. Windows in a PC) is also included in this investment. These equipment can be used within the firm premises or not, for example, at home by a teleworker.

[22]The local taxes are based on the estimated rental value of a property. The old/modern nature of the offices thus leads to different tax levels, which supports the reliability of this information.

[23]This variable can be constructed using the CASD database, BIC-IS.

Table 10: Telework and office IT equipment

Dependent Variable:	Office equipment change 2019-2022	
Model:	(1)	(2)
Variables		
TW Share 2022	0.074***	
	(0.028)	
Office equipment per FTE 2019	-0.156***	-0.156***
	(0.007)	(0.007)
TW Share 2022 × no separate office in 2019		0.160***
		(0.048)
TW Share 2022 × separate offices in 2019		0.064**
		(0.029)
Fixed-effects		
Sector/Section	Yes	Yes
Enterprise size	Yes	Yes
Fit statistics		
Observations	6,593	6,593
R^2	0.129	0.130

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reading note: Column (2) shows that this association is stronger for firms with no separate office premises in 2019 (coefficient 0.160*) than for firms with separate offices (coefficient* 0.064*).*
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate.
Source: Dares ACEMO-Covid, Insee FARE, authors' calculations.

Analysis design. Two auxiliary regressions take telework share in 2022 as a predictor of the log growth of office IT equipment per FTE worker between 2019 and 2022[24]. All specifications include sector/section and enterprise-size fixed effects, and control for the 2019 office equipment per FTE worker. Specifically, we estimate (1) a baseline OLS regression, (2) a model allowing heterogeneous effects depending on whether the firm had a separate office in 2019.

Findings. In the baseline OLS (column 1), the 2022 telework share is positively associated with a 7% increase in the gross office equipment per FTE over 2019–2022. In the heterogeneous specification (column 2), the association holds both for firms without a separate office in 2019 and for those with a separate office. Consistent with the findings on the evolution of modern office spaces, the coefficient is much larger, at 0.16 for firms with no separate office in 2019[25].

[24]Note that about 5% of observations have zero equipment in the raw variable; to keep these observations, the 2019 and 2022 levels are winsorized at the 10th. They are also at the 99th percentiles.
[25]By construction these firms are *always takers* in the IV.

A 7% increase implies that, for the median firm, the addition of one teleworker is associated with an increase of roughly EUR 200 in office equipment. Even when considering the large cross-sectional elasticity between office equipment and value added per full-time equivalent (FTE) worker observed for 2022 in our sample (0.15), the implied contribution of additional office equipment would explain at most approximately one-seventh of the labour productivity gains obtained from OLS estimates.

In summary, the observed changes in office use and equipment are consistent with an ongoing reallocation of capital prompted by the rise of telework in France. However, in 2022, the magnitudes of these real estate and office equipment changes were limited, suggesting that the reduced-form estimates of the productivity effect of telework capture additional channels beyond real estate reconfiguration. These results further support the two underlying assumptions of our instrument design. Firms that rented office space and have adopted teleworking have reduced the amount of space they lease; however, the relatively modest magnitude of this reduction is consistent with the view that premises configuration primarily reflects an organisational structure already conducive to teleworking. Stated differently, since telework reshapes task coordination, real estate adjustments represent only a partial explanation of the overall productivity gains.

9 Conclusion

Apart from randomised experiments, whose external validity is limited, exploring the consequences of post-Covid teleworking on firms' performance using company data faces the challenge of identifying a causal impact. Our paper suggests that the pre-Covid configuration of corporate real estate, in particular office arrangements, offers a possible avenue for an instrumental approach. The use of offices – mainly rented – in separate units in 2019 accounts for a significant share of the adoption of telework in 2022 in French non-financial and non-real-estate firms. This use, in itself, would not be a direct factor of improved performance as confirmed by placebo exercises. However, firms that had such offices may find in telework a way to reduce their costs. From an organisational perspective, for firms that had already physically separate offices from other production sites, telework merely extends this separation in another form.

Our main contribution is to provide a credible causal estimate of the firm-level productivity effects of post-Covid telework adoption. Both OLS and IV results point to positive but moderate productivity improvements from post-Covid telework adoption from a moderate 0.5% (lowest OLS estimate) to a significant 2.7 % (LATE estimates) for a 10-percentage-point increase in the teleworker share. The IV results are robust to alternative specifications. The IV magnitudes should be interpreted as a local average treatment effect (LATE), i.e. the effect of telework for firms whose adoption decision is shifted by office-space flexibility (the compliers). As such, they should not be mechanically extrapolated to all firms: the average effect in the whole economy

may differ if telework yields smaller or larger gains for firms that would adopt regardless of office constraints.

Complementary analyses indicate (i) larger gains below the 22% telework threshold, (ii) stronger correlations in the manufacturing sector, (iii) small reductions in obsolete office space and direct real estate costs, alongside a moderate increase in office IT equipment, and (iv) suggest that this office modernisation can explain only a limited share of the observed improvement in labour productivity.

However, these results at the firm level do not translate to the macro-level in the short to medium run. First, our study does not cover the finance and insurance sector where companies are owners of their offices. Second, telework has side effects. The real estate sector suffers revenue losses that cut its apparent productivity. It also affects many activities, for example, restaurants in business districts. A full potential effect on telework on productivity would thus require a capital reallocation in the long-run.

Finally, the identification strategy developed here opens promising avenues to study how hybrid work reshapes labour markets, firm behaviour, and the geography of production.

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Appendices

A Data

A.1 Scope of the study and definitions

Our empirical sample comprises legal units within the scope of the ACEMO-Covid survey that operate outside the financial and real-estate sectors in both 2019 and 2022 according to FARE. Since ACEMO-Covid is intended to survey only establishments and thus units with 10 or more workers, to ensure comparability over time, units with less than 10 full-time-equivalent (FTE) positions in both years are removed.[26] Because the interest variable is the log evolution of productivity, only units exhibiting strictly positive value added are kept. This is the case of 97% of the observations.[27] In total, the final sample includes 6,593 legal units, accounting for just under 3 million FTEs in 2022.

Throughout the paper, a *firm* refers to a legal unit. An *enterprise* follows the INSEE definition: the smallest combination of legal units that is an organisational unit producing goods and services, enjoying a certain decision-making autonomy, especially for the allocation of its current resources. A legal unit may therefore correspond to an enterprise itself or belong to a larger umbrella enterprise.

The INSEE further classifies enterprises into four categories:

- Small and medium-sized enterprises consist of enterprises which employ less than 250 persons and either have an annual turnover not exceeding EUR 50 million or a balance sheet total not exceeding EUR 43 million. Micro-enterprises are included in this category. They are defined as enterprises employing less than 10 persons and either have an annual turnover or a total balance sheet not exceeding 2 million euros.

- An intermediate-sized enterprise (ETI) is a company with between 250 and 4,999 employees, and a turnover which does not exceed 1.5 billion euros or a balance sheet total which does not exceed 2 billion euros. A company with fewer than 250 employees but a turnover greater than 50 million euros and a balance sheet exceeding 43 million euros is also considered to be of intermediate size.

[26] 86 out of 6870 observations had less than 10 FTE in 2019 according to FARE. The mean of the share of teleworkers for these observations is 0.19 compared to 0.22 for the remaining sample.

[27] The 191 observations with non-positive value added in 2019 or 2022 had an average share of teleworkers in 2022 of 0.34 compared to 0.22 for the remaining sample. 76 firms had according to FARE a non-positive value added both in 2019 and 2022; among them, the two largest employers were a public industrial and commercial establishment and a private non-profit hospital.

- A large enterprise is an enterprise that checks at least one of the following two conditions: at least 5,000 employees; an annual turnover greater than 1.5 billion euros and a balance sheet total of more than 2 billion euros.

By construction, there is no micro-enterprises in the sample used for this study.

Table A11 reports the coverage of the analytical sample relative to the FARE population in 2019 by enterprise size of the enterprise that the firm is in. While microenterprises account for the vast majority of firms in the population, they are not included in the analytical dataset by construction of ACEMO-Covid. The sample instead focuses on SMEs, mid-cap, and large enterprises, which together represent about one fifth of total employment observed in FARE. Coverage rises sharply with enterprise size, reaching over 40% for large firms.

Table A11: Composition of the sample relative to to the universe of firms in 2019 (Fare), by enterprise size class

Enterprise size	Count (sample)	Count 1000's (Fare)	Employment 1000's (sample)	Employment 1000's (Fare)	Coverage Emp. (%)
Micro	0	3 992.1	0.0	2 421.7	0.0
SME (excl. micro)	3,069	299.8	191.2	4 307.3	4.4
Mid-cap	2,483	66.2	875.7	3 727.5	23.5
Large enterprises	1,041	26.6	1 928.9	4 353.6	44.3
Total	6,593	4 384.7	2 995.8	14 810.1	20.2

Reading note: The last column reports the share of total employment (from FARE) covered by the analysis sample within each enterprise-size category; for instance, the sample covers 44.3% of employment in large enterprises.

Coverage: French private-sector firms, by enterprise-size category; the "sample" corresponds to firms observed in the ACEMO-Covid April 2022 matched dataset used in the analysis.

Source: Dares's ACEMO-Covid, Insee's FARE, authors' calculations.

Table A12: Composition of the sample relative to the universe of firms in 2019 (Fare), by sector

Sector	Count (sample)	Count 1000's (Fare)	Excl. micro	Employment 1000's (sample)	Employment 1000's (Fare)	Excl. micro	Coverage Emp. non-micro (%)
Mining-quarrying	16	1.7	0.8	1.6	21.4	20.0	8.0
Manufacturing	1,755	225.6	40.1	773.1	2 673.4	2 451.5	31.5
Electricity-Gas	18	34.6	6.2	23.9	163.5	162.4	14.7
Water-Waste	84	12.3	2.5	17.2	149.2	141.6	12.1
Construction	412	516.3	51.5	110.0	1 390.6	945.3	11.6
Trade	1,303	715.4	72.3	498.0	2 864.1	2 309.0	21.6
Transport-Storage	512	153.2	15.6	436.5	1 297.5	1 221.4	35.7
Accommodation-Food s.	217	277.1	26.0	53.2	931.1	584.4	9.1
Info-Comm	444	155.8	14.1	247.2	823.9	756.6	32.7
Sci-Tech	751	563.5	43.6	157.7	1 170.4	937.6	16.8
Admin.-support	645	234.3	26.5	557.1	1 825.0	1 711.6	32.5
Education	56	157.3	3.7	17.9	117.7	82.3	21.7
Health-Social	255	515.4	10.1	78.4	563.1	485.8	16.1
Arts-Leisure	74	154.2	3.7	11.0	132.3	104.3	10.6
Other services	51	241.2	5.2	13.1	223.4	109.3	12.0
Forestry operations	0	4.2	0.2	0.0	5.7	3.2	0.0
Holdings-Financial Aux.	0	179.1	48.6	0.0	227.8	185.8	0.0
Real estate	0	243.5	21.6	0.0	230.1	176.4	0.0
Total	6,593	4 384.7	392.6	2 995.8	14 810.1	12 388.3	24.2

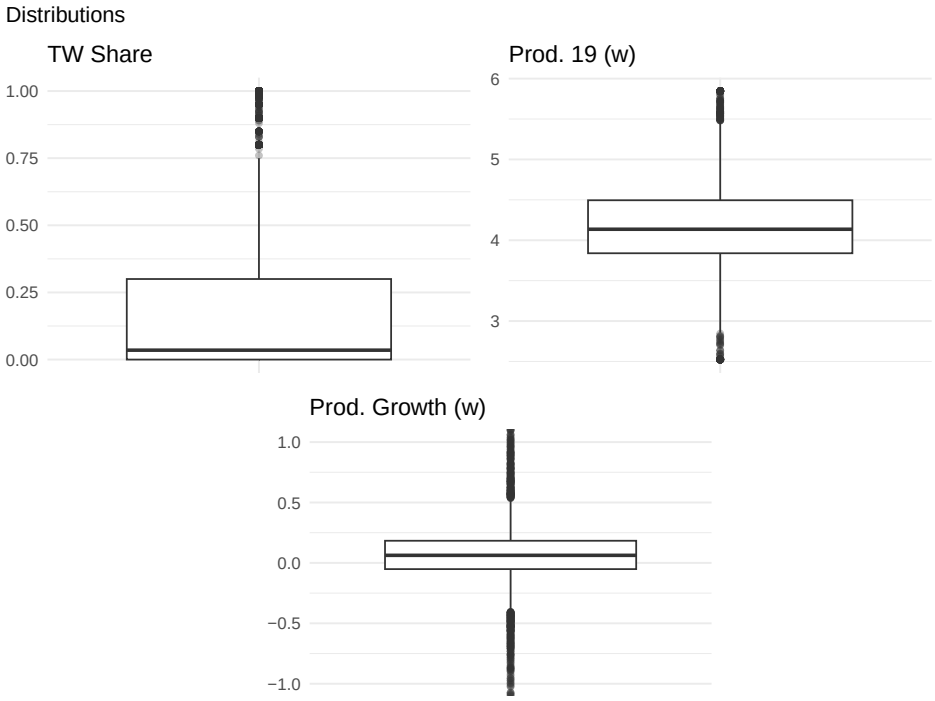
Reading note: The last column reports the share of non-micro employment (from FARE) covered by the analysis sample within each sector; for instance, the sample covers 32.7% of non-micro employment in Information–Communication.

Coverage: French private-sector firms, by broad sector; employment coverage is computed relative to the FARE non-micro aggregate (micro-enterprises excluded), and the analysis sample corresponds to firms observed in the ACEMO-Covid April 2022 matched dataset.

Source: Dares's ACEMO-Covid, Insee's FARE, authors' calculations.

Table A12 presents the distribution of firms and employment across sectors, comparing the analytical sample with the FARE population. Coverage varies by sector: it is high in manufacturing, transportation and storage services, and administrative and support activities, and lower in accommodation and food services, arts, and other service sectors, which are dominated by small firms. Overall, the sample captures roughly one quarter of non-micro employment in the FARE data.

Figure A4: Distributions of the main variables : Boxplots of TW Share in 2022, Productivity in 2019, and Productivity Growth 2019-22

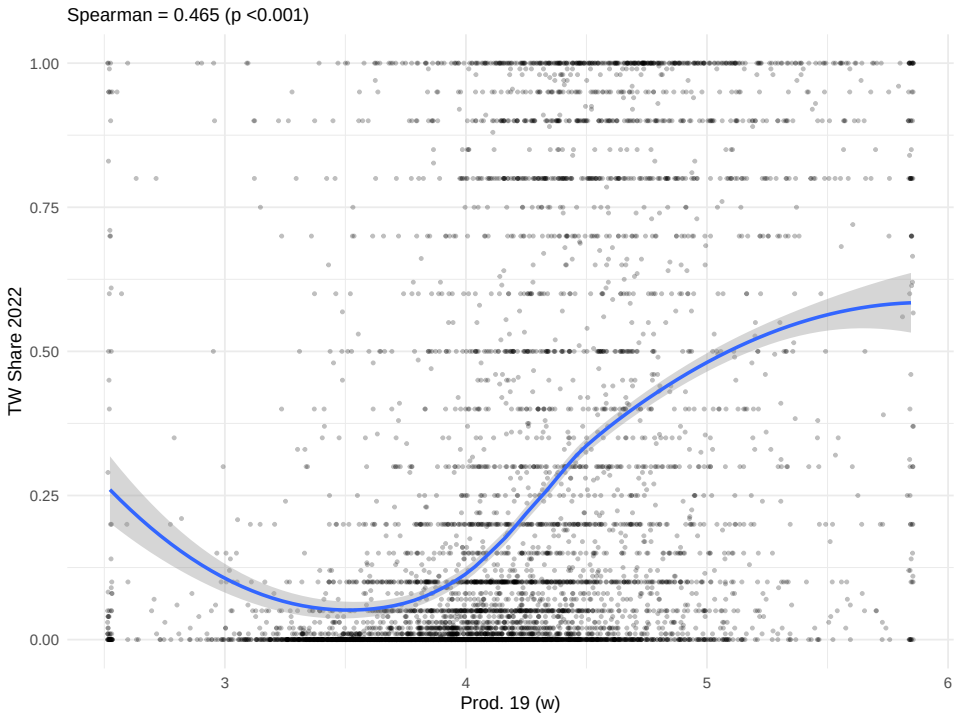


Reading note: The boxplots show the median (central line), interquartile range (box), and outliers (dots) for the telework share in 2022, log labour productivity in 2019, and productivity growth over 2019–2022.
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate.
Source: Dares's ACEMO-Covid, Insee's FARE, authors' calculations.

Figure A4 displays the distributions of key variables used in the analysis. The share of telework is highly skewed, with most establishments exhibiting low levels of telework. Log productivity in 2019 shows a relatively symmetric distribution centred around its median, while productivity growth is tightly distributed around zero, with a few outliers reflecting sharp firm-level adjustments. Overall, these patterns indicate substantial heterogeneity in telework potential and productivity dynamics across firms.

Figure A5 plots the share of telework in 2022 against firms' initial productivity levels. Telework share is relatively low among firms with intermediate productivity, while both low- and high-productivity firms display higher telework shares. The positive Spearman correlation (0.485, $p < 0.001$) indicates a moderate overall association between telework and productiv-

Figure A5: Scatterplot of TW Share in 2022 against initial productivity with LOESS fit and 95% confidence band



Reading note: Each dot represents a firm. The blue LOESS curve (with 95% confidence band) shows a positive association between initial log productivity in 2019 and the telework share in 2022 (Spearman $\rho = 0.465$*,* $p < 0.001$*).*
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate.
Source: Dares's ACEMO-Covid, Insee's FARE, authors' calculations.

ity, suggesting that more productive firms tend to offer greater scope for telework, although substantial heterogeneity remains across the productivity distribution. Such a pattern hints at possible endogeneity, as productivity may itself influence firms' ability or incentive to adopt telework—through differences in capital intensity, management quality, or digital infrastructure, or broader compositional effects—thereby motivating the use of our instrumental variable based on separate office surface per employee.

A.2 Surface of separate offices

CFE To construct the instrument, we exploit administrative files from the French local business tax register (Cotisation Foncière des Entreprises, CFE). It covers a large part of French firms (almost 90%)[28]. We begin with the premises table produced from Form 6660, which reports, for every professional property, its taxable floor area, the type of premise and the part of the floor that the establishment (SIRET) occupies. We restrict the sample to premises classified

[28]In particular, it excludes some firms without identifiable business premises (e.g., fully mobile activities or home-based businesses) and a small number of firms with missing or unmatchable premises information.

as offices, specifically focusing on two distinct administrative categories: (i) BUR1, defined as offices located in buildings of older design without specialized amenities; and (ii) BUR2, defined as offices located in recently constructed or significantly renovated buildings featuring modular layouts (e.g., movable partitions) and integrated IT infrastructure. The sample is balanced across the two categories.

We then link each record to the establishment register via the unique property identifier "cle_cfe", which lists all SIRET codes occupying the same premise. When several establishments share the same premise, we allocate the total floor area across them through the variable "TXVAVL".

The CFE is computed based on the premises occupied two years earlier (year $n-2$), but it is paid by the firm occupying the premises on January 1 of year n. Therefore, if a firm leaves the premises before that date, it no longer pays the CFE, and the new occupant becomes liable. For example, to construct the 2019 premises database, we start from the 2021 administrative files and match them with the 2020 files to check whether the firms present in 2021 were already operating in 2020. When a firm appears in 2021 but not in 2020, we treat it as a new occupant and retrieve the corresponding premises from the 2020 files to complete the database. This matching procedure generates an establishment-level dataset in which each observation records the square metres available to a given SIRET at a given location, and it forms the basis of the instrumental variable used in the analysis.

TF Next, we merge the CFE-based file with the TF/Majic property-tax register, which records the legal owner of each premise through its SIREN identifier. For every office identified earlier, we compare the owner SIREN from Majic with the occupant SIREN from the CFE match: when the two coincide, we label the corresponding floor area as owner-occupied; otherwise, it is classified as tenant-occupied. Summing these areas across all premises gives, for each SIREN, (i) total owner-occupied office surface, (ii) total tenant-occupied office surface, and (iii) an indicator equal to one when the firm occupies only office premises and zero otherwise. This firm-level table completes the construction of the instrumental variable.

Table A13 presents the distribution of rented office space across different firm size categories. The data reveals substantial heterogeneity in rented office space depending on firm scale. Notably, the median rented office space for the overall sample is zero, indicating that at least half of the observed firms do not rent any office premises separated from the other premises. This aggregate pattern is primarily driven by small and medium-sized enterprises (SMEs) and mid-cap firms, both of which report a median of zero. In contrast, large enterprises exhibit a distinctly different profile: they are the only category with a strictly positive median rented space (1.07) and report the highest mean (5.21).

Table A14 shows that 46.4% of firms report a positive office surface area, but only 17.7% operate in office-only premises. The prevalence of office space is strongly sectoral: knowledge-intensive services lead—Information–Communication (80.9% with offices; 49.5% office-only)

Table A13: Distribution of rented office space. Mean and quartiles of observed firms by enterprise size.

Enterprise size	Count	Employment	Q1 rented office space	Mean rented office space	Median rented office space	Q3 rented office space
SME (excl. Micro)	3,069	191,215	0.00	4.27	0.00	3.44
Mid-cap	2,483	875,676	0.00	3.72	0.00	3.74
Large enterprises	1,041	1,928,890	0.00	5.21	1.07	6.77
Total	6,593	2,995,781	0.00	4.22	0.00	4.18

Reading note: The "Total" row shows that across the 6,593 observed firms, the mean rented office space is 4.22, while the median is 0.00, indicating that at least half of the overall firms do not rent office space. Rented office space is notably higher among large enterprises, which report the highest mean (5.21) and are the only size category with a strictly positive median (1.07).
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate, by firm size.
Source: Dares's ACEMO-Covid, Insee's FARE, CFE, Majic, authors' calculations.

Table A14: Share of firms with separate offices (owners and tenants). Average of observed firms by sector in %

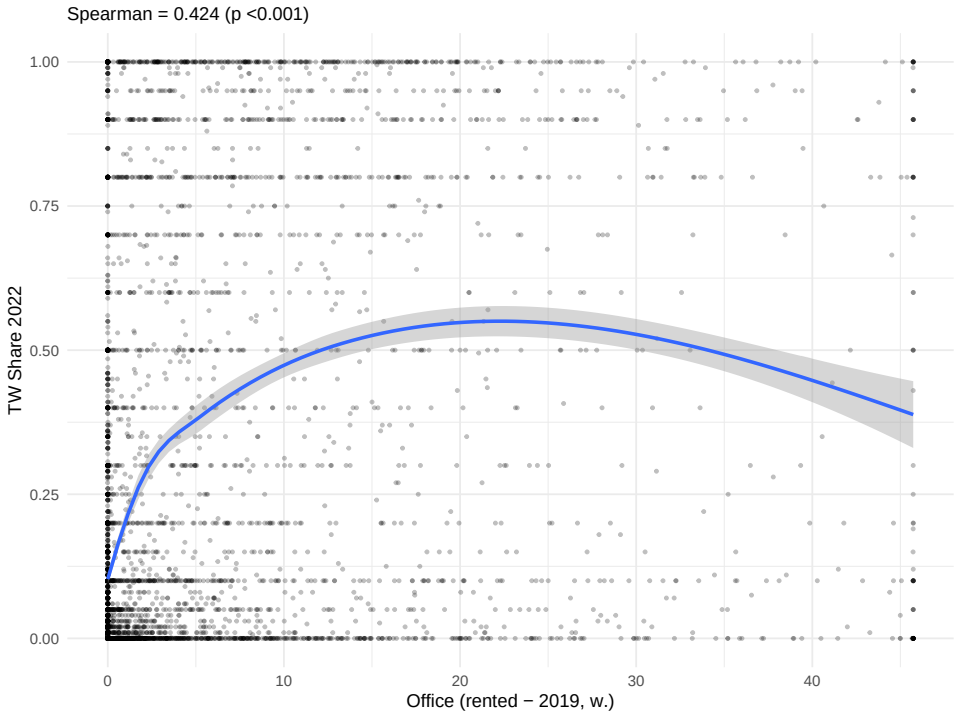
Sector	Share of firms with positive office surface area	Share of firms with positive office surface area, only offices
Mining and quarrying	43.8%	12.5%
Manufacturing	26.2%	1.9%
Electricity-Gas	77.8%	5.6%
Water-Waste	44.0%	1.2%
Construction	54.6%	18.2%
Trade	37.5%	10.4%
Transportation and Storage services	46.9%	9.8%
Accommodation and Food services	19.8%	2.8%
Information and Communication services	80.9%	49.5%
Science and Technology services	78.8%	52.7%
Administrative and Support services	62.5%	31.2%
Education	48.2%	10.7%
Health and Social services	45.5%	9.8%
Arts and Leisure	33.8%	9.5%
Other services	49.0%	13.7%
Total	46.4%	17.7%

Reading note: The first column shows that 46.4% of firms have a strictly positive office surface area; the second column restricts to firms whose premises are exclusively offices, for which the share is 17.7%. Office-only premises are concentrated in information–communication and scientific–technical activities (around one-half of firms).
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate, by broad sector.
Source: Dares's ACEMO-Covid, Insee's FARE, CFE, Majic, authors' calculations.

and Scientific–Technical activities (78.8%; 52.7%)—followed by Administrative and support services (62.5%; 31.2%). In contrast, Accommodation and food services (19.8%; 2.8%) and Manufacturing (26.2%; 1.9%) seldom occupy offices exclusively. Utilities display a mixed pat-

tern—Electricity–Gas has a high share with any offices (77.8%) but a very low office-only share (5.6%)—consistent with technical facilities. Construction lies near the middle (54.6%; 18.2%). Overall, the figures indicate substantial heterogeneity, with office-only premises concentrated in knowledge-based services and rare in production- or facility-oriented sectors.

Figure A6: Scatterplot of TW Share 2022 against rented office surface in 2019 with a LOESS fit and 95% confidence band

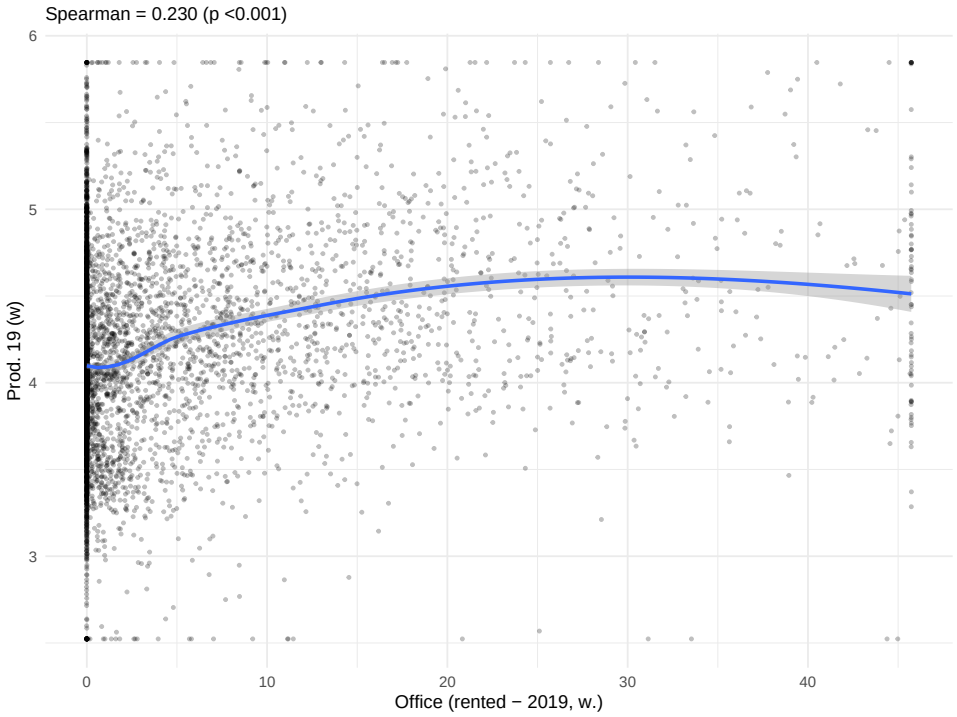


Reading note: Each dot represents a firm. The blue LOESS curve (with 95% confidence band) shows a positive association between the telework share in 2022 and rented separate office surface per FTE in 2019 (Spearman $\rho = 0.424$, $p < 0.001$*).*
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2019 and 2022, and at least one premise in 2019, excluding finance, insurance and real estate.
Source: Dares's ACEMO-Covid, Insee's FARE, CFE, Majic, authors' calculations.

Figure A6 documents a clear but non-linear association between telework adoption and pre-pandemic office capacity. The LOESS smoother rises steeply for small values of rented office surface, then flattens and bends slightly downward at the upper tail, suggesting diminishing returns and a mild inverted-U pattern; dispersion is largest near zero office space and at the extremes, and the rank correlation is moderate and highly significant (Spearman $\rho = 0.424$, $p < 0.001$). This descriptive pattern complements our first-stage regressions by visually reinforcing instrument *relevance*: even without controls, firms with (some) office capacity exhibit systematically higher telework shares, consistent with the strong first-stage coefficients reported in Table 4. Motivated by the evident non-linearity and potential threshold effects at low and high values or outliers, we discretize the office variable into four bins—no office, < 5 m^2/FTE, < 15 m^2/FTE, and > 15 m^2/FTE—which reduces functional-form sensitivity and makes the

first stage less driven by outliers.

Figure A7: Scatterplot of initial productivity against rented office surface in 2019 with a LOESS fit and 95% confidence band



Reading note: Each dot represents a firm. The blue LOESS curve (with 95% confidence band) shows a weak positive association between initial log productivity in 2019 and rented separate office surface per FTE in 2019 (Spearman $\rho = 0.230$, $p < 0.001$).
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2019 and 2022, and at least one premise in 2019, excluding finance, insurance and real estate.
Source: Dares's ACEMO-Covid, Insee's FARE, CFE, Majic, authors' calculations.

Figure A7 shows a mild, concave association between initial productivity and rented office surface in 2019. The LOESS fit rises quickly at very small office capacities and then flattens with substantial dispersion at all levels and a visible mass at zero office space. The rank correlation is modest but statistically significant (Spearman $\rho = 0.230$, $p < 0.001$). Overall, the pattern suggests only a limited link between baseline productivity and pre-pandemic office capacity. While the correlation is positive, it is modest and concentrated at very small office capacities, providing little evidence of a strong mechanical channel whereby inherently more productive firms systematically secure larger offices. This supports the exclusion restriction for our office-based instrument: pre-pandemic office capacity is only weakly related to initial productivity and, crucially, our falsification checks show no systematic pre-trend in productivity once we control for the existence of a telework agreement in 2019 (which signals a pre-COVID telework practice) (see Table 5).

A.3 Predictions of teleworkability

Occupation–level probabilities. We start from the French Labour Force Survey (Enquête *Emploi en continu*, EEC) over the eleven quarterly waves spanning 2022 Q3 to 2025 Q1. For each *professions et catégories socioprofessionnelles* 4-digit code (PCS4) we compute the following survey-weighted prevalence:

- The share of employees that declare that their job is teleworkable.

Averaging this share across the eleven quarters yields a single, time-invariant probability of being teleworkable for every occupation PCS_{2020} and call it $AvTWable_{PCS_{2020}}$.

Mapping to the 2003 PCS. Because firm-level payroll data in 2019 are coded in the 2003 PCS nomenclature, we transpose the occupation-level probabilities using the official $PCS_{2020} \to PCS_{2003}$ concordance published by INSEE. When a PCS_{2003} category aggregates several PCS_{2020} codes, we take the employment-weighted mean of the corresponding $AvTWable_{PCS_{2020}}$ values to get a probability of teleworkability for every occupation in the old classification$TWable_{PCS_{2003}}$. The match between the two classifications of occupation is not perfect so we cannot compute this probability for 3 percent of jobs.

Firm–level predictions. We then turn to the exhaustive 2019 "Base Tous Salariés" register, which records each employee's PCS 2003 and SIREN identifier. For every legal unit f we calculate the employment share $\omega_{f,c}$ of each PCS 2003. Multiplying these shares by the mapped occupation probabilities and summing across categories gives the predicted incidence of telework and teleworkability at the firm level:

$$\widehat{TWable}_f \;=\; \sum_{PCS_{2003}} \omega_{f,PCS_{2003}}\, TWable_{PCS_{2003}}.$$

The resulting variable *predicted teleworkability* is expressed as percentages of the firm's workforce and enters the empirical analysis as forward-looking measures derived independently of the outcome data.

Table A15 compares the outcomes of our teleworkability construction across sectors. According to the ACEMO-Covid survey, 60.6% of firms reported some use of telework, corresponding to 22.0% of total employment working remotely. The predicted share of teleworkable employment, derived from task composition, reaches a comparable magnitude (25.1%), which supports the external validity of our approach. The incidence of telework differs substantially across sectors: information and communication, scientific and technical activities, and education exhibit the highest levels, while accommodation and food services, transportation and storage services, and construction remain largely constrained by the nature of their tasks. The 2019 share of

managers follows a similar gradient, consistent with the notion that managerial occupations are more compatible with telework.

Table A15: Telework share and teleworkability. Average of observed firms by sector in %

Sector	Share of firms with TW (Acemo-covid)	TW Share (Acemo-covid)	TWable Share (predicted)	Share of managers 2019
Extractive	56.2%	3.9%	14.4%	13.5%
Manufacturing	70.3%	14.7%	20.4%	16.7%
Electricity-Gas	88.9%	26.4%	27.2%	22.9%
Water-Waste	51.2%	8.2%	13.2%	10.5%
Construction	45.9%	7.0%	14.3%	13.3%
Trade	48.9%	17.0%	26.0%	16.2%
Transport	41.0%	6.4%	9.7%	6.3%
Accommodation	25.3%	2.4%	5.3%	4.3%
Info-Comm	94.8%	73.1%	54.4%	65.0%
Sci-Tech	88.1%	52.0%	53.2%	49.5%
Admin support	49.8%	19.0%	16.1%	12.9%
Education	76.8%	34.8%	37.4%	31.3%
Health-Social	33.7%	4.0%	11.2%	5.5%
Arts-Leisure	47.3%	13.9%	19.8%	17.3%
Other services	72.5%	30.5%	26.5%	22.2%
Total	60.6%	22.0%	25.1%	21.4%

Reading note: Telework intensity varies widely across sectors: for instance, in Information–Communication, 94.8% of firms report using telework and the mean telework share reaches 73.1%, compared with 60.6% and 22.0% in the full sample; sectors with higher predicted teleworkability and higher manager shares tend to display higher telework prevalence.

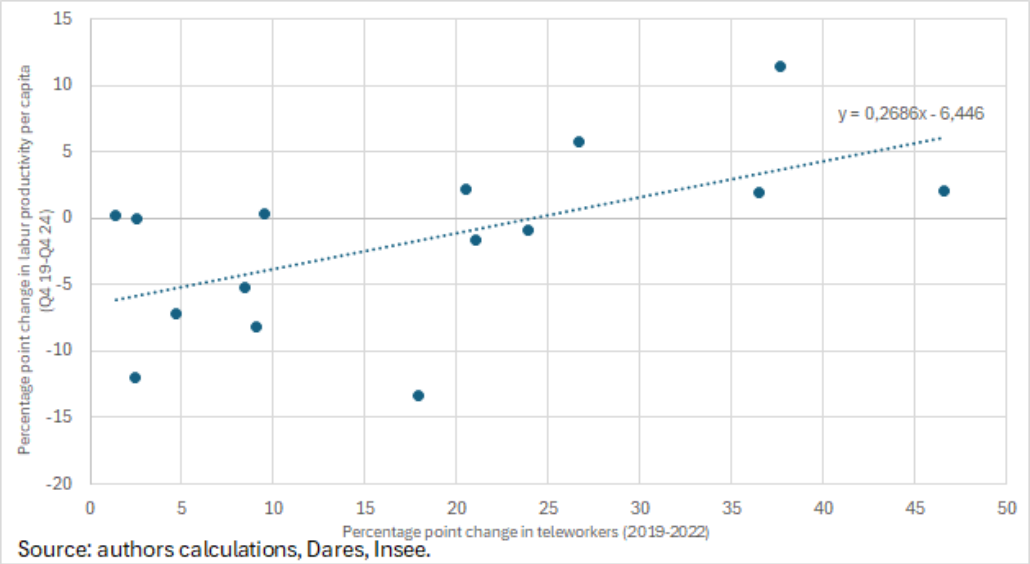
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate, by broad sector.

Source: Dares's ACEMO-Covid, Insee's FARE, BTS, authors' calculations.

B Complementary findings

B.1 Telework and productivity growth by main industries in France

Figure A8: Pre and post-Covid telework *versus* Productivity Growth Q4-2019-Q4-2024 by main industries in France



Reading note: The fitted line has slope 0.2686*: across broad industries, a 10 percentage-point increase in the share of teleworkers between 2019 and 2022 is associated with about 2.7 percentage points higher labour productivity growth over the same period.*
Coverage: France; private-sector employees; by broad industries; excluding agriculture, finance and real estate.
Source: Working Conditions Survey 2019 and ACEMO-Covid Survey 2022 (Dares); Dares; National Accounts (Insee) accessed 1st January 2026.

B.2 OLS: pre-trend control

Table A16: OLS Estimates of Productivity Growth (2019–2022)

Dependent Variable:	Productivity Growth 2019-2022		
Model:	(1)	(2)	(3)
Variables			
TW Share 2022	0.083***	0.065***	0.060***
	(0.020)	(0.019)	(0.019)
Prod. 2019	-0.107***	-0.080***	-0.105***
	(0.011)	(0.010)	(0.011)
Productivity Growth 2016-2019		-0.149***	-0.145***
		(0.024)	(0.024)
Fixed-effects			
2-digit Sector	Yes	Yes	
Enterprise size	Yes	Yes	Yes
3-digit Sector			Yes
Fit statistics			
Observations	5,979	5,979	5,979
R^2	0.037	0.058	0.092

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reading note: In column (2), the coefficient 0.065 *implies that a 10 percentage-point increase in the telework share in 2022 is associated with about 0.65pp higher productivity growth over 2019–2022, conditional on baseline productivity and pre-trends (productivity growth over 2016–2019).*
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity in 2016, 2019 and 2022, excluding finance, insurance and real estate.
Source: Dares's ACEMO-Covid, Insee's FARE; authors' calculations.

B.3 OLS : Spatial robustness

Characteristics of the areas in which firms operate—such as population density, communication networks, and labour supply—are key drivers of labour productivity. These same characteristics may also influence the diffusion of telework. For example, access to high-speed internet can simultaneously boost productivity and facilitate remote working. At the regional level, Île-de-France (Paris and its commuting belt) concentrates larger, higher-productivity firms and occupations that are more amenable to remote work, while the rest of the country is characterised by a denser base of on-site activities. The French Labour Force Survey shows that hybrid telework is a much more common work practice in the capital region (Askenazy et al., 2025b). Consistently, in our sample, firms with no establishments in Île-de-France exhibit a much lower average telework share; they also had a lower pre-COVID productivity level than firms with at least some presence in Île-de-France (see Table A17). Beyond this regional divide,

municipal density within regions also matters: dense urban communes differ markedly from less densely populated areas in both telework penetration and baseline productivity. Even within Île-de-France, differences associated with urban density point to agglomeration forces—such as urban structure, sectoral mix, and skill composition. Consequently, we may be concerned that the observed relationship between telework and subsequent productivity dynamics is, at least in part, shaped by the spatial conditions in which firms operate.

Table A17: Geographical Coverage of the Sample (Île-de-France vs. Rest of France)

Region	Count	Employment	Mean TW share	Median TW Share	Mean Prod. 19.	Median Prod. 19
Not in Ile-de-France	4,196	734,628	0.11	0.00	4.06	4.05
Mix	1,269	2,020,180	0.41	0.29	4.36	4.34
Fully in IDF	1,128	240,973	0.41	0.20	4.38	4.38
Total	6,593	2,995,781	0.22	0.04	4.17	4.14

Reading note: Telework is substantially higher for firms with employment in Île-de-France: the mean telework share is 0.41 for firms operating fully in IDF (and also for "Mix" firms), compared with 0.11 for firms not in IDF. Mean productivity in 2019 is reported in logs and is higher for IDF-related firms (4.36–4.38) than for firms outside IDF (4.06).
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate, by IDF exposure category.
Source: Dares's ACEMO-Covid, Insee's FARE, authors' calculations.

To account for geographic composition, we use establishment-level employment to compute, for each firm, the proportion of its workforce located in each region and, separately, within each *Aire d'Attraction des Villes* (AAV) of the French urban hierarchy. These firm-specific employment shares summarize the internal geography of activity—rather than just headquarters—and capture exposure to dense urban cores versus less-dense areas. We then use these distributions as controls in our OLS, so that comparisons of telework and productivity are made net of regional mix and urban-density composition. This approach mitigates confounding from agglomeration forces and ensures that our results are not mechanically driven by where firms' employees are concentrated. In fact, most spatial controls are insignificant and have negligible impact on the model fit.

Table A18 shows that the estimated effect of TW Share is virtually unchanged once we control for firms' spatial employment composition—by region (Model 2) and by AAV (Model 3).

We then probe spatial heterogeneity by interacting TW Share with firms' geographic footprint (fully outside Île-de-France, mixed, or fully in Île-de-France) to assess whether the telework–productivity relationship varies across agglomeration contexts (Table A18, Model (4)) Second, interacting the telework share with firms' location reveals no meaningful differentials: compared to firms with no employees in Île-de-France, the additional effect of telework for firms operating both in the capital region and in other regions, as well as for firms located exclu-

Table A18: Geographical robustness: Île-de-France interactions and spatial controls

Dependent Variable:	Productivity Growth 2019-2022			
Model:	(1)	(2)	(3)	(4)
Variables				
TW Share 2022	0.096***	0.094***	0.090***	0.070***
	(0.020)	(0.020)	(0.020)	(0.026)
Prod. 2019	-0.151***	-0.153***	-0.154***	-0.152***
	(0.012)	(0.013)	(0.013)	(0.013)
Share of workers in IDF				-0.003
				(0.014)
TW Share 2022 for firms in IDF and other				0.035
				(0.029)
TW Share 2022 for firms only in IDF				0.037
				(0.033)
Fixed-effects				
Sector/Section	Yes	Yes	Yes	Yes
Enterprise size	Yes	Yes	Yes	Yes
Controls				
Proportion of employees by region		Yes		
Proportion of employees by AAV			Yes	
Fit statistics				
Observations	6,593	6,593	6,593	6,593
R^2	0.058	0.062	0.061	0.058

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

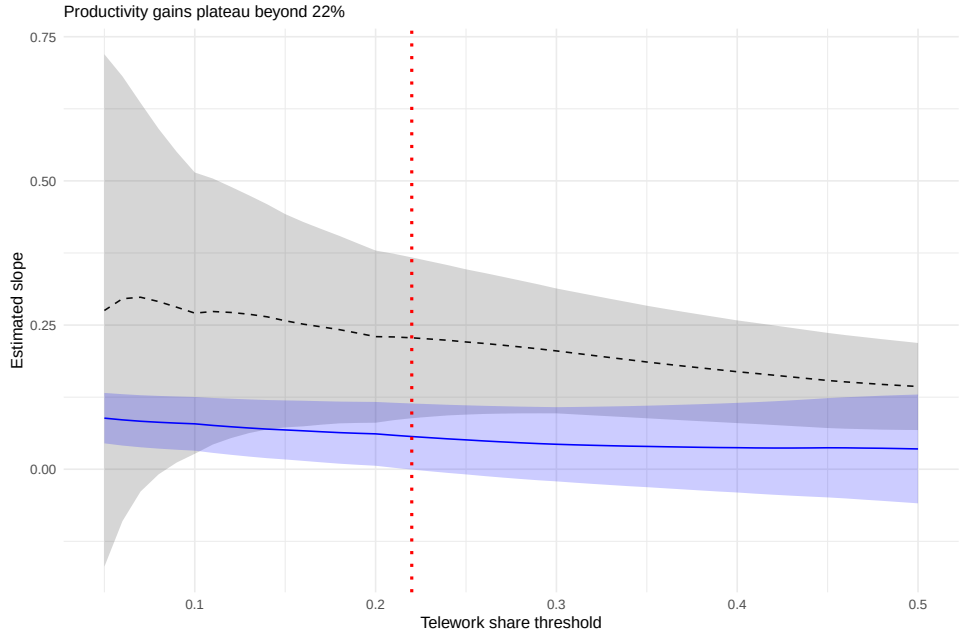
Reading note: In column (1), the coefficient 0.096 *implies that a 10 percentage-point increase in the telework share in 2022 is associated with about 1.0pp higher productivity growth over 2019–2022; the estimate remains of similar magnitude when controlling for firms' spatial employment composition (columns 2–3) and when allowing for differential effects by Île-de-France exposure (column 4).*
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate.
Source: Dares's ACEMO-Covid, Insee's FARE, authors' calculations.

sively in IDF, is positive but rather small and not statistically significant. The overall model fit remains essentially unchanged.

To sum up, controlling for the spatial composition of employment and allowing for Île-de-France–specific slopes leaves our results unchanged: the positive association between telework intensity and subsequent productivity growth holds broadly across regions and is not driven by Île-de-France–specific effects.

B.4 OLS: grid-search and teleworkability control

Figure A9: Estimated productivity slope below and above telework thresholds.



Reading note: The solid (blue) line shows the estimated telework–productivity slope below each candidate breakpoint, while the dashed (black) line shows the slope above it; the vertical red line indicates the selected breakpoint (22%). The figure suggests diminishing returns, with productivity gains flattening once the telework share exceeds roughly 22%.

Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate.

Source: Dares's ACEMO-Covid, Insee's FARE, authors' calculations.

Table A19: OLS Estimates of Productivity Growth (2019–2022) with predictions of share of teleworkable jobs

Dependent Variable:	Productivity Growth 2019-2022		
Model:	(1)	(2)	(3)
Variables			
TW Share 2022	0.096***	0.048**	0.055**
	(0.020)	(0.021)	(0.022)
Prod. 2019	-0.151***	-0.167***	-0.162***
	(0.012)	(0.014)	(0.013)
TWable Share 2022 (occupational est.)		0.177***	
		(0.034)	
Manager Share 2019			0.109***
			(0.030)
Fixed-effects			
Sector/Section	Yes	Yes	Yes
Enterprise size	Yes	Yes	Yes
Fit statistics			
Observations	6,593	6,593	6,593
R^2	0.058	0.063	0.060

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

*Reading note: In column (2), even after controlling for the predicted share of teleworkable jobs, the telework coefficient remains positive and significant (*0.048*), implying that a 10 percentage-point increase in the telework share is associated with about 0.5pp higher productivity growth over 2019–2022.*

Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate.

Source: Dares's ACEMO-Covid, Insee's FARE, LFS, BTS, authors' calculations.

B.5 IV first stage, falsification, robustness, alternative instrument

Table A20: Separate rented office space predicts the coverage by collective telework agreement.

Dependent Variables:		Valid agreement 2019	Valid agreement 2023
Model:		(1)	(2)
Variables			
Office lots (rented) per FTE in 2019	0 m^2 (ref.)	–	–
	$>$ 0–5 m^2	0.442*** (0.074)	0.437*** (0.056)
	$>$ 5–15 m^2	0.690*** (0.090)	0.593*** (0.069)
	$>$ 15 m^2	0.703*** (0.102)	0.636*** (0.079)
Office lots (owned) per FTE in 2019	0 m^2 (ref.)	–	–
	$>$ 0–5 m^2	0.536*** (0.097)	0.529*** (0.089)
	$>$ 5–15 m^2	0.473*** (0.171)	0.462*** (0.149)
	$>$ 15 m^2	0.511** (0.219)	0.348** (0.171)
Fixed effects			
Sector/Section		Yes	Yes
Enterprise size		Yes	Yes
Fit statistics			
Observations		6 427	6 427
Pseudo R^2		0.17	0.19

Heteroskedasticity-robust standard errors in parentheses
*Signif. Codes: *** 0.01, ** 0.05, * 0.1*

Reading note: In column (2), the coefficient 0.437 *for firms renting $>$ 0–5 m^2 of separate office space per FTE implies a substantially higher likelihood of being covered by a telework agreement in 2023 than firms with no rented separate office space (reference category).*

Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2019 and 2022 and at least one premise in 2019, excluding finance, insurance and real estate.

Source: Dares's ACEMO-Covid, CFE, Majic, administrative records on collective agreements (2019 and 2023), authors' calculations.

Table A21: Separate office space (per FTE) and productivity in 2022. Full sample

Dependent Variable:		Prod. 2022	
Model:		(1)	(2)
Variables			
Office lots (rented) per FTE	0 m^2 (ref.)	–	–
	> 0–5 m^2	0.021*	0.018*
		(0.011)	(0.010)
	> 5–15 m^2	0.044***	0.043***
		(0.014)	(0.014)
	> 15 m^2	0.049***	0.049***
		(0.017)	(0.017)
Office lots (owned) per FTE	0 m^2 (ref.)	–	–
	> 0–5 m^2	–	0.039
			(0.024)
	> 5–15 m^2	–	0.025
			(0.030)
	> 15 m^2	–	0.052*
			(0.027)
Prod. 2019		0.856***	0.854***
		(0.013)	(0.013)
Fixed effects			
Sector/Section		Yes	Yes
Enterprise size		Yes	Yes
Fit statistics			
Observations		6,427	6,427
R^2		0.705	0.706
Within R^2		0.653	0.653

Heteroskedasticity-robust standard errors in parentheses
*Signif. Codes: *** 0.01, ** 0.05, * 0.1*

Reading note: In column (1), firms renting > 5–15 m^2 of separate office space per FTE have a 2022 log productivity that is higher by 0.044 *than firms with no rented separate office space (reference category), conditional on 2019 productivity and fixed effects.*

Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2019 and 2022, and at least one premise in 2019, excluding finance, insurance and real estate.

Source: Dares's ACEMO-Covid, Insee's FARE, CFE, Majic, authors' calculations.

Table A22: Firms with almost no teleworker

Dependent Variable:		Prod. 2022	
Model:		(1)	(2)
Variables			
Office lots (rented) per FTE	0 m^2 (ref.)	–	–
	$>$ 0–5 m^2	−0.002	−0.004
		(0.014)	(0.014)
	$>$ 5–15 m^2	0.008	0.007
		(0.024)	(0.024)
	$>$ 15 m^2	0.018	0.018
		(0.027)	(0.027)
Office lots (owned) per FTE	0 m^2 (ref.)	–	–
	$>$ 0–5 m^2	–	0.034
			(0.032)
	$>$ 5–15 m^2	–	0.113**
			(0.044)
	$>$ 15 m^2	–	0.041
			(0.029)
Prod. 2019		0.839***	0.837***
		(0.024)	(0.024)
Fixed effects			
Sector/Section		Yes	Yes
Enterprise size		Yes	Yes
Fit statistics			
Observations		2,545	2,545
R^2		0.672	0.673

Heteroskedasticity-robust standard errors in parentheses
*Signif. Codes: *** 0.01, ** 0.05, * 0.1*

Reading note: In column (2), among firms with exclusively office premises, owning $>$ 5–15 m^2 of separate office space per FTE is associated with a 0.113 *higher log productivity in 2022 than owning none (reference category), conditional on 2019 productivity and fixed effects.*
Coverage: Firms with exclusively office premises in the ACEMO-Covid April 2022 matched sample, with 10 or more employees and positive productivity, excluding finance, insurance and real estate.
Source: Dares's ACEMO-Covid, Insee's FARE, CFE, Majic, authors' calculations.

Table A23: IV robustness checks - First stages

Dependent Variables:		TW Share 2022			SME	ILE
Model:		(1)	(2)	(3)	(4)	(5)
Variables						
Office lots (rented) per FTE	0 m^2 (ref.)	–	–	–	–	–
	> 0–5 m^2	0.083*** (0.009)	0.074*** (0.008)	0.085*** (0.009)	0.090*** (0.015)	0.089*** (0.011)
	> 5–15 m^2	0.173*** (0.013)	0.147*** (0.013)	0.157*** (0.015)	0.146*** (0.020)	0.202*** (0.017)
	> 15 m^2	0.167*** (0.016)	0.160*** (0.016)	0.190*** (0.022)	0.103*** (0.023)	0.234*** (0.021)
Prod. 2019		0.155*** (0.008)	0.129*** (0.008)	0.133*** (0.008)	0.128*** (0.012)	0.171*** (0.010)
Fixed-effects						
Sector/Section		Yes		Yes	Yes	Yes
Enterprise size		Yes	Yes	Yes	Yes	Yes
Subsector/Division			Yes			
Fit statistics						
Observations		6,427	6,427	5,012	2,968	3,459
R^2		0.453	0.505	0.386	0.436	0.464

Heteroskedasticity-robust standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reading note: In column (1), renting > 5–15 m^2 of separate office space per FTE (in 2019) is associated with a 0.173 higher telework share in 2022 (i.e., +17.3 percentage points) relative to firms with no rented separate office space (reference category); the remaining columns show that this strong first-stage relationship holds under alternative fixed effects and within the SME and ILE subsamples.

Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2019 and 2022 and at least one premise in 2019, excluding finance, insurance and real estate (with additional subsample restrictions as indicated by SME and ILE).

Source: Dares's ACEMO-Covid, Insee's FARE, CFE, Majic, authors' calculations.

Table A24: IV-rented additional controls

Dependent Variable:	Productivity Growth 2019-2022
Model:	(1)
Variables	
TW Share 2022	0.267***
	(0.085)
Prod. 2019	-0.186***
	(0.019)
Fixed-effects	
2-digit Sector	Yes
Enterprise size	Yes
Firm age group	Yes
Proportion of employees by AAV category	Yes
Fit statistics	
Observations	6,427
R^2	0.050
Kleibergen-Paap, p-value	0.000
Sargan, p-value	0.975
Wu-Hausman, p-value	0.025

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reading note: In column (1), the coefficient 0.267 *implies that a 10 percentage-point increase in the telework share in 2022 raises productivity growth between 2019 and 2022 by about 2.7pp.*
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2019 and 2022 and at least one premise 2019, excluding finance, insurance and real estate.
Source: Dares ACEMO-Covid, Insee FARE, authors' calculations.

Table A25: IV-rented pre-trend - First stages

Dependent Variable:	TW Share 2022	
Model:	(1)	(2)
Variables		
Office lots (rented) per FTE		
0 m^2 (ref.)		
> 0–5 m^2	0.086***	0.084***
	(0.009)	(0.009)
> 5–15 m^2	0.177***	0.174***
	(0.013)	(0.013)
> 15 m^2	0.179***	0.175***
	(0.017)	(0.016)
Prod. 2019	0.162***	0.176***
	(0.008)	(0.008)
Productivity Growth 2016–2019		-0.083***
		(0.014)
Fixed-effects		
2-digit Sector	Yes	Yes
Enterprise size	Yes	Yes
Fit statistics		
Observations	5,848	5,848
R^2	0.465	0.471

Heteroskedasticity-robust standard errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reading note: In column (2), renting > 5–15 m^2 of separate office space per FTE (in 2019) is associated with a 0.174 higher telework share in 2022 (i.e., +17.4 percentage points) relative to firms with no rented separate office space (reference category).
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2016, 2019 and 2022 and at least one premise in 2019, excluding finance, insurance and real estate.
Source: Dares's ACEMO-Covid, Insee's FARE, CFE, Majic, authors' calculations.

Table A26: IV-rented pre-trend - Second Stages

Dependent Variable:	Productivity Growth 2019-2022	
Model:	(1)	(2)
Variables		
TW Share 2022	0.191***	0.153**
	(0.067)	(0.066)
Prod. 2019	-0.129***	-0.099***
	(0.018)	(0.017)
Productivity Growth 2016-2019		-0.146***
		(0.024)
Fixed-effects		
2-digit Sector	Yes	Yes
Enterprise size	Yes	Yes
Fit statistics		
Observations	5,848	5,848
R^2	0.031	0.056
Kleibergen-Paap, p-value	0.000	0.000
Sargan, p-value	0.940	0.940
Wu-Hausman, p-value	0.089	0.165

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reading note: In column (1), the coefficient 0.191 *implies that a 10 percentage-point increase in the telework share in 2022 raises productivity growth between 2019 and 2022 by about 1.9pp.*
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2016, 2019 and 2022 and at least one premise 2019, excluding finance, insurance and real estate.
Source: Dares ACEMO-Covid, Insee FARE, authors' calculations.

Table A27: Alternative IV - First stage

Dependent Variable:		TW Share 2022	
Model:		(1)	(2)
Variables			
Office lots (rented) per teleworkable FTE	0 m^2 (ref.)	–	–
	$>$ 0–20 m^2	0.149*** (0.010)	0.147*** (0.010)
	$>$ 20–60 m^2	0.133*** (0.013)	0.132*** (0.013)
	$>$ 60 m^2	0.049*** (0.012)	0.048*** (0.012)
Office lots (owned) per teleworkable FTE	0 m^2 (ref.)	–	–
	$>$ 0–20 m^2	–	0.021 (0.018)
	$>$ 20–60 m^2	–	0.087*** (0.033)
	$>$ 60 m^2	–	−0.030 (0.028)
Prod. 2019		0.161*** (0.008)	0.160*** (0.008)
Fixed effects			
Sector/Section		Yes	Yes
Enterprise size		Yes	Yes
Fit statistics			
Observations		6,323	6,323
R^2		0.453	0.454

Heteroskedasticity-robust standard errors in parentheses
*Signif. Codes: *** 0.01, ** 0.05, * 0.1*

Reading note: In column (1), renting $>$ 0–20 m^2 of separate office space per teleworkable FTE is associated with a 0.149 higher telework share in 2022 (i.e., +14.9 percentage points) relative to firms with zero rented office space per teleworkable FTE (reference category).
Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2019 and 2022 and at least one premise in 2019, excluding finance, insurance and real estate.
Source: Dares's ACEMO-Covid, Insee's FARE, CFE, Majic, authors' calculations.

Table A28: Alternative IV

Dependent Variable:	Productivity Growth 2019-2022	
Model:	(1) IV-rented offices	(2) IV-rented and owned offices
Variables		
TW Share 2022	0.257***	0.261***
	(0.073)	(0.072)
Prod. 2019	-0.182***	-0.183***
	(0.019)	(0.019)
Fixed-effects		
Sector/Section	Yes	Yes
Enterprise size	Yes	Yes
Fit statistics		
Observations	6,323	6,323
R^2	0.045	0.044
Kleibergen-Paap, p-value	0.000	0.000
Sargan, p-value	0.691	0.729
Wu-Hausman, p-value	0.018	0.013

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reading note: In column (1), the coefficient 0.257 *implies that a 10 percentage-point increase in the telework share in 2022 raises productivity growth between 2019 and 2022 by about 2.6pp, consistent with the first IV results.*

Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees, positive productivity in 2019 and 2022, at least one premise in 2019, and a number of FTE BTS that matches the FARE number in 2019 (as the predicted variable is calculated on BTS employment but the productivity is based on FARE employment), excluding finance, insurance and real estate.

Source: Dares's ACEMO-Covid, Insee's FARE, authors' calculations.

B.6 Telework and real estate costs

Table A29: Telework and real estate costs

Dependent Variable:	Rental costs Growth 2019-2022	
Model:	(1)	(2)
Variables		
TW Share 2022	-0.273	
	(0.189)	
Rental costs 2019	0.025**	0.026**
	(0.013)	(0.013)
× no separate office (2019)		-0.151
		(0.302)
× separate office (2019)		-0.308
		(0.211)
Fixed-effects		
Sector/Section	Yes	Yes
Enterprise size	Yes	Yes
Fit statistics		
Observations	6,291	6,291
R^2	0.013	0.013

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reading note: In column (1), the coefficient -0.273 *suggests that a 10 percentage-point increase in the telework share in 2022 is associated with about 2.7pp lower rental-cost growth over 2019–2022, although the estimate is not statistically significant.*

Coverage: Firms in the ACEMO-Covid April 2022 sample with 10 or more employees and positive productivity, excluding finance, insurance and real estate, with non-missing information on rental costs and separate office status in 2019.

Source: Dares's ACEMO-Covid, Insee's FARE, authors' calculations.