

Retreat or reallocation? Economic structure and the persistence of remote work in EU regions, 2018–2024

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Abstract. This paper asks how the pandemic expansion of remote work was distributed across EU regions, whether that distribution has proved durable, and whether the decline observed after 2021 is a genuine retreat or a change in form. Using EU-LFS microdata for 204 regions in the 27 member states over 2018–2024, we distinguish three margins of home-working: the Eurostat categories usually and sometimes, and their sum. We treat the pandemic as the event in an event study with region and year fixed effects and ask whether regions responded to it differently depending on their pre-pandemic employment structure. Regions with a higher pre-pandemic share of knowledge-intensive services responded far more strongly: those in the top quarter of pre-pandemic knowledge-intensive employment gained around 3 percentage points more participation than the rest, and the gap was as wide in 2024 as in 2021. Comparing regions only with others in the same country narrows the gap by about a quarter, but most of it remains. What has changed is the form, not the extent. The apparent return to the office is largely a move from full-time to hybrid work, visible only when remote work is measured by intensity. Economic structure, not income, education or digital infrastructure, is what separates regions. Remote work has so far accrued to the regions that already had the employment structure to absorb it.

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1. INTRODUCTION

In 2025, the share of employed persons in the European Union who usually work from home in the age group of 15-64 stood at 8.8 percent, down from a peak of 13.3 percent in 2021. In the same year, the share of workers working from home at least occasionally reached 14.2 percent, its highest level on record (Eurostat, 2026). The same data source, read through two different indicators, supports two opposite headlines: a retreat from remote work, or its continued expansion. Which reading is correct matters beyond measurement, because remote work has been widely presented as a mechanism capable of loosening the tie between where people live and where economic opportunity is located (Choudhury, 2025; Kužmar et al., 2026), and thus of narrowing the gap between prosperous and lagging regions. If the retreat is real, that mechanism was a temporary artifact of the pandemic. If it is not, the question becomes which regions kept it - and whether they are the ones that needed it.

The answer is unlikely to lie in connectivity. Video conferencing, cloud storage, and collaboration software were poised for widespread adoption before 2020, and household broadband access across EU regions has since approached saturation. What separates regions is less the technology than the social infrastructure surrounding it (Rooksby et al., 2002): the composition of regional employment, the education and skills of the workforce, and the institutional settings in which firms decide how work is organised (Van Dijk & Hacker, 2003; Choudrie et al., 2005). Whether an economy can move work into the home is therefore not primarily a question of whether the connection exists, but of what kind of work travels down it.

This study asks two questions. First, how was the pandemic expansion of remote work distributed across EU regions, and has that distribution persisted? Second, does the decline observed after 2021 represent a genuine retreat or a change in the form remote work takes? We answer them using EU-LFS microdata for 204 territorial units in the 27 member states over 2018-2024 - predominantly NUTS 2 regions, with Germany and Austria observed at NUTS 1 and the Netherlands at the national level, of which 199 have complete data and enter estimation. Throughout, we distinguish three margins of home-working: usual, occasional, and any. The two pre-pandemic years are what make the design possible: rather than describing cross-sectional correlations, we treat the pandemic as a common shock and ask why regions absorbed it differently, given an employment structure fixed before it began.

The paper makes two contributions. First, it extends the regional evidence three years beyond the most recent assessment available (Eurofound & JRC, 2024), which observes only the first year of the post-peak decline, and it identifies economic structure, rather than income, education, or household connectivity, as the characteristic that separates regions once all of them are entered jointly. Second, it shows that conclusions about the persistence of remote work depend critically on which margin is measured, and it makes that dependence explicit. This second point allows us to bring EU regional evidence to bear on the 'Nike swoosh' hypothesis formulated on US data (Barrero et al., 2023), according to which a period of return to the office is followed by stabilisation and renewed growth. Our data cover the years in which that path was predicted to materialise, so the hypothesis can be tested rather than assumed.

Two findings follow. The first concerns form. The three margins are mechanically linked, and the way their sum is preserved after 2021 shows that the decline in full-time home-working is offset almost exactly by a rise in occasional arrangements within the same regions: the swoosh appears in the intensity of remote work, while participation shows a step. The apparent retreat is therefore largely a reallocation from full-time to hybrid work, and this result holds across every specification we estimate. The second concerns distribution and is more qualified. Regional exposure to the shock, measured by the 2019 share of employment in knowledge-intensive services, is associated with 3.19 percentage points of additional remote-work participation per standard deviation in 2021 and 3.29 points in 2024, so the gap opened in the first pandemic year did not close. Once national policy environments are absorbed by country-by-year effects,

the differential declines by roughly a quarter. Most of the persistence therefore holds within countries, though a part of it comes from differences between member states. In the cross-section, the coefficient on knowledge-intensive employment grows from 0.545 in 2019 to 0.947 in 2024. Over the period observed, remote work therefore did not spread towards the regions that the equalising hypothesis would require it to reach

The remainder of the paper is organised as follows. Section 2 reviews the literature on remote work as a potential force for reducing spatial inequality and derives two testable propositions. Section 3 documents the evolution of working from home in EU regions between 2018 and 2024. Section 4 describes the data and the empirical strategy. Section 5 presents the cross-sectional and event-study results, the reallocation from full-time to hybrid work, and robustness checks. Section 6 concludes.

2. REMOTE WORK AND REGIONAL DISPARITIES: LITERATURE REVIEW

Remote work separates where work is performed from where the worker lives, removing geographical and commuting barriers to employment (Barrero et al., 2023; Choudhury, 2025; Kuźmar et al., 2026). The equalising hypothesis follows directly: workers in regions with thin labour markets gain access to jobs located elsewhere, previously inactive groups – carers, older workers, people with disabilities, residents of peripheral areas – can be drawn into employment, and high-earning remote workers relocate towards cheaper, less densely populated regions, transferring purchasing power outwards (Gupta et al., 2022; Gokan et al., 2023; Jansen et al., 2024). The 'donut effect' documented for US cities is the most visible expression of this mechanism (Ramani & Bloom, 2021).

The opposite expectation rests on the observation that the capacity to work remotely was fixed before the pandemic began. Dingel and Neiman (2020) show that the share of jobs that can be performed at home varies from roughly a quarter to a half across countries and is governed by occupational and sectoral composition. Sostero et al. (2020) find the same gradient across EU regions and interpret it as a new digital divide. Subsequent work confirms that teleworkability concentrates in knowledge-intensive activities and among the highly educated (Crowley & Doran, 2020; Adams-Prassl et al., 2022; Aksoy et al., 2025). Because this structure was inherited rather than chosen, an aggregate shock of common origin necessarily produced differential regional responses. Access to infrastructure is a weakening part of the explanation: household connectivity is approaching saturation across the EU, while divides in digital skills, motivation, and use persist (van Deursen & van Dijk, 2019; Helsper, 2021), and institutional settings differ systematically enough that European regions can be grouped into distinct telework regimes (Sanz de Miguel et al., 2026).

Evidence for the EU has so far stopped short of the post-pandemic equilibrium. Eurofound and the JRC (2024) document the geography of telework across NUTS 2 regions to 2022 and attribute it primarily to occupational structure, with the concentration of knowledge-intensive services in capital and urban regions driving both employment resilience and telework incidence; they warn of territorial divergence but observe only the first year of the decline. Sostero et al. (2024) reach similar conclusions from an occupational decomposition. The question of whether the pandemic gap subsequently closed, persisted or widened therefore remains open at the regional level, even though the aggregate trajectory is now well documented. WFH has stabilised at roughly one day per week among college-educated workers across forty countries since 2022 (Aksoy et al., 2025), and hybrid arrangements have been shown not to reduce performance while substantially improving retention (Bloom et al., 2024), which weakens the main organisational argument for a full return to the office.

This points to a measurement problem that the regional literature has largely overlooked. Most evidence on persistence focuses on the *intensity* of remote work - days or shares of days worked from home (Barrero et al., 2023; Alipour & Krause, 2024; Aksoy et al., 2025). Survey instruments, including the Labour

Force Survey, place an administrative boundary between 'usual' and 'occasional' home-working on half of the days worked. If the post-pandemic equilibrium is hybrid rather than fully remote (Eurofound, 2023), workers can cross that boundary without ceasing to work remotely, and intensity-based measures will record a retreat where participation-based measures record none. Whether the observed decline is a reversal or a change in form is thus partly a matter of definition, and it has not been tested using regional data.

We accordingly formulate two propositions. H1: Because the capacity for remote work was determined by pre-pandemic employment structure, regions with a higher share of knowledge-intensive services experienced a stronger increase in remote work, and the resulting gap did not close after the pandemic. H2: The decline observed after 2021 reflects reallocation between margins rather than a return to pre-pandemic arrangements, and is therefore visible in intensity but not in participation. Sections 5.2 and 5.3 test them in turn.

3. WORK FROM HOME IN EU REGIONS IN 2018-2024

Between 2018 and 2024, the incidence of working from home in the European Union went through three distinct phases. Before the pandemic, the phenomenon was stable and limited: in 2019, 5.4 percent of employed persons aged 15-64 usually worked from home and a further 9.0 percent did so occasionally, so participation in either form stood at 14.5 percent. The first pandemic year produced the largest single shift in work organisation recorded by the Labour Force Survey, with the share of usual home-workers more than doubling to 12.1 percent in 2020 and reaching 13.3 percent at the EU-wide peak in 2021. In ten member states, including Poland, Italy, and Spain, the national peak occurred in 2020, reflecting the different timing of containment measures; the aggregate peak in 2021 is driven by the large western European economies.

The third phase is the one that motivates this paper. After 2021, the share of usual home-workers declined to 8.9 percent in 2023 and 2024 and stabilised at 8.8 percent in 2025, which has been widely read as a retreat from remote work. Participation tells a different story. Adding the two Eurostat categories together, 22.6 percent of employed persons worked from home in 2024, against 24.1 percent at the peak and 14.5 percent before the pandemic: roughly 85 percent of the pandemic-era increase was still in place, compared with about 44 percent for usual home-working alone. The difference between the two readings is the occasional margin, which rose in every year after 2020 and reached 13.8 percent in 2024, its highest level on record. What appears as a retreat in the intensity measure is, to a large extent, a reallocation from full-time to hybrid remote work; we return to this point in Section 5.3.

Figure 1 shows the geography of the shock and what survived of it. In 2019, participation exceeded 24 percent in only 13 percent of regions, concentrated in Sweden, Finland, Denmark, the Benelux countries and around the largest western capitals, while 38 percent of regions remained below 8 percent, almost all of them in southern and central-eastern Europe. By 2021 those two shares had almost exactly traded places, at 37 and 13 percent, and the maximum had risen from 48.3 to 59.1 percent in Stockholm. The pandemic moved the whole map upward without reordering it: the rank correlation between regional participation in 2019 and in 2021 is 0.90. The third panel carries the argument of this paper. Between 2021 and 2024 the average region gave back part of its pandemic gain, but the distance between regions did not shrink with it. The retreat was concentrated at the bottom of the distribution, the lowest regional values fall from 3.5 percent in 2021 to 1.8 percent in 2024, while Stockholm loses 1.4 points from a level above 57 percent and the ordering of regions is by 2024 closer to the pre-pandemic one than it was at the peak, with a rank correlation of 0.93 against 2019. Four years after the shock, the map is the 2019 map redrawn at a higher level and with wider gaps.

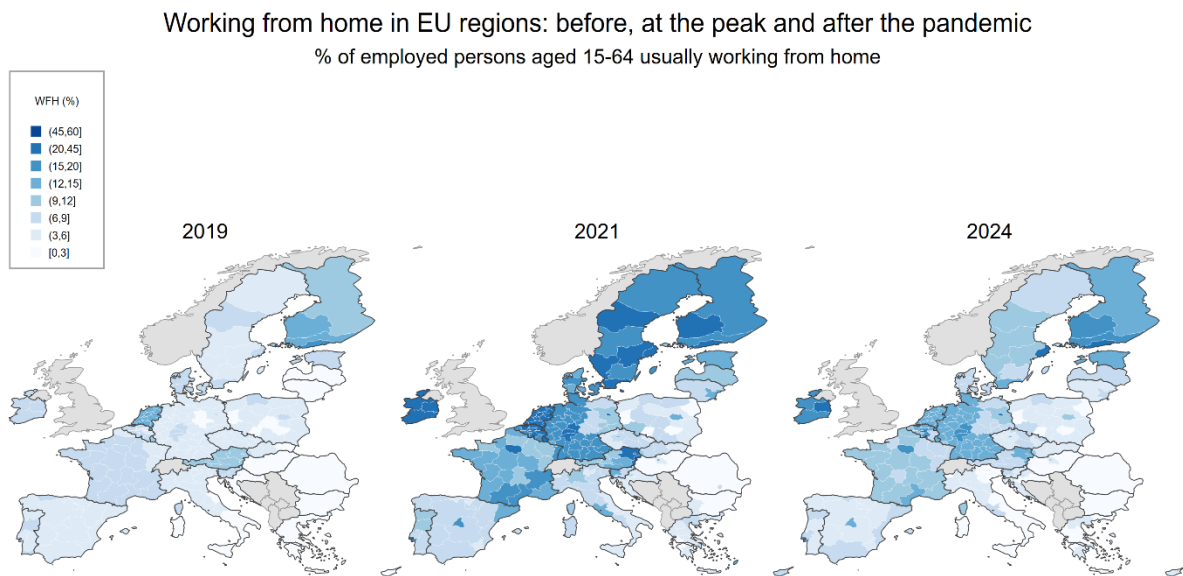


Figure 1. Working from home in EU regions in 2019, 2021 and 2024

Note: share of employed persons aged 15-64 working from home usually or sometimes. Both panels use a common colour scale. Germany and Austria are observed at the NUTS 1 level, and the Netherlands at the national level.

Source: own elaboration based on EU-LFS microdata.

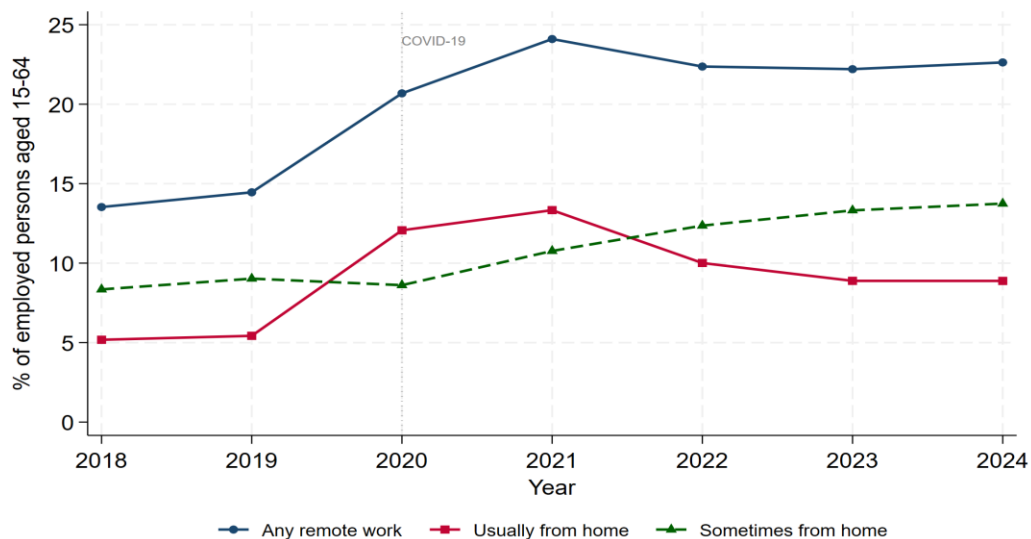


Figure 2. Working from home in the EU27, 2018-2024

Note: employment-weighted EU27 aggregates computed from regional data. Usually: working from home on at least half of the days worked in the four weeks preceding the interview; sometimes: on fewer than half of those days; any: either of the two.

Source: own elaboration based on EU-LFS microdata.

Figure 2 sets the three margins against each other and previews the central finding. The participation series rises in two steps, in 2020 and 2021, and then flattens: between 2022 and 2024 it moves within a range of 0.4 percentage points. Beneath that flat surface the composition changes continuously. Usual home-working spikes and recedes, tracing the swoosh-shaped path described for the United States, while occasional home-working falls in 2020, when containment measures pushed workers from partial into full-time remote arrangements, and then rises in every subsequent year. The two series cross twice: usual home-working exceeds occasional home-working only in 2020 and 2021, and by 2023 the pre-pandemic ordering is restored at a higher level. Which of the three lines is read therefore determines whether remote work appears to have retreated, persisted, or kept growing.

4. DATA AND METHODOLOGY

4.1. Data

The analysis covers 204 territorial units in the 27 EU member states over 2018–2024, defined on the NUTS 2024 classification¹. The dependent variables are computed from EU-LFS microdata for employed persons aged 15–64 and distinguish three measures: usually working from home (at least half of the days worked in the four-week reference period), sometimes working from home (fewer than half of those days), and any remote work (the sum of the two). An earlier analysis of the 2021–2022 window (Woźniak-Jęchorek & Matuszak, 2023) used a shorter panel and a different parameterisation of economic structure. The present paper extends the observation window to 2018–2024, adds two pre-pandemic years required for identification, and replaces the ten-sector parameterisation with the KIS/LKIS aggregation

Explanatory variables come from Eurostat regional statistics. Income is measured by GDP per capita in purchasing power standards (EU27 = 100), human capital by the share of persons aged 25–64 with tertiary education, demography by the share of population aged 60 and over and by population density, and infrastructure by the share of households with internet access at home. Economic structure is measured by the shares of employment in knowledge-intensive services (KIS) and in less knowledge-intensive services (LKIS), following the Eurostat classification of activities in dataset *htec_emp_reg2*²; the omitted reference category comprises agriculture, industry, and construction. This parameterisation replaces the full set of ten NACE section shares. Because sectoral shares sum to a constant, entering all of them jointly induces severe compositional collinearity, which inflates standard errors and renders individual coefficients uninformative; the two-aggregate parameterisation removes the problem by construction, and the mean variance inflation factors in the estimated models lie between 1.75 and 1.79 with a maximum of 2.66. The KIS share is also the variable with the strongest bivariate association with remote work in our data, ahead of income and tertiary education. Table 1 reports descriptive statistics for the last pre-pandemic year and the last observed year. Since the outcome variables changed sharply over the period, averages pooled across 2018–2024 would not reflect the actual state of the world; the two boundary years show where the regions started and where

¹The units of observation follow the resolution of the LFS microdata on working from home: Germany and Austria are observed at the NUTS 1 level and the Netherlands at the national level. All explanatory variables are taken from Eurostat at the matching territorial level.

²The dataset *htec_emp_reg2* has no age dimension, so the denominator of the two service shares is total employment aged 15 and over, whereas the remaining indicators refer to persons aged 15–64. Workers aged 65 and over account for roughly 2–3 percent of EU employment, so the discrepancy is minor.

they ended up. The treatment of suppressed cells, the small number of imputed values, and the reconstruction of population density for regions affected by the NUTS 2024 revision are documented in the Appendix, and every affected observation carries a flag used in the robustness analysis.

Table 1

Descriptive statistics, estimation sample

<i>Variable</i>	<i>Description</i>	2019		2024	
		<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>
WFH (any)	Employed persons working from home usually or sometimes, % of employment aged 15-64	13.11	9.73	19.18	12.91
WFH (usually)	Working from home on at least half of the days worked, %	4.81	2.87	7.28	5.13
WFH (sometimes)	Working from home on fewer than half of the days worked, %	8.30	7.56	11.90	8.83
GDP per capita	GDP per capita in purchasing power standards, EU27 = 100	89.77	36.45	90.41	36.33
Tertiary education	Population aged 25-64 with tertiary education, %	30.65	10.00	34.64	11.04
KIS employment	Employment in knowledge-intensive services, % of total employment	38.18	8.87	39.97	8.88
LKIS employment	Employment in less knowledge-intensive services, %	31.19	5.88	30.66	5.48
Population 60+	Population aged 60 and over, % of total population	27.05	3.70	28.73	3.97
Population density	Inhabitants per square kilometre	286.4	727.2	291.7	747.1
Internet access	Households with internet access at home, %	87.21	6.40	93.45	3.59

Note: 199 regions with complete data on all model variables (of 204 in total). WFH indicators are computed from EU-LFS microdata for persons aged 15-64. Knowledge-intensive services follow the Eurostat classification; the reference category is agriculture, industry, and construction.

Source: own elaboration based on EU-LFS microdata and Eurostat.

4.2. Empirical strategy

We use two complementary designs. The first is a sequence of cross-sectional regressions of the form:

$$WFH_i = a + \beta X_i + \varepsilon_i,$$

estimated separately for 2019, 2021, and 2024. The dependent variable WFH_i is the share of employed persons aged 15-64 in region i working from home usually or sometimes; the vector X_i contains the regional characteristics described in Section 4.1 and ε_i , an error term. These regressions describe which regional characteristics are associated with remote work at each time point. Because unobserved heterogeneity is likely to be spatially correlated across neighbouring regions, statistical inference uses the spatial HAC estimator of Conley (1999) with a 300 km distance cut-off, implemented with the `acreg` package (Colella et al., 2019); the conclusions are unchanged at 200 and 500 km.

The second design exploits the pandemic as a shock of differential intensity. The ability to move work into the home depends on the pre-existing structure of employment (Dingel & Neiman, 2020; Sostero et al., 2020), so regions entered 2020 with different exposure to the same aggregate shock. We measure exposure by the standardised KIS employment share in 2019 and estimate the event-study specification:

$$WFH_{it} = \alpha_i + \lambda_t + \sum_t \beta_t (KIS_{i,2019} \times D_t) + \varepsilon_{it},$$

where α_i are region fixed effects, λ_t are year fixed effects, and the base period pools 2018 and 2019. The coefficients β_t measure, in percentage points per one standard deviation of the 2019 KIS share (about 9 percentage points), how much more strongly exposed regions responded in year t relative to the pre-pandemic baseline. Region fixed effects absorb all time-invariant regional characteristics, including income, education, and density levels, while year effects absorb shocks common to all regions, including the EU-wide course of the pandemic.

Identification rests on the assumption that, absent the pandemic, regions with different KIS shares would have followed parallel paths. Two pre-pandemic years allow a direct test: re-estimating the model with 2019 as the single base year yields a 2018 coefficient of 0.014 for usual home-working, indistinguishable from zero, and -0.346 for overall participation, which is small relative to the post-2020 estimates but statistically significant (Appendix Table A1). We therefore treat specifications with region-specific linear trends and with country-by-year fixed effects as integral parts of the analysis rather than as optional robustness checks. Since exposure is continuous, the estimates are interpreted as the differential response associated with higher pre-pandemic exposure rather than as a causal dose-response function, which would require stronger assumptions (Callaway et al., 2024). Standard errors are clustered by region³.

5. EMPIRICAL RESULTS

5.1. Cross-sectional determinants of remote work

Table 2 presents the cross-sectional estimates for overall participation in remote work. Three results stand out. First, economic structure dominates the regression in every year: the KIS coefficient is large, precisely estimated, and grows from 0.545 in 2019 to 0.947 in 2024, while the LKIS coefficient is negative throughout. First, economic structure dominates the regression in every year. The coefficient on knowledge-intensive services is large, precisely estimated, and grows from 0.545 in 2019 to 0.947 in 2024. The 2024 estimate means that two regions differing by ten percentage points in the share of employment in knowledge-intensive services differ by about 9.5 percentage points in remote-work participation, holding income, education, demography and connectivity constant. A joint test that the two service shares are zero is rejected with chi-squared statistics ranging from 40 to 90. It is therefore not services as such that predict remote work but specifically their knowledge-intensive segment. Second, once the economic structure is controlled for, income and tertiary education add little: GDP per capita is significant only from 2021 onwards, with a small coefficient, and education is significant only in 2019. Third, internet access at home plays a modest role, reflecting its near saturation; by 2024, the regional mean is 93.5 percent with a standard deviation of 3.6, so the variable has little variation left to explain. The growing KIS coefficient already points towards a widening structural divide, but cross-sections cannot separate the effect of the pandemic from permanent differences between regions. That is the task of the event-study design.

³The Integrated European Social Statistics regulation changed national survey designs in 2021. LFS sample sizes fell by more than half in that year in 25 of the 204 regions, all in Greece, Ireland and Portugal. The drop is uncorrelated with the observed volatility of the WFH indicators ($r = -0.05$) and Table 4 shows that excluding 2021 leaves the estimates unchanged.

Table 2

Cross-sectional determinants of working from home

	(1) 2019	(2) 2021	(3) 2024
GDP per capita (PPS, EU27 = 100)	0.009 (0.018)	0.049*** (0.018)	0.034* (0.020)
Tertiary education (%)	0.215** (0.108)	0.134 (0.110)	0.141 (0.103)
Knowledge-intensive services (%)	0.545*** (0.092)	0.891*** (0.094)	0.947*** (0.111)
Less knowledge-intensive services (%)	-0.312*** (0.096)	-0.203 (0.128)	-0.210** (0.103)
Population aged 60+ (%)	-0.192 (0.170)	-0.045 (0.158)	-0.016 (0.141)
Log population density	-0.829 (0.573)	-0.095 (0.706)	-0.031 (0.772)
Internet access (%)	0.265** (0.121)	0.224 (0.144)	0.362* (0.198)
Constant	-19.316* (11.597)	-35.871** (15.320)	-53.440** (22.587)
<i>Observations</i>	199	199	199
<i>R-squared</i>	0.687	0.794	0.756
<i>Joint test, services (chi2)</i>	40.18	89.85	72.43
<i>p-value</i>	<0.001	<0.001	<0.001

Note: dependent variable: share of employed persons aged 15-64 working from home usually or sometimes. The omitted reference category for economic structure is agriculture, industry, and construction. Conley (1999) standard errors in parentheses, distance cut-off 300 km. The joint test refers to the null that both service-share coefficients equal zero. The Ramsey RESET test indicates departures from linearity (Appendix Table A2). A logit transformation of the dependent variable removes the rejection in 2019 and attenuates it in later years; its implications are discussed in Table 4. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: own elaboration based on EU-LFS microdata and Eurostat.

5.2. The pandemic as a shock of differential intensity

Table 3 and Figure 3 contain the central results. Each coefficient compares two regions that differ by one standard deviation in pre-pandemic levels of KIS employment, about nine percentage points, and reports how much further apart their remote-work rates moved in a given year relative to 2018-2019. A value of 2.0 therefore means two points of additional divergence, on top of whatever happened to all regions that year. Consider first usual home-working (Panel B). More exposed regions pull ahead immediately, by 1.97 points in 2020. The gap widens to 4.37 in 2021 and then narrows, to 1.78 by 2024, about two fifths of the peak, but still large and highly significant. Taken alone, this pattern would support the retreat narrative with a persistent residue.

Overall participation (Panel A) behaves differently. The coefficient rises to 3.19 in 2021 and then stays essentially flat: 3.11 in 2022, 3.17 in 2023, and 3.29 in 2024. The advantage high-KIS regions gained in participation during the pandemic did not diminish over the four subsequent years in the baseline specification. The same conclusion follows from simple correlations: the association between the 2019 KIS share and regional WFH participation rose from 0.72 in 2019 to 0.79 in 2024. Column (2) replaces year effects with country-by-year effects, so that identification uses only within-country variation and all national

policies, including the timing and stringency of containment measures, are absorbed. The estimates are smaller, as expected when cross-country variation is removed, and the profile also changes.

Table 3

Event-study estimates of the differential response to the pandemic

	(1)	(2)
	<i>Region and year FE</i>	<i>Region and country-by-year FE</i>
<i>Panel A. Any remote work</i>		
KIS x 2020	1.472*** (0.372)	1.779*** (0.498)
KIS x 2021	3.193*** (0.396)	2.849*** (0.687)
KIS x 2022	3.110*** (0.371)	2.162*** (0.671)
KIS x 2023	3.172*** (0.336)	1.814*** (0.577)
KIS x 2024	3.294*** (0.356)	2.058*** (0.647)
<i>Within R-squared</i>	0.252	0.112
<i>Panel B. Usually working from home</i>		
KIS x 2020	1.973*** (0.319)	1.864*** (0.396)
KIS x 2021	4.373*** (0.490)	2.710*** (0.531)
KIS x 2022	2.700*** (0.345)	1.660*** (0.431)
KIS x 2023	1.934*** (0.295)	1.379*** (0.383)
KIS x 2024	1.775*** (0.284)	1.242*** (0.392)
<i>Within R-squared</i>	0.294	0.130
<i>Panel C. Sometimes working from home</i>		
KIS x 2020	-0.501*** (0.185)	-0.086 (0.291)
KIS x 2021	-1.180*** (0.394)	0.140 (0.517)
KIS x 2022	0.410 (0.309)	0.502 (0.456)
KIS x 2023	1.238*** (0.257)	0.435 (0.342)
KIS x 2024	1.520*** (0.284)	0.815* (0.417)
<i>Within R-squared</i>	0.164	0.020
<i>Observations</i>	1423	1381

Note: coefficients are percentage points per one standard deviation of the 2019 knowledge-intensive employment share. The base period pools 2018 and 2019. Standard errors clustered by region in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Source: own elaboration based on EU-LFS microdata and Eurostat.

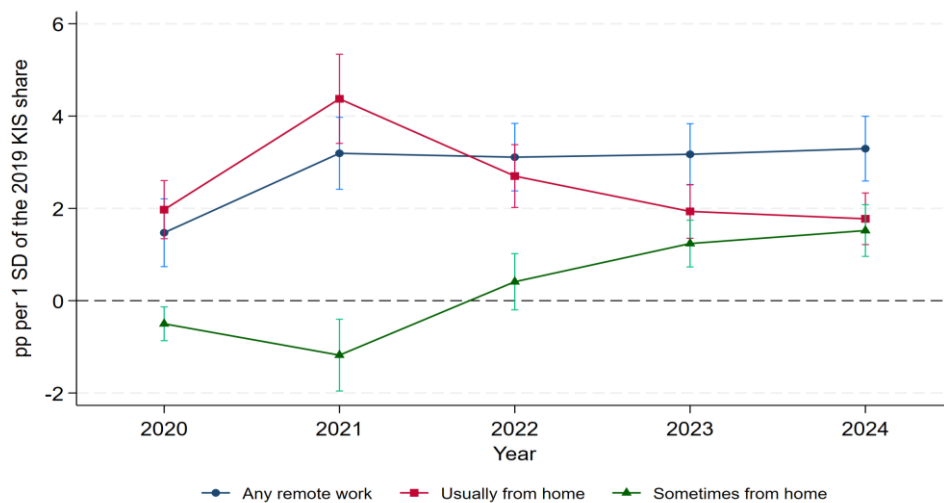


Figure 3. Event-study coefficients for the three measures of working from home

Note: point estimates from column (1) of Table 3 with 95 percent confidence intervals; the base period pools 2018 and 2019.

Source: own elaboration based on EU-LFS microdata and Eurostat.

The participation coefficient reaches 2.85 in 2021, falls to 1.81 by 2023, and stands at 2.06 in 2024, so roughly a quarter of the 2021 differential is lost over the following three years, against none in column (1). Two implications follow. The participation gap remains large and highly significant within countries, the 2024 estimate is about three fifths of the baseline coefficient and significant at the 1 percent level, so most of the persistence is not an artefact of comparing Sweden with Romania. But the part that does reflect composition between member states is not negligible, and the claim that the gap did not close is accurate for the EU as a whole while being too strong as a statement about divergence within national labour markets. Panel B is unaffected by this distinction: usual home-working falls from 4.37 to 1.78 in column (1) and from 2.71 to 1.24 in column (2), declines of 59 and 54 percent respectively, so the retreat in the intensity margin is identified equally well within and across countries.

Panel C completes the picture. The coefficient for occasional home-working is negative at the height of the pandemic, when workers in exposed regions moved into full-time remote arrangements, turns positive in 2022, and reaches 1.52 in 2024. The three panels are mechanically linked, since the coefficients in Panels B and C sum to those in Panel A, and the way the sum is preserved is informative: after 2021, the decline in the intensity margin is offset almost exactly by the rise in the occasional margin.

Panels B and C are mirror images of each other, as Figure 3 shows, and that mirroring identifies the mechanism behind the apparent retreat. Between 2021 and 2024 usual home-working fell in 178 of 199 regions while occasional home-working rose in 136, and in 123 regions both movements occurred together, so the two are not geographically separate phenomena but the same regions doing both. In 56 regions both margins declined, and these regions are systematically those with least remote work to begin with: their mean participation in 2021 was 13.4 percent against 20.7 percent across the sample, and they are concentrated in Italy, Romania, Portugal, Greece, Poland and Bulgaria. A further 13 regions, mostly in Poland and Romania, saw no material movement on either margin. Where remote work was already scarce, the post-2021 adjustment was a genuine withdrawal rather than a shift into hybrid arrangements.

This reallocation qualifies the return-to-office narrative documented for the United States, where full days worked from home stabilised after 2022 (Barrero et al., 2023). In EU regional data, the swoosh-shaped path appears only in the intensity measure. In the participation measure, there is no swoosh; there is a step. The practical implication for measuring remote work is that conclusions about its retreat or persistence depend on where the arbitrary boundary between usual and occasional home working is drawn:

participation-based measures are robust to shifts across that boundary, whereas intensity-based measures are not.

5.3. Robustness

Table 4 reports the 2024 coefficient, the most policy-relevant quantity, under seven variations of the baseline design. The estimate for WFH participation is stable between 2.9 and 3.9 when the exposure measure is replaced by the narrower high-technology share, when observations with imputed values are dropped, when regressions are weighted by the underlying LFS sample sizes and when 2021, the year affected by the survey redesign, is excluded; the last of these leaves the coefficients unchanged to the second decimal, which shows that the series break plays no role in the results. Country-by-year effects reduce the coefficient to 2.06 without affecting its significance.

Two rows warrant explicit discussion. With region-specific linear trends, the participation coefficient falls to 1.35 and loses statistical significance, while the coefficient for usual home-working is essentially unchanged at 1.80 and remains significant at the 1 percent level. With only two pre-pandemic years, the regional trends are identified largely from post-shock observations and therefore absorb part of any persistent effect, so these estimates understate the true response. The contrast between the two outcomes nevertheless reflects the pre-trend documented in Table A1, which is present for participation and absent for usual home-working, and we report it accordingly. Second, with a logit-transformed outcome, the coefficient for usual home-working remains positive and significant, while the coefficient for participation is close to zero. Since the logit scale measures proportional rather than absolute differences, this indicates that the widening of the participation gap is a phenomenon of absolute levels: exposed regions pulled further ahead in percentage points, while relative odds moved roughly in parallel. For the question of regional cohesion, it is the absolute gap that matters, since infrastructure use, commuting patterns, and local demand respond to the number of remote workers rather than to log odds, but the distinction belongs in the interpretation of the results.

Table 4

Robustness of the 2024 event-study coefficient

	Any remote work	Usually from home
Baseline	3.294*** (0.356)	1.775*** (0.284)
Region-specific linear trends	1.348 (0.818)	1.801*** (0.501)
Country-by-year fixed effects	2.058*** (0.647)	1.242*** (0.392)
Excluding 2021	3.297*** (0.356)	1.777*** (0.284)
Weighted by LFS sample size	3.826*** (0.419)	2.081*** (0.451)
HTC exposure instead of KIS	2.910*** (0.398)	2.042*** (0.309)
Excluding imputed observations	3.875*** (0.318)	1.728*** (0.260)
Logit-transformed outcome (a)	0.017 (0.032)	0.096** (0.042)

Note: each row reports the coefficient on KIS x 2024 from a separate estimation; standard errors clustered by region in parentheses.

(a) Coefficients on the logit scale; only sign and significance are comparable with the other rows. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: own elaboration based on EU-LFS microdata and Eurostat.

6. CONCLUSION

This paper asked how the pandemic expansion of remote work was distributed across EU regions, and whether that distribution has proved durable. Regions differed in their capacity to move work into the home before the pandemic began, and a one-standard-deviation increase in pre-existing exposure is associated with 3.19 percentage points of additional remote-work participation in 2021 and 3.29 points in 2024. The gap that opened in the first pandemic year has not closed at the EU level; when identification is restricted to variation within countries it narrows by about a quarter, while remaining large and highly significant. H1 is therefore supported, with the qualification that part of the persistence reflects differences in employment structure between member states rather than divergence between regions of the same country. Cross-sectional evidence points in the same direction. The coefficient on knowledge-intensive employment rises from 0.545 in 2019 to 0.947 in 2024, while income, tertiary education and household internet access matter little once economic structure is controlled for. What distinguishes regions is therefore not income or education as such, but the sectoral composition of employment, and specifically its knowledge-intensive segment, whose predictive power has strengthened rather than weakened since 2019.

The second finding concerns how remote work is measured, and supports H2. The retreat reported for the EU after 2021 is largely an artefact of the chosen indicator. Usual home-working fell in 178 of 199 regions between 2021 and 2024, but occasional home-working rose in 136; the two changes are negatively correlated across regions ($r = -0.665$, slope = -0.76), and in the participation measure, the pandemic increment is essentially fully retained. What is read as a return to the office is, in large part, a reallocation from full-time to hybrid arrangements within the same regions. Statements about the persistence of remote work should therefore specify the margin they refer to: participation-based measures are robust to movements across the usual–occasional boundary, intensity-based measures are not.

Read together, the two findings weaken the empirical premise of the equalising view. The pandemic demonstrated that a large share of work can be done from home, but the capacity to exploit that demonstration was distributed according to a structure set in place before 2020, and the four years since have consolidated rather than eroded that distribution. The equalising view requires remote work to reach lagging regions; over seven years it did not. Whether the resulting distribution feeds through to income, employment or migration is a separate question, which our data cannot answer.

The policy implication follows from what the estimates do and do not support. Interventions aimed at household connectivity have largely exhausted their scope: by 2024, the regional mean of internet access is 93.5 percent with a standard deviation of 3.6 points, leaving little variation for policy to act on. Nor do our results support income transfers as an instrument for closing the remote-work gap. What separates regions is the presence of activities that can be performed remotely. The lever, if there is one, is therefore industrial rather than digital: policies that build or attract knowledge-intensive activity in lagging regions. Our estimates do not test whether such policies work, only that the constraint they would have to address is the one that binds.

Four qualifications should be kept in view. About a quarter of the persistence in participation is attributable to composition between member states rather than to divergence within them. Specifications with region-specific linear trends, identified largely from post-shock observations, reduce the participation coefficient to insignificance. Moreover, estimates on the logit scale indicate that the widening gap is one of absolute levels rather than relative odds, which we regard as the quantity relevant to cohesion but which restricts the claim; and because exposure is continuous, the estimates describe differential responses associated with pre-pandemic structure rather than a causal dose–response relationship (Callaway et al., 2024). These qualifications bound the interpretation without altering its direction. The open question is whether the hybrid equilibrium now observed will remain a property of the regions that reached it first, or

whether the diffusion of remote practices into less knowledge-intensive activities will eventually loosen the structural constraint that this paper documents. Answering it will require regional data on the intensity margin at a finer resolution than the usual occasional dichotomy allows.

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APPENDIX

A.1. Data construction and treatment of suppressed cells

Eurostat suppresses regional cells that fall below the underlying survey's reliability thresholds, and the treatment of such cells materially affects the sample. Three decisions are documented here. First, NACE section L (real estate activities) is excluded from the analysis. The section accounts for 0.9 percent of employment on average, yet about 40 percent of its regional cells are suppressed, and the suppressed regions are systematically smaller and poorer, with GDP per capita around 73 percent of the EU average against 101 percent for regions with published values and remote-work incidence lower by roughly 3.5 percentage points. Coding suppressed cells as zeros, therefore generates measurement error correlated with the dependent variable, and the apparent explanatory power of the real-estate share reported there should be read as an artefact of this mechanism.

Second, the agriculture share is suppressed in 121 region-year observations concentrated in metropolitan regions, with a mean population density of about 1975 inhabitants per square kilometre. Unlike in Section L, the suppression here occurs when the true share is close to zero, so these cells are set to zero and flagged; Table 4 shows that dropping all flagged observations leaves the estimates unchanged. Third, population density is missing for the Croatian and Portuguese regions in the years before the NUTS 2024 revision because Eurostat has not backcast the density series onto the new boundaries. Land area is time-invariant, so density is recovered exactly from population and the area implied by the years in which both series are observed. After these steps, the estimation sample covers 199 of 204 units, between 97 and 98 percent of observations in every year; the excluded units are Ceuta, Melilla, the Åland Islands, and two newly delineated Croatian regions, all with very small LFS samples.

The internet access variable is not reported at the NUTS 2 level in all countries and, where necessary, takes the value of the parent NUTS 1 unit or the country. In countries reporting both levels, the median absolute deviation of a region from its parent was 0.69 percentage points in 2024, compared with a cross-regional standard deviation of 3.03 percentage points; the variable is close to saturation, so it plays only a supporting role in the analysis. All processed observations carry flags, and the full processing code is available from the authors.

A.2. Pre-pandemic trends

Table A1 re-estimates the event-study specification with 2019 as the single base year, so that the 2018 coefficient provides a direct test of differential pre-pandemic trends. For usual home-working, the coefficient is 0.014 and statistically indistinguishable from zero. For overall participation, the value is -0.346 and is significant, indicating that exposed regions were already gaining slightly in participation between 2018 and 2019. The pre-pandemic trend is small, about one tenth of the 2024 effect, but a linear extrapolation over five years would account for a nontrivial part of it, which is why the main text reports the specification with region-specific trends alongside the baseline and treats its estimate as a conservative bound.

Table A1

Event study with 2019 as the base year

	Any remote work	Usually from home
KIS x 2018	-0.346*** (0.131)	0.014 (0.071)
KIS x 2020	1.300*** (0.385)	1.980*** (0.325)
KIS x 2021	3.021*** (0.390)	4.381*** (0.486)
KIS x 2022	2.938*** (0.365)	2.707*** (0.340)
KIS x 2023	3.000*** (0.328)	1.941*** (0.293)
KIS x 2024	3.122*** (0.351)	1.782*** (0.282)
Observations	1423	1423

Note: the coefficient on KIS x 2018 tests for differential pre-trends. Region and year fixed effects; standard errors clustered by region in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Source: authors' calculations.

A.3. Specification diagnostics

Table A2 reports diagnostics for the cross-sectional models of Table 2. The hypothesis of normally distributed residuals is not rejected in any year by either the Shapiro-Wilk or the skewness-kurtosis test. Breusch-Pagan and White tests reject homoskedasticity, which is expected in regional data and is why inference relies on Conley standard errors, which are robust to heteroskedasticity and spatial correlation alike. The Ramsey RESET test rejects the linear functional form in all three years. A logit transformation of the bounded dependent variable removes the rejection in 2019 and attenuates it in 2021 and 2024. The event-study results under the transformation are reported in Table 4. Mean variance inflation factors lie between 1.75 and 1.79 with a maximum of 2.66, confirming that the two-aggregate parameterisation of economic structure resolves the collinearity that affected the previous version of the model.

Table A2

Diagnostics for the cross-sectional models

	2019	2021	2024
Shapiro-Wilk, p-value	0.89	0.38	0.13
Skewness-kurtosis test, p-value	0.75	0.20	0.10
Ramsey RESET, F-statistic	9.40	6.73	8.43
Ramsey RESET, p-value	<0.001	<0.001	<0.001

Note: diagnostics refer to the models of Table 2 estimated by ordinary least squares.

Source: authors' calculations.