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The Impact of Local Digital Infrastructure Expenditure on Women's and Men's Employment

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The Impact of Local Digital Infrastructure Expenditure on Women's and Men's Employment

Abstract

This paper examines the impact of local digital infrastructure (DI) expenditure on women's and men's employment using data from the UK Household Longitudinal Study linked with detailed local authority (LA) expenditure records for England in 2019–24. Our starting point is a fixed-effects multinomial logit (MNL) model that distinguishes three labour market states: paid employment, self-employment, and non-employment. It shows that greater DI expenditure raises the relative risk of both paid employment and self-employment relative to non-employment. Because both margins respond in the same direction, our main specification combines them into a single employment outcome and is estimated as a linear probability model with individual-LA fixed effects, which account for any individual-LA specific characteristics that could be correlated with employment status. A £10 per capita increase in DI spending is found to raise the probability of employment by 0.9 percentage points in the same financial year and by 1 percentage point in the following year, equivalent to 1.2–1.3% of the mean. Both women's and men's employment respond, and the gender difference is not statistically significant. The findings are robust to alternative specifications and controls for other local expenditures. Our results suggest that investment in DI can enhance employment plausibly by enabling home-based and technology-enabled work but is unlikely to close the gender gap in employment.

JEL classification

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digital infrastructure, employment

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1 Introduction

Local governments worldwide are committing substantial resources to digital infrastructure (DI) capital investment. The central question this paper addresses is whether such expenditure translates into measurable employment gains for local residents and whether there are any gendered impacts on how local residents engage with the labour market.

The existing literature on the impacts of broadband access on employment probabilities mainly relies on variation generated by private-sector rollout or national programmes rather than local government budget allocation. It tends to find that broadband access raises employment. This paper contributes to the literature by estimating the effect of local government DI expenditure on employment outcomes. We link UK Household Longitudinal Study (UKHLS) data to local-authority records of DI expenditure for 2019-2024 financial years. We begin with a fixed-effects multinomial logit (MNL) model that distinguishes three states: working as an employee, self-employed, and non-employed. We start here because DI can plausibly move people into either form of work, and because paid employment and self-employment are alternatives to one another as well as to non-employment, so the two margins need to be examined jointly before either is examined alone. Since we find that both margins respond positively, the main analysis combines paid employment and self-employment into a single employment outcome, and self-employment is then analysed separately. We also evaluate whether any employment effects of DI expenditure spill over into income and wellbeing as well as whether local DI investments improve job quality. Finally, we explore the ways DI can help individuals move from non-employment to employment, including home-based work, gig-economy participation, and demand for IT specialists.

Our results show that local DI expenditure has positive effects on employment. A £10 per capita increase in local DI expenditure raises the probability of employment by about 0.9 percentage points contemporaneously and by about 1 percentage point in the following year. The underlying MNL estimates are positive for both paid employment and self-employment relative to non-employment. When self-employment is examined separately, it is found that self-employment rates increased by about 0.6 percentage points in the current year, but the effect does not persist. Gender differences in the employment effects are found to be largely statistically insignificant. The movement of individuals from non-employment into employment is indeed driven by home-based work, and with a lag, gig-economy participation. However, support for a demand channel for IT specialists is limited. Secondary outcomes are

mixed: income increases significantly only for women, and there is no clear improvement in job quality or wellbeing.

2 Literature Review and Our Contribution

2.1 DI and Labour Market Outcomes

The prior literature establishes the potential of DI expenditure to raise employment probability. However, the effects of DI vary by context and worker type. Evidence from national broadband rollouts indicates that fast internet is beneficial to both employers and the unemployed by reducing search frictions (Bhuller et al, 2023; Gürtzgen et al, 2021), but workers are affected unequally with especially large productivity gains for workers with college degrees in high-return fields (science, technology, engineering, and business) and productivity losses for workers without a high-school diploma (Akerman, Gaarder, and Mogstad, 2015). Alternative identification strategies also suggest that broadband internet increases the likelihood of employment (Dettling, 2017; Hjort and Poulsen, 2019; Zuo, 2021). Beyond access alone, the speed and quality of the connection matter for economic outcomes (Edquist, 2022). The study by Hegde and Van Parys (2024) is closest to ours, because it focuses on the role of local governments in the provision of broadband internet. It shows that restrictions on local government’s rights to provide internet had a negative effect on employment during the COVID-19 pandemic in the US, but only for married mothers.

From a local investment perspective, LA DI expenditure functions as a local investment shock, and the individual-LA fixed-effects design employed in this paper isolates this local channel. The literature on local fiscal multipliers demonstrates that local public investment generates employment gains that are difficult to identify at the national level. Infrastructure projects create demand for workers to design, construct, and maintain public assets (Infrastructure Australia, 2021), and once established, the additional services available in local areas increase both the quality and quantity of local employment opportunities (Denham *et al.*, 2018). Moretti (2010) estimates that each additional manufacturing job in a given city creates 1.6 jobs in the non-tradable sector in the same city, illustrating the local employment multiplier.

Our contribution is to identify the employment effects of a local government’s own investment decision. Most of the literature reviewed above identifies effects from broadband availability or speed generated by private-sector rollout or national programmes. The closest study is Hegde and Van Parys (2024), discussed above, and we differ from it in several ways. First, the

treatment differs: they exploit US state laws restricting whether municipalities may provide broadband at all, whereas we observe the amount each local authority actually spends on DI in each financial year. The first tells us what happens when public provision is prohibited; the second tells us what an additional pound of public spending buys, which is the question an authority with a fixed budget faces. Second, the institutional setting differs in more than just the national context: US municipal broadband involves local government acting as a provider in competition with private internet service providers, whereas UK local authorities largely co-finance and enable private deployment. Third, their estimates come from the COVID-19 period, when the value of connectivity was inflated by the closure of workplaces, whereas our panel spans 2019/20 to 2024/25 and allows us to ask whether the effects persist beyond it. Finally, identification also differs: we use within-individual, within-authority variation in annual expenditure rather than cross-state variation in regulation. This shifts, rather than removes, the threats to identification, and we address the resulting concerns about reverse causality and time-varying confounders in Section 5 and test them in Section 6.

A further contribution follows from the expenditure data. Because we observe the full ledger of local authority spending across every service category, we can hold other spending fixed and, additionally, estimate the effect of shifting funds between categories. This allows us to speak to the trade-off an authority faces — DI against social care, transport, or environmental services out of a single budget — which studies identifying effects from broadband availability, or from restrictions on public provision, cannot address.

2.2 Digital Infrastructure, Paid Employment, and Self-Employment

DI affects paid employment and self-employment through a substantially common set of channels. Faster and more reliable internet reduces search and matching frictions by improving access to information about vacancies on one side, and about customers, suppliers, and prices on the other (Bhuller *et al.*, 2023; Gürtzgen *et al.*, 2021). It relaxes location constraints by making home-based and remote work feasible, which lowers commuting costs and weakens the requirement to be physically present in a particular place at a particular time. It raises productivity in tasks that are intensive in information processing and communication, although these gains accrue unevenly across skill groups (Akerman, Gaarder, and Mogstad, 2015). And by improving connectivity for local firms, it can raise labour demand within the LA, which shows up as paid employment for residents (Hjort and Poulsen, 2019). On each of these channels we would expect DI expenditure to raise the probability of working for an employer

and of working for oneself, relative to not working at all. This is why our starting point is a model of all three labour market states rather than of either form of work alone.

The two states nevertheless differ in ways that lead us to expect effects of different size and timing, and comparative work has long treated self-employment as having its own dynamics of entry and exit rather than as a residual category of employment (Arum and Müller, 2004). Entry into self-employment requires the individual to find customers, establish a business, and bear the associated fixed costs, so it is particularly sensitive to anything that lowers the cost of reaching a market. DI lowers non-capital transaction costs such as search, transportation, tracking, replication, and verification costs (Goldfarb and Tucker, 2019), and online customer acquisition can extend market reach well beyond the entrepreneur's immediate location. Because the baseline self-employment rate is low, a given absolute increase is also proportionally much larger than the same increase in paid employment. In contrast, DI does not relax the capital and regulatory constraints on business entry: wealth matters because business ownership is risky and allows individuals to obtain non-pecuniary benefits such as autonomy and schedule flexibility (Hurst and Lusardi, 2004), and the cost of complying with incorporation requirements can itself deter entry (Klapper, Laeven, and Rajan, 2006). Entry into paid employment, by contrast, depends on employers posting vacancies, so it is more exposed to local labour demand and to hiring frictions such as fixed-term contracts. This is one reason we allow for a lagged, as well as a contemporaneous effect on both margins. Cross-country evidence links infrastructure provision more generally to entrepreneurial development (Azmi and Azmi, 2023). Consistent with a response at the entry margin, high-speed internet has been linked to increased business formation in the United States (Biedny, Whitacre, and Van Leuven, 2024) and to individual entrepreneurship in China (Li *et al.*, 2024).

A further reason to treat the two states jointly is that they are alternatives to each other and not only to non-employment. If DI raises local labour demand, some individuals who would otherwise have worked for themselves may take a paid job; if it lowers the cost of operating independently, some employees may move in the opposite direction. The effect on employment overall therefore need not equal the sum of the two state-specific effects, and a model that examines self-employment in isolation cannot separate entry from non-employment from switching out of paid work. Digital platforms sharpen the point. They mediate customer acquisition and the delivery of short-term services, offering flexibility over schedules, locations, and tasks (Williams *et al.*, 2022), but platform-mediated work is classified as paid employment or as self-employment depending on the contractual relationship. Self-

employment is itself heterogeneous, spanning autonomous business ownership at one end and atypical, dependent work at the other (Jansen, 2019), and platform-mediated work sits closer to the latter. The same technology can therefore move both margins and shift the boundary between them.

Whereas the studies reviewed above identify the effects of DI from broadband speed or availability, this paper identifies the effect of a public investment decision on both forms of work. We are not aware of prior estimates of the effect of local government DI expenditure on self-employment.

2.3 Gendered Gaps in Employment and the Role of DI

Despite the substantial convergence in the roles and educational attainment of men and women over the past century (Goldin, 2014), gender gaps in the labour market persist, and they are far wider in self-employment than in paid employment. In our sample, 64.3% of women and 66.8% of men work for an employer, a gap of about two percentage points, whereas 6.2% of women and 13.0% of men are self-employed, so men are roughly twice as likely to be self-employed as women (Table 1). The same contrast holds more broadly: participation and employment gaps in industrialised countries have narrowed considerably (Olivetti and Petrongolo, 2016), while the gap in self-employment has proved persistent (van der Zwan, Verheul, and Thurik, 2012; Caliendo, Fossen, and Kritikos, 2015), a contrast documented across a wide range of countries (World Bank, 2012). Goldin (2014) attributes the remaining gaps to non-linear returns to hours: in many occupations, hours of work are worth more when supplied at particular times and when they are more continuous, so that a flexible schedule comes at a high price, channelling women into specific occupations such as pharmacy. Women face higher implicit costs of commuting, mobility, and fixed-schedule employment due to care obligations (Kleven *et al.*, 2019) and workplace hour penalties (Goldin, 2014); the commuting burden itself is shaped by urban structure and is systematically related to employment status (Li, Dodson, and Goldie, 2021). These constraints bear on both forms of work, but they bind differently: in paid employment they operate largely through the schedule and location an employer requires, whereas in self-employment they also operate through the time and mobility needed to find customers and build a business.

The gender gap is further explained by the “child penalty” – the adverse effect of children on women’s labour force participation, hours of work, and wage rates (Kleven *et al.*, 2019). Fontenay (forthcoming) shows that paid maternity leave raises female entrepreneurship by

protecting women's re-entry option. Zandberg (2021) shows that the constraint operates through the timing of fertility itself: improved access to reproductive health care raises women's entry into entrepreneurship, narrowing the gap.

Peer effects also contribute to the gender gap in entrepreneurship: women are more influenced by female peers, while men are more influenced by male peers, and there are fewer successful female entrepreneurs to serve as role models (Field et al., 2016). Markussen and Røed (2017) show, using Norwegian register data, that exposure to entrepreneurial peers among family members, neighbours, and co-workers raises the propensity to become an entrepreneur, and that this transmission runs disproportionately within gender. A scarcity of female entrepreneurs is therefore partly self-reinforcing, which is one reason the gap has closed more slowly in self-employment than in paid employment. Female entrepreneurship also experiences a spatial mismatch: women tend to be less networked than their male counterparts and therefore derive less benefit from agglomeration (Rosenthal and Strange, 2012). Women may also bear greater domestic burdens, face higher effective commuting costs, and consequently choose locations farther from agglomerations or commute shorter distances (Rosenthal and Strange, 2012).

These barriers make DI expenditure potentially consequential for women on both margins of employment. For paid employment, better connectivity makes home-based and flexible-schedule work feasible, which directly attenuates the commuting and fixed-schedule costs that fall most heavily on women with care responsibilities, although the digital economy has been shown to reproduce as well as relax existing gender inequalities in work (Rani, Castel-Branco, Satija, and Nayar, 2022). Dettling (2017) and Hegde and Van Parys (2024) find that exogenously determined high-speed internet access has a positive impact on the labour force participation of married women, especially those with children, but not of single women or men. For self-employment, DI additionally attenuates the agglomeration premium by enabling market access from non-core locations: access to digital technologies and platforms increases business visibility and expands an entrepreneur's domestic and international market reach without requiring proximity to agglomerations (Khoo *et al.*, 2024), and it lowers the cost of operating a business from home — a shift that also alters the spatial relationship between where people live and where work is located (Li, Kent, Dodson, and Sima, 2025). Investment in DI can also address the child-penalty explanation for the gender gap by reducing the cost of combining motherhood with either form of work. Because the gender gap is proportionally much wider in self-employment than in paid employment, an absolute effect of a similar size would represent a much larger relative gain for women on the self-employment margin. We

therefore expect DI expenditure to raise women’s employment on both margins, with the proportionally larger response in self-employment, but we do not expect it to close the gender gap in employment overall.

3 DI in the UK

For our analysis period, UK DI expenditure primarily concerned expanding broadband coverage and access. The ONS defines DI as “the fixed, physical assets needed to maintain broadband communications systems and allow the flow of communication data” (Office for National Statistics, 2024). UK policy has treated broadband and mobile connectivity as core economic infrastructure. The UK Digital Strategy describes them as a “fourth utility” and links improved connectivity to participation in the digital economy, business growth, innovation and productivity (Department for Science, Innovation & Technology, 2023). Public investment has generally been channelled through grants to providers to extend networks to areas unlikely to receive sufficient commercial investment, including through the Superfast Broadband Programme (Office for National Statistics, 2024). Regulation has shaped the UK broadband market alongside public investment: Nardotto, Valletti, and Verboven (2015) find that local loop unbundling in the UK raised broadband quality but had little effect on overall penetration, which is one reason coverage in commercially unattractive areas has continued to depend on public subsidy.

National programmes targeted at local authorities include Project Gigabit, which is designed to extend fast, reliable gigabit-capable broadband to hard-to-reach homes and businesses that fall outside commercial deployment plans.¹ Local authorities can affect these outcomes through their broadband, highways, and planning functions, including by resolving deployment constraints, facilitating wayleaves and street works, and supporting local take-up. Local authorities therefore provide a relevant local channel through which public investment may translate into improved connectivity and employment outcomes.

Evidence from evaluations of the UK Superfast Broadband Programme is consistent with local employment effects. The 2025 evaluation of the programme reports approximately 23,700 local jobs created by the end of 2021 and higher annual business turnover in upgraded areas (Building Digital UK, 2025). Earlier local authority evaluation linked subsidised coverage to a 0.8 percent increase in employment, a 1.2 percent increase in turnover (almost £9.0 billion),

¹ <https://www.gov.uk/guidance/project-gigabit-uk-gigabit-programme>.

and reductions in Jobseekers Allowance claims of 8,800 overall and 2,500 among long-term claimants by 2016 (Department for Digital, Culture, Media & Sport (DCMS), 2018). However, DCMS found less evidence that coverage improved job search or take-up of teleworking roles, possibly because the anticipated teleworking roles were limited and lower-income residents faced affordability or skills constraints (DCMS, 2018).

4 Data

4.1 UK Household Longitudinal Study data

This study draws on data from the UK Household Longitudinal Study (UKHLS), also known as *Understanding Society* (University of Essex, Institute for Social and Economic Research, 2026). The survey collects information from households across the UK, covering a broad set of social, economic, and behavioural domains and following them up annually. At the time of the analysis, fifteen waves were available covering the period of 2009-2025. All adult members of participating households are interviewed at each wave (Institute for Social and Economic Research, 2026). For the analysis, we use data on adult working-age individuals between 18 and 64 years old, who are most likely to be economically active. We also restrict the sample to the individuals residing in England and surveyed in 2020-2024 financial years, to match the data on local DI expenditure (75,332 observations initially).

UKHLS includes an extensive set of information on individuals' lives, economic circumstances and socio-economic characteristics. Information on employment is collected in every wave. Individuals are asked what their main current economic activity is and they can answer using one of the following options: self-employed; in paid employment; unemployed; retired; on maternity leave; full-time student; long-term sick or disabled; on government training scheme; doing an apprenticeship; doing something else. Understanding Society also includes very rich information about individuals' workplace, income, and wellbeing. We use this information to explore heterogeneity, mechanisms, and spillovers to other outcomes.

Further, Understanding Society contains information on the key individual and household characteristics, including gender, age, the number of adults and children of different ages in the household, and whether an individual has own children in the household. Importantly, we also have access (under a special licence) to the information on the respondents' local authority (LA) identifier, which allows us to link the survey data to the LA expenditure data.

4.2 LA expenditure data

We merge the Understanding Society data with LA expenditure data compiled by Ministry of Housing, Communities and Local Government and Department for Levelling Up, Housing and Communities. Both revenue² and capital³ expenditure data are available. Within revenue expenditures we focus on service expenditures, which are used to provide services to the residents including education, transport, social care, public health, housing, cultural, environmental, planning and development, central and other services⁴. We use data on net service expenditure, which is calculated subtracting fees, charges and any other income related to service provision from the expenditure. Therefore, service expenditure can be negative, if income generated from a given service exceeds spending on this service. Capital expenditure is used to purchase, construct or improve long-term assets such as land, buildings, roads, vehicles, equipment and IT systems. Capital expenditure is categorised in a similar way as service expenditure, except for additional categories of trading services and DI⁵. We use expenditure data from 2019/20 financial year, when DI was first recorded as a separate category, to 2024/25 financial year. In the UK, financial year runs from April to March. Service and capital expenditures in each category are added and normalised by the population of the LA, so that expenditures are measured in 10 GBP per capita⁶.

There are different types of local authorities in the UK: London boroughs, metropolitan districts, shire (non-metropolitan) districts, shire counties, unitary authorities, and other authorities (combined authorities, Greater London Authority, fire and rescue, police, park, and waste authorities). LA identifier (ONS code) allows us to identify the London borough, metropolitan district, shire district, or unitary authority in which the respondent lives. We assign the expenditures of shire counties to shire districts, the expenditures of Greater London Authority to London boroughs, and the expenditures of combined authorities to its member

² <https://www.gov.uk/government/collections/local-authority-revenue-expenditure-and-financing>

³ <https://www.gov.uk/government/collections/local-authority-capital-expenditure-receipts-and-financing>

⁴ Besides service expenditure, revenue expenditure includes housing benefits (social housing), precepts and levies, trading accounts and adjustments, and non-current expenditure and receipts. Only services funded from General Fund Revenue Account (GFRA), including homelessness prevention, temporary accommodation, housing advice, are included in housing service expenditure. We also do not use police and fire service expenditures, because it is common for these services to be provided by special police and fire authorities.

⁵ Capital expenditure can also be negative, although it is uncommon.

⁶ We use the population in the current year to normalize the expenditure. An alternative is to normalize it using population in the first period (2019), which we do in the sensitivity analysis.

authorities. The number of local authorities varies from 317 in 2019-20 financial year to 296 in 2023-24 financial year, because the administrative structure of local authorities has changed over time.

4.3 Analysis sample

We match the UKHLS observations to the LA expenditure data using the LA identifier and the financial year in which the respondent is interviewed. In the UK, financial year starts in April and ends in March. We can match most of the observations (74,746 out of 75,332).

In this analysis, we focus on DI expenditure that according to the current ONS definition includes any investment in physical assets needed to maintain broadband communications systems and allow the flow of communication data, such as fibre-optic networks, coaxial and copper cables, and communication towers. As discussed in the introduction, this expenditure can benefit local residents in several ways. First, better internet connection can enable individuals to work or operate a business from home, which may especially be attractive to women. Second, greater connectivity can create more favourable conditions for local businesses. Third, it could generate demand for IT specialists.

We apply a few sample restrictions. Since our data is set at the financial year level, some (2,617) UKHLS respondents are interviewed in the same financial year twice (in two separate waves). We keep only one (latest) observation for such respondents. Next, we exclude 2,993 and 16,527 observations with missing contemporaneous and lagged expenditure, respectively. Further 1,746 observations have missing information on the main economic activity and control variables. Finally, 7,127 individuals are excluded because they are observed only once and therefore do not contribute to the identification. The final estimation sample comprises 43,736 observations on 13,340 individual-LA pairs (13,306 individuals) from 290 LAs. Females contribute somewhat more observations to the sample (57%) than males.

Appendix Table A1 presents the means of personal, household and LA characteristics for the observations that are dropped (Column 1) and the observations that are included in the analysis sample (Column 2). The t-statistics presented in Column (4) suggest that there are statistically significant differences between the two groups, but absolute differences (presented in column 3) are mainly small. The samples are comparable in terms of household composition, LA type, DI and other expenditure, but analysis sample has somewhat more employed and self-employed individuals. There is also a four-year difference in average age between the two

groups: further investigation reveals that younger individuals are more likely to have lagged expenditure information missing and less likely to remain in the data for at least two years. These patterns suggest that it is more difficult to consistently track younger individuals in the survey. The regressions control for age (by including wave effects as explained below), and we also perform heterogeneity analysis by age.

4.4 Descriptive statistics

Table 1 presents summary statistics for our full analysis sample as well as by gender, including information on labour force participation, household composition, LA type, and annual expenditure per capita across a wide gamut of local government services. On average, there are between two and three adults (16 years of age or older) in the household, and a third of respondents have their children (0-15 years old) living with them, consistent with the average age being 45 years. The proportions of respondents who report that there are children under five and children over five in the household are 13.8% and 38.0%, respectively. As to the main economic activity, women are less likely to be self-employed than men (6.2% versus 13.0%), but similar proportions of women and men work for employers (64.4% versus 66.9%). Moreover, women are more likely to be entirely outside of the labour force compared to men (23.7% versus 15.2%), but unemployment rates are comparable at 5-6%. Most of the respondents (33.4%) live in shire districts that tend to be more rural, followed by those living in unitary authorities (27%), metropolitan districts (23.7%), and London boroughs (15.9%).

In our analysis period, LA expenditure on DI is relatively small at around £3.3 per capita. The graph on the left in Figure 1 shows that many local authorities do not make any investments into DI in a given year. However, among those that invest into DI, there is substantial variation in the amount of the expenditure, reflected by the standard deviation of £5.3. There is also substantial within-LA variation in DI (within s.d. = £3.4), which is important for the identification of the impact of this expenditure on employment. Most of LA funds are spent on education (£690 per capita), social care (£585 per capita), and transport (£258 per capita). There are no gender differences in LA expenditures, indicating no gender-based selection into LAs on the basis of expenditure.

5 Methodology

We start by investigating the impact of local government DI expenditure on three employment states: working as an employee, being self-employed, and non-employed⁷. For this purpose, we estimate a multinomial logit (MNL) model, in which the probability of employment state m is calculated as:

$$Prob(es_{iat} = m | X_{iat}, \beta_j, \mu_{iaj}) = \frac{\exp(\beta_{0m}DI_{iat} + \beta_{1m}DI_{iat-1} + X'_{iat}\delta_m + \gamma_{tm} + \nu_{wm} + \mu_{iam})}{\sum_{j=1}^J \exp(\beta_{0j}DI_{iat} + \beta_{1j}DI_{iat-1} + X'_{iat}\delta_j + \gamma_{tj} + \nu_{wj} + \mu_{iaj})} \quad (1),$$

where i denotes individuals, a LA, t year, w wave, and j employment state. We add DI expenditure in both the current and the past financial years. Lagged expenditure is added, because employment decisions are likely delayed in adjusting to new DI investment. Indeed, starting a business often requires time to plan and acquire start-up capital, whilst labour market frictions (such as fixed-term contracts) may also delay the ability to enter employment in response to new opportunities presented by DI investment. Additionally, we want to allow for the persistence in the impact of local DI expenditure. Vector X_{iat} includes current and lagged other expenditures as well as control variables (the number of adults and the number of children in the household). Year and wave fixed effects⁸ are denoted by γ_{tj} and ν_{wj} . The survey is organised so that all respondents are interviewed at every year of age. Thus, wave effects and age are almost perfectly correlated, and we do not control for age.

Parameter μ_{iaj} is the individual-LA fixed effect that controls for any individual-LA-specific time-invariant factors. It is not sufficient to include individual FE, because some UKHLS respondents move across local authorities. There is a concern that LA expenditure on DI may be correlated with individual-LA-specific factors μ_{iaj} . Individuals who live in LAs that spend more on DI could be more likely to be employed or self-employed for other reasons. For example, they may be more educated or more entrepreneurial. For this reason, we estimate conditional (FE) MNL⁹ model, which allows local DI expenditure and other variables to be correlated with μ_{iaj} . The coefficients in this model are identified only from individuals who change their employment status in the analysis period. Additionally, since we estimate individual-LA FE model, the impact of local government expenditures on employment is

⁷ Non-employed individuals include the unemployed and those not in the labour force.

⁸ Year and wave fixed effects are not perfectly correlated, because each UKHLS wave spans three years.

⁹ We use *xtnlogit* command in Stata 19MP.

identified only from the variation in expenditures in each LA, not from people moving to different local authorities. This addresses the concern that individuals may move to the local authorities with greater increases in DI expenditure.

It is not possible to estimate marginal effects based on the conditional MNL. Therefore, we present exponentiated coefficients that are interpreted as the relative risk ratios (RRR). A relative risk is calculated as the probability of outcome j divided by the probability of base outcome (in our case non-employed). We evaluate this relative risk at $x + 1$ and at x and take the ratio:

$$rrr_j = \frac{Prob(es = j|x + 1)/Prob(es = 1|x + 1)}{Prob(es = j|x)/Prob(es = 1|x)} \quad (2)$$

Thus, the RRR shows how the relative probability of outcome j is affected as an independent variable increase by one unit. If this effect is positive, RRR is greater than one, and if it is negative, RRR is less than one.

Table 2 presents the estimates of a FE MNL model. The results suggest that an increase in local government's DI positively affects relative risks of both employment and self-employment. In the full sample, all RRRs are greater than one and statistically significant except for the lagged DI expenditure and self-employment. In women's subsample, self-employment is found to be statistically significantly affected by contemporaneous DI expenditure. None of the exponentiated coefficients are statistically significant in men's subsample but positive effects cannot be ruled out due to wide confidence intervals.

As an alternative to FE MNL model, we also estimate MNL model with Mundlak correction, which involves including individual-LA-specific means of the time-varying variables in the model. The advantage of this model is that it is possible to estimate marginal effects, but it relies on a stronger assumption that individual-LA-specific means of the time-varying variables fully control for individual-LA-specific heterogeneity. The results, presented in Panel A of Appendix Table A2, are qualitatively similar to FE MNL results but smaller in magnitude. We find statistically significant effects of local DI expenditure on relative risks of employment and self-employment for both women and men. Average marginal effects presented in panel B show that in the full sample the probability of being an employee increases by 0.8 percentage points one year after an increase in local DI expenditure by £10 per capita. The probability of self-employment increases by 0.5 percentage points but in the same year only. Relative to the

mean, the increase in self-employment (5.5%) is much greater than the increase in paid employment (1.2%). The probability of non-employment decreases for both men and women, although the marginal effects on employment and self-employment cannot be precisely separately identified for men.

Overall, MNL estimates suggest that both working as an employee and self-employment is positively affected and that there may be some gender differences in these effects. In the main analysis, we combine paid employment and self-employment into a single employment outcome (and later analyse self-employment separately). We estimate the following linear probability model (LPM):

$$employed_{iat} = \beta_0 DI_{at} + \beta_1 DI_{at-1} + X'_{iat} \delta + \mu_{ia} + \gamma_t + \nu_w + u_{iat} \quad (3)$$

The coefficients of interest are β_0 and β_1 , which show the effect of a £10 per capita increase in DI expenditure on the probability of being employed *as opposed to* being non-employed in the current and the following financial year, respectively. Control variables X_{iat} include the number of adults in the household, the numbers of children aged 0-2, 3-4, 5-11, and 12-15 in the household, an indicator for *not* having *own* children in the household, and the interactions of the latter variable with the numbers of children of different ages. Thus, the coefficients on the numbers of children of different ages are interpreted as the effects of having *own* children of different ages in the household.

Parameter μ_{ia} is the individual-LA fixed effect that controls for any individual-LA-specific time-invariant factors, and year and wave fixed effects are denoted by γ_t and ν_w . As in FE MNL, the impact of local expenditures on employment is identified only from the variation in expenditures in each LA, not from people moving to different LAs. The right panel of Figure 1 shows that sufficient variation in DI expenditure remains after controlling for all the variables, which enables us to identify parameters of interest β_0 and β_1 .

Parameter u_{iat} is the error term that is assumed to be independent of local government expenditure and control variables (exogeneity assumption). The latter assumption could be violated if LA decisions on DI investments are affected by employment in the LA (reverse causality). There could also be unobserved time-varying variables correlated with both employment and local DI expenditure. We address these threats to the exogeneity assumption in several ways. First, we include other expenditure categories (both in the same year and in the previous year), because an increase in DI expenditure could be correlated with increases in

other types of expenditure. Holding these expenditures fixed, the concern about other factors driving an increase in both DI expenditure and employment is somewhat mitigated. Second, we include LA-specific time trends as a sensitivity check. Third, potential reverse causality is less of a concern for the lagged expenditure, because we would not expect the expenditure in the last year to be affected by employment in the current year (except for via serial correlation in unemployment). To further check whether reverse causality could be an issue, we also estimate a model with leads of expenditure included. The coefficients on the leads are expected to be statistically insignificant, if DI expenditure is not determined by the rate of employment in the LA.

We estimate all regressions separately by gender to check whether women and men are affected by local DI expenditure differently. As mentioned above, we expect potentially larger effects on women's employment due to the greater constraints they face and flexible work opportunities DI offers. To test whether these differences are statistically significant, we estimate a specification, in which the expenditures (and other control variables) are interacted with an indicator for being male.

We also explore heterogeneity along other dimensions (age, presence of children, partner, and long-term health conditions, time, and LA type), as detailed in Subsection 6.1. To evaluate whether any employment effects we find spill-over to income and wellbeing, we estimate the effects on these outcomes. Since faster local internet enabled by better DI can help individuals to not only move from non-employment to employment but also transition to better jobs, we check whether local DI expenditure affects job quality and job-related wellbeing. Finally, we explore potential mechanisms: working from home, working for 'gig' economy, and increased demand for IT specialists.

6 Results

The baseline estimates of the impact of local government DI expenditure on men's and women's employment are presented in Table 3. For comparison, Panel A presents the estimates of the regressions that do not control for other LA expenditures, and Panel B presents the estimates of the regressions with the controls for these expenditures. It is evident that the addition of other expenditure categories has little effect on the estimated effect of DI expenditure. Panel B shows that a £10 per capita increase in annual DI expenditure increases the employment rate by 0.9 percentage points in the current year and by 1 percentage point in the following year. These increases are equivalent to 1.2-1.3% of the employment rate in the

sample¹⁰. LPM estimates are qualitatively consistent with MNL estimates presented in Tables 2 and A2. Both women's and men's employment rates are positively affected, although the contemporaneous effect is statistically insignificant for women. Gender differences in the point estimates are small and statistically insignificant, as shown in Column (4). Thus, local DI expenditure has the potential to stimulate women's employment but is unlikely to close gender gap in employment.

In Table 4, we provide estimated effects of other expenditure categories. We can observe that changes in most other expenditure categories do not have any significant impact on employment rates of men or women. However, there are some notable exceptions. An increase in social care expenditure by £100 per capita is found to increase employment rate by 0.9 percentage points (calculated as $10 \times 0.0009 \times 100$). Furthermore, this effect is only statistically significant for women. Improved social care provision by local authorities may free up more time for individuals who previously had to care for their dependants including children and elderly relatives. In contrast, increases in expenditures on environmental/regulatory services (which include waste collection and regulation of different areas) and central services (which include local court services and expenses related to council tax collection) are found to decrease employment rate. Transport expenditure also has a small negative contemporaneous coefficient and a small positive lagged one, which offset each other. More research needs to be done to understand what is driving these negative effects as these categories include many different services, but it is outside the scope of our paper.

As local governments often have rather fixed budgets and need to make decisions how to spend their funds most effectively, we explore the trade-off between increasing expenditure on DI and decreasing expenditure on other areas of responsibility (in Appendix Table A3). Consistent with Table 4, we find that shifting spending from other areas to DI is beneficial for employment. Both women and men would benefit from such redistribution of local funds.

Motivated by the discussion of the potential of DI to stimulate women's entrepreneurship, we have separately estimated the impact of local DI expenditure on self-employment (versus working as an employee or being non-employed). Appendix Table A4 shows that in the year that local DI expenditure increases by £10 per capita, self-employment rate increases by 0.6

¹⁰ Since prior studies identify the effects of broadband availability or speed rather than of a marginal pound of local expenditure, our estimates are not directly comparable with them, but an increase of one within-authority standard deviation in DI spending (roughly 3.4 pounds per capita) raises employment by about 0.3 percentage points, which is within the range of the effects of gaining broadband access reported by Zuo (2021).

percentage points. This increase is equivalent to 6.6% of the mean, which is substantially greater than the relative increase in overall employment rate (1.2%), but it does not carry over into the following year. There is no clear gendered pattern in the results. Although the contemporaneous effect of local DI investment is only statistically significant for women, the lagged effect is statistically significantly greater for men. As to the other expenditures, of particular interest is planning and development expenditure, which is intended to create favourable conditions for local businesses. The impact of this expenditure is neither economically nor statistically significant in the full sample, but for men there is a small (0.07 percentage point increase) a year after planning and development expenditure increases by £10 per capita. We have further explored whether any of the subcategories of this expenditure, in particular business support, may have significant effects on employment but found no evidence of it¹¹.

In Table 5, we present several sensitivity checks. First, we deal with the threats to the exogeneity assumption. In Panel A, we add LA-specific linear time-trends, which control for any unobservable factors that may evolve differently across LAs (in linear fashion), and find that the results remain robust. In Panel B, we add the leads of expenditure as a test for reverse causality using the observations from the 2019-23 period. As expected, we find no statistically significant effects of local government expenditure on DI in period $t + 1$ on employment in period t .

Next, we check robustness of our baseline results to using alternative identifying variation in DI expenditure. In Panel C, we restrict the sample to those local authorities for which there is variation in annual DI expenditure (37,539 observations). Some local authorities record no DI expenditure during the sample period and therefore do not contribute to identifying its effect on employment in the FE model. Excluding such local authorities, we continue to find that a rise in DI expenditure increases employment rate (by 0.9 and 1.0 percentage points in the current and following year, respectively). Gender-specific effects are more precisely identified and similar to the effects in the full sample.

In Panel D, we estimate a specification in which quartiles of DI expenditure are added instead of continuous expenditure. Adding quartiles allows for a non-linear effect and attenuates the impact of outliers but reduces identifying variation in DI expenditure. This may explain why the coefficients on the quartiles of DI expenditure in the current period are not statistically

¹¹ These results are not included in the paper but available upon request.

significant. We continue to find statistically significant effects of the lagged DI expenditure for men but not for women. Men's probability of being employed in the full sample increases by 1.9 and 1.7 percentage points, when lagged local DI expenditure shifts from the first quartile to the third and fourth quartiles, respectively. However, the differences in the effects of local DI expenditure by gender remain statistically insignificant.

Panel E presents coefficient estimates based on a specification in which individual and LA fixed-effects are added separately (instead of individual-LA fixed-effects as in the baseline). In this specification, some of the impact of DI expenditure can be driven by an increase in DI expenditure in a LA attracting individuals from other LAs. Although there are slight changes in the results for women and men, the results in the full sample remain unaffected.

In remaining panels, we present a few other checks. In Panel F, we adjust expenditures by LA population in 2019 instead of the contemporaneous population. On the one hand, the advantage of this definition of expenditure is that the variation is not driven by population growth. On the other hand, the expenditure of a LA is expected to grow as its population grows, so adjusting expenditure by base period population overestimates (underestimates) the growth in expenditure in the areas with population growth (decline). Nonetheless, the results based on this measure of expenditure are consistent with the baseline.

Finally in Panel G, we add education as a control variable. We do not control for education in the baseline specification, because it may be affected by LA expenditures, especially the expenditure on education. But there is a possibility that investment in DI in a LA may be affected by the level of education of its residents. Since the results practically do not change when education is added, there is little support for the latter conjecture.

Overall, the results remain largely robust, especially for the lagged effect of local DI expenditure. In most specifications, we continue to find that employment rate increases by approximately 1 percentage point as local DI expenditure increases by £10 and this increase persists in the following year. Although there are some differences in point estimates between men and women, these gender differences are not statistically significant in either specification.

6.1 Heterogeneity analysis

We now turn to considering heterogeneity in the effect sizes by various characteristics that may moderate the impact of local DI investment on employment¹². First, in Panel A of Table 6 we split the sample into two age brackets based on the median age in the sample: aged under 47 years or aged 47 years and older. It is important to check whether there is heterogeneity by age, as older individuals are more likely to be in our analysis sample, as discussed in Subsection 4.3. The impact of DI can vary by age for several reasons, and the overall effect of age is ambiguous. Younger individuals may be more able to make use of opportunities offered by high-speed internet. Younger individuals, especially women, are also more likely to have childcare responsibilities, which both hinder employment and make flexible work attractive. As to self-employment, starting a business usually requires experience and capital, which increase with age. These opposing mechanisms may explain why we find no statistically significant differences by age.¹³

To explore the role of children further, we consider heterogeneity in the effect sizes by presence of own children (0-15 years old) in a household (in Panel B of Table 6) but find no statistically significant differences for either women or men. It may be that not only the presence of children matters to how much fast internet benefits employment but also the age of children. However, when the sample is split by the age of children in the household, the numbers in each subsample are too small to enable identification.

Presence of a partner at home may also moderate the impact of fast internet on employment. Single individuals have less choice about whether to work, because there is no other income that they can rely on. Therefore, partnered individuals may be more responsive to the opportunities that fast internet opens. However, the results presented in Panel C of Table 6 do not support this conjecture.

We next explore heterogeneity by long-term illness status¹⁴. Flexible work options enabled by fast internet may be more relevant to persons with long-term illnesses, which may prevent them

¹² In all regressions, we interact not only DI expenditure but also all other variables with the respective moderator.

¹³ For related reasons, we also explore heterogeneity by education level (results not reported, but available upon request). The effects of local DI expenditure do not vary statistically significantly between individuals with a higher degree and individuals with lower qualifications.

¹⁴ Long-term illness status is based on the following question: "Do you have any long-standing physical or mental impairment, illness or disability? By 'long-standing' I mean anything that has troubled you over a period of at least 12 months or that is likely to trouble you over a period of at least 12 months."

from working in traditional office-based jobs (Burn et al., 2026). We find evidence for this hypothesis in Panel D of Table 6 but for women only. The rise in employment probability in the year following an increase in local DI expenditure by £10 is substantially (by 1.9 percentage points) larger for women with long-term illnesses¹⁵.

To explore whether the impact of local DI expenditure varies over time, we interact local expenditure variable with an indicator for 2022-24 period. As 2020-21 includes the COVID-19 pandemic, this specification also allows us to evaluate whether faster internet played a larger role during the pandemic when options to work outside home were limited. Panel E of Table 6 suggests that this may be a case, as estimated effects are larger in 2020-21. Any pandemic-period effect should be read against the sharply gendered shock to self-employment over the same window: Graeber, Kritikos, and Seebauer (2021) document that female self-employed workers were considerably more likely than male self-employed workers to lose income during the first wave. We have also checked that our baseline results are not completely driven by the COVID-19 pandemic: excluding the data from 2020, we continue to find statistically significant effects of local DI investments on employment rate.

Finally, we investigate whether the effects of DI expenditure on employment vary across different types of LAs: unitary authorities, shire districts, metropolitan districts, and London boroughs. Investment in DI may have more impact in areas with worse internet connection, and the quality of internet connection may vary across LAs. For example, we would expect residents living in London boroughs or other metropolitan districts to have better internet access than residents living in shire districts or unitary authorities that are more rural. European evidence documents a persistent urban-rural divide both in broadband access and in the strength of its association with economic growth (De Clercq, D’Haese, and Buysse, 2023). In Appendix Table A5, we interact local DI expenditure with the type of LA with London boroughs being the base category. We find statistically significant effects of local DI expenditure in London boroughs, which are comparable to the estimates based on the full sample. Men living in London may especially benefit from local DI investments, but we cannot reject the equality of coefficients between women and men. Although the point estimates suggest that the effects are larger in

¹⁵ The results presented in Table 6 are based on the current status of long-term illness. We have also used an indicator variable for reporting a long-term illness in the last available wave before the analysis period to address any endogeneity issues. The results based on this alternative definition are very similar but less precisely estimated.

shire districts, the effects are smaller in unitary authorities, and none of the differences between LA types are statistically significant¹⁶.

6.2 Other outcomes

In this subsection we explore the effect of local DI expenditure of other outcomes of interest¹⁷. First, we look at two alternative definitions of employment. All UKHLS respondents are asked whether they did any paid work last week and if they have paid job (if they did not do any paid work last week). We create a variable that takes the value 1, if a respondent did any paid work last week or did not do any paid work last week but had a paid job, and the value 0 otherwise. This includes both working as an employee and self-employment. It should be noted that this variable is not perfectly correlated with our main employment variable, as it is expected based on the definitions of both variables. Among those who based on their main economic activity are non-employed, 15% report that they have paid job, and among those who are employed, 6% do not report that they have paid job. Additionally, respondents are asked how many hours they normally work per week (with those not in paid employment set at zero). Table 7 suggests that both the probability of having a paid job and work hours are positively affected in the same year as local DI expenditure increases. Gendered effects also follow similar pattern to the baseline with women more affected in the same year and men in the following year. Given the large standard errors, the estimates are too imprecise to support firm conclusions. People may not be more likely to be paid or work any more hours than before as local DI investment increases, even if they are more likely to report that their main activity is employment or self-employment. But we also may need more data and/or variation in DI expenditure to identify these effects.

Second, we explore how an increase in local DI expenditure affects other outcomes that are related to employment: income and wellbeing. Given the results on paid work and work hours above, we may not necessarily observe an increase in income when local DI expenditure increases. Wellbeing may be positively affected, because employment usually gives people purpose, but it may also place additional pressure on people, especially if their other responsibilities cannot be easily adjusted. We analyse individual monthly gross (before-tax)

¹⁶ We also do not find evidence that residents of more deprived areas would benefit more from local DI expenditure.

¹⁷ Since we are testing multiple hypotheses, we need to be conservative when interpreting statistical significance of the coefficients. Thus, we only present these results to complement and understand our main findings with this caveat in mind.

income and the following wellbeing variables: SF-12 Physical Component Summary (as a measure of physical health), SF-12 Mental Component Summary (as a measure of mental health), and overall life satisfaction. Additionally, we study satisfaction with leisure. Wellbeing variables are standardised, because they do not have meaningful measurement units. Table 8 shows no statistically significant increase in income as local DI expenditure increases in the full sample, but women's income increases by £43 per month¹⁸. There is some evidence of positive effects on physical and mental health. Men's satisfaction with overall life and leisure increases more so than women's satisfaction. Women, in fact, experience a decrease in satisfaction with leisure, which suggests that an increase in employment activities comes at the cost of their leisure.

So far, we have analysed the impact of local DI investments on the transition from non-employment to employment. However, faster internet may enable those who are already employed to move to better, more flexible jobs. To investigate this possibility, we estimate the effects of local DI expenditure on job flexibility, autonomy, satisfaction, job-related mental health, and job insecurity and present them in Table 9. Job flexibility is a count of flexible work arrangements that varies from 0 to 8. Autonomy is based on five questions about agency at work. Job-related mental health is defined using six questions on anxious and depressive feelings experienced at work. Insecure jobs are defined as zero-hour contracts or on-call working. Autonomy, satisfaction, and mental health indices are standardized. Some of these variables are available in every second wave and some are asked to employees only, as indicated in the notes to Table 9. We find no evidence that an increase in local DI expenditure increases job flexibility, autonomy, or satisfaction. There is, in fact, a small decrease in job flexibility. There are some gender differences in the impact on job-related mental health and insecurity. Men's job-related mental health increases less than women's mental health in the year that local DI investments increase. Panel E suggests that a larger increase in the probability of insecure employment among men may contribute to the latter finding.

6.3 Exploration of potential mechanisms

We conclude by exploring potential mechanisms via which local expenditure on DI may affect employment. As discussed in the introduction, better internet connectivity may enable people to work from home or start a home-based business. To explore this mechanism, we use the

¹⁸ Additional analyses show that for women increase in total income is driven by labour income. There are no statistically significant changes in household income or satisfaction with income.

information on the location of work available in the UKHLS data for both employed and self-employed individuals. We create a variable with three categories: (1) employed or self-employed mainly outside home, (2) employed or self-employed mainly at home, and (3) non-employed. We then estimate the impact of local DI expenditure on this variable using FE MNL model. Results presented in Panel A of Table 10 suggest that fast internet may indeed enable previously non-employed people to start working from home. There are no statistically significant effects on employment outside home, but the relative risk of employment at home is greater when local DI expenditure increases by £10 per capita (relative risk ratio is 1.152, only statistically significant in the current period).

Better internet connectivity may also enable individuals to start internet-based businesses or work for a company that provides internet-based services. Starting Wave 13, UKHLS respondents are asked whether their job is part of the 'gig economy', that is, whether "they use websites or digital platforms to get work for their job"¹⁹. We use this information to estimate the impact of local DI expenditure on employment in gig economy and employment in other sectors versus non-employment in FE MNL model. Panel B of Table 10 shows that as local DI expenditure increases the relative risk of working in gig economy versus being non-employed increases a year after (relative risk ratio is 1.321), unlike the relative risk of working in other sectors. Furthermore, this effect is observed for both women and men.

Finally, as the local government invests in DI, the demand for IT specialists may increase. In this case, we would expect the employment rates to especially increase among those with IT experience. Therefore, we estimate the regressions separately by whether an individual worked in an IT occupation or industry at any point before 2019. The results presented in Table 11 provide limited support for this hypothesis. In the full sample, the impact of local government DI expenditure is either smaller or similar for people with IT experience as for those without it. For women, IT experience reduces the effect of local DI investment on employment probability in the current year but increases this impact a year after. Since the proportion of individuals with IT experience is very small (6.7%), these results merit investigating further.

¹⁹ The wording of the question changed slightly one year into Wave 13, when a clarification was added. We use both versions of the question to maximise the number of observations, but results are qualitatively similar though weaker when only the new wording is used.

7 Discussion and conclusion

In this paper, we link the UK Household Longitudinal Study to English LA expenditure records over 2019–2024 and use within-LA variation in spending to identify the impact of local government investment in DI on women’s and men’s employment. Our baseline results show that local government investment in DI raises employment rate. A £10 per capita increase in annual DI expenditure lifts the probability of employment by about 0.9 percentage points in the same financial year and by about 1 percentage point in the following year—roughly 1.2–1.3% of the sample employment rate. The effect is robust to controlling for all other expenditure categories, including LA-specific time trends, restricting to LAs with genuine DI variation, re-basing the population denominator, separating the individual and LA FEs, and adding education. We also show that DI expenditure in the next financial year does not affect current employment rate, supporting our assumption of no reverse causality. The estimates are less precisely identified when we restrict the variation in DI expenditure by categorising it into quartiles. We contribute to the literature by showing that a local government’s own investment decision, rather than privately driven or nationally directed broadband rollout, raises local employment, and by estimating the effect of shifting funds towards DI from other areas of local spending. The closest prior study, Hegde and Van Parys (2024), asks a related question with a different treatment (US state restrictions on municipal provision), a different period (the COVID-19 pandemic), and a different source of variation (cross-state regulation rather than within-authority spending over time).

Four findings merit emphasis. First, the response operates on both margins of employment but appears to be proportionally larger in self-employment. A £10 per capita increase in DI expenditure raises the self-employment rate by about 0.6 percentage points (6.6% of its mean) in the same financial year²⁰. This is consistent with DI attenuating the market-access, flexibility, and mobility barriers in many jobs. However, we find little evidence of persistence in the impact of local DI investment on self-employment, as opposed to overall employment.

Second, gender differences in absolute effects are small and statistically insignificant. Local DI expenditure therefore has real potential to stimulate women's employment but, on this

²⁰ These results are based on FE LPM with self-employment as an outcome variable (presented in Table 5), but they are consistent with the estimates of MNL model with Mundlak correction presented in Appendix Table A2. In the latter model, overall self-employment rate is found to increase by 0.5 percentage points in the same year (5.5% of the mean).

evidence, is unlikely to close the gender gap. Third, we find no evidence of heterogeneity along other demographic characteristics, including age, child or partner presence. The clearest significant differential is by health: women with a long-term illness gain an additional 1.9 percentage points in employment rate following an increase in DI expenditure—exactly the pattern expected if DI's value lies in enabling work that does not require a fixed, commuting schedule.

Fourth, the mechanism evidence points to changes in *where and how* people work: local DI investments raise the relative risk of being employed *at home* and of gig-economy participation a year later, with only limited support for an IT-specialist demand channel. Finally, these gains do not translate into a broad improvement in income or wellbeing. Income rises significantly only for women (about £43 per month, from labour income); hours and alternative employment measures move in the expected direction but imprecisely. There is some evidence of better physical and mental health, but not overall life satisfaction and lower leisure satisfaction among women. Local DI investments appear to move people into work, but the time cost of that transition may fall disproportionately on women. Local DI investments also do not appear to move people to better jobs: those already employed do not gain in flexibility, autonomy, or satisfaction at work. This also bears on how the self-employment response should be read, since a higher rate of self-employment is not in itself evidence of better outcomes (Yerrabati, 2022). Given the number of secondary outcomes examined, these results should be read conservatively.

For local policymakers operating under fixed budgets, three implications follow. First, DI spending is currently very small—around £3 per capita, with many authorities investing nothing—so the marginal employment returns we estimate are large relative to the outlay, and the substitution analysis shows that shifting funds from almost any other category toward DI is associated with higher employment for both women and men. Second, because the effect works largely by enabling home-based and platform-mediated work, DI is best understood as a lever for *labour-market inclusion* rather than as a general jobs programme; complementary policies (skills support, affordable connectivity for lower-income households) are likely needed for the gains to reach those groups. Third, the muted income and job-quality results counsel realism: expanding *access* to work is not the same as improving jobs, and monitoring job security and earnings quality should accompany any DI-led employment push.

Several caveats bound these conclusions: the expenditure series is short and, for many authorities there is no variation in DI expenditure, which limits precision; effects are somewhat larger during the 2020–2021 pandemic, raising the question of post-pandemic persistence; and the secondary outcomes warrant conservative interpretation given multiple testing. Finally, longer expenditure panels and administrative or firm-level data would allow the business-formation and earnings channels to be traced more directly.

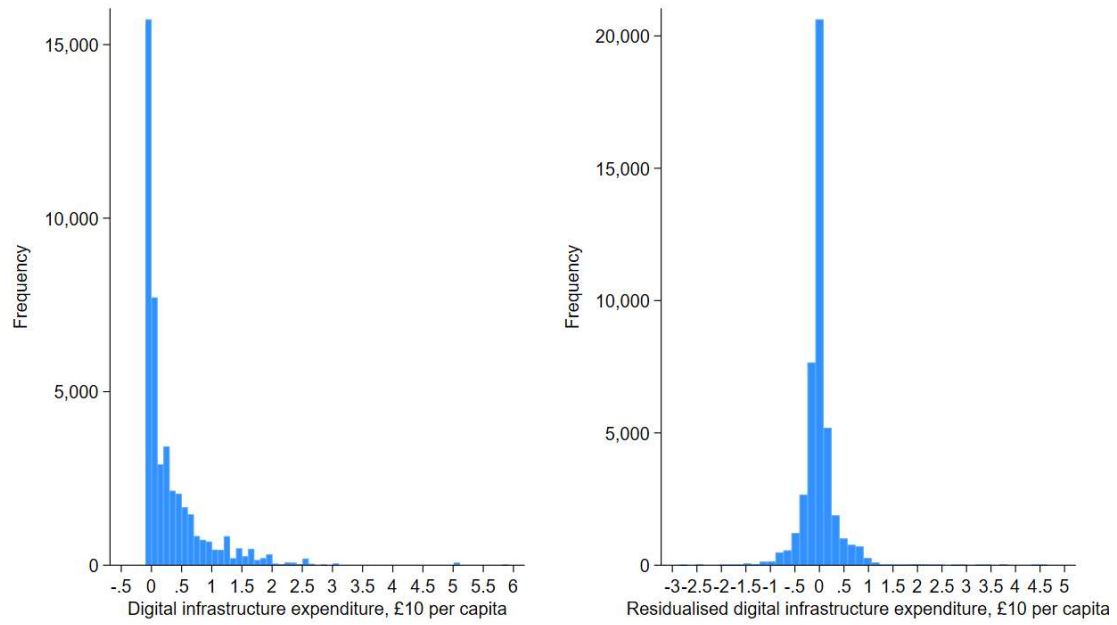
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[47]. Figure 1. Distribution of digital infrastructure expenditure



Notes: The graph on the left presents the histogram of the actual LA expenditure on digital infrastructure. The graph on the right presents the histogram of the residuals from a regression of DI expenditure on the control variables, year, wave, and individual-LA effects, estimated by FE LPM.

Table 1. Summary statistics

	All (1)	Women (2)	Men (3)
Self-employed	0.091	0.062	0.130
Employed	0.655	0.644	0.669
Unemployed	0.054	0.057	0.050
Not in labour force	0.201	0.237	0.152
Age	44.726 (12.840)	44.366 (12.843)	45.205 (12.820)
Number of adults in household	2.571 (1.185)	2.545 (1.181)	2.606 (1.190)
Own children in household	0.329	0.332	0.325
Children aged 0-2 in household	0.076	0.077	0.074
Children aged 3-4 in household	0.062	0.061	0.064
Children aged 5-11 in household	0.208	0.210	0.206
Children aged 12-15 in household	0.172	0.177	0.166
Unitary authority	0.270	0.273	0.266
Shire district	0.334	0.334	0.332
Metropolitan district	0.237	0.234	0.241
London borough	0.159	0.159	0.160
Digital infrastructure expenditure	0.325 (0.534)	0.326 (0.536)	0.323 (0.531)
Education expenditure	69.009 (21.306)	69.078 (21.368)	68.917 (21.223)
Social care expenditure	58.546 (10.185)	58.543 (10.221)	58.551 (10.136)
Transport expenditure	25.833 (18.520)	25.823 (18.558)	25.846 (18.468)
Housing expenditure	18.762 (24.516)	18.659 (24.084)	18.899 (25.079)
Environment/regulation expenditure	11.155 (3.619)	11.140 (3.587)	11.175 (3.660)
Central services expenditure	9.839 (6.791)	9.840 (6.727)	9.838 (6.876)
Planning/development expenditure	7.832 (7.142)	7.819 (7.158)	7.850 (7.121)
Public health expenditure	7.094 (2.664)	7.090 (2.662)	7.099 (2.666)
Culture expenditure	6.684 (3.570)	6.686 (3.573)	6.680 (3.567)
Other expenditure	3.132 (8.519)	3.128 (8.496)	3.137 (8.549)
Total expenditure	218.211 (61.534)	218.132 (61.403)	218.315 (61.710)
Observations	43,736	24,981	18,755

Notes: Presented figures are means with standard deviations in parentheses. Local authority expenditures are measured in £10 per capita.

Table 2. Impact of local DI expenditure on employment status, FE MNL estimates

	All		Women		Men	
	(1)		(2)		(3)	
<i>Employee</i>						
DI expenditure t	1.137**	(0.071)	1.054	(0.083)	1.165	(0.133)
DI expenditure $t-1$	1.244**	(0.111)	1.117	(0.103)	1.242	(0.186)
<i>Self-employed</i>						
DI expenditure t	1.524***	(0.167)	1.498**	(0.302)	1.090	(0.159)
DI expenditure $t-1$	1.060	(0.133)	0.798	(0.183)	1.328	(0.323)
Observations	9,948		6,168		3,780	

Notes: Presented figures are exponentiated FE MNL coefficients, interpreted as relative risk ratios (where relative risk is measured as the probability of the outcome j relative to the probability of base outcome, which is evaluated at $x + 1$ and x before taking the ratio) and their standard errors clustered at the local authority (LA) level (in the parentheses). Digital infrastructure (DI) is measured in £10 per capita. Regressions control for the numbers of adults and own children in the households, wave, year, and individual-LA effects. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3. Effect of local DI expenditure on employment, FE LPM estimates

	All	Women	Men	All
	(1)	(2)	(3)	(4)
<i>A. No controls for other expenditures</i>				
DI expenditure t	0.009** (0.004)	0.008 (0.006)	0.009** (0.005)	0.008 (0.006)
DI expenditure $t-1$	0.009** (0.004)	0.010* (0.005)	0.009 (0.006)	0.010* (0.005)
Male x DI expenditure t				0.001 (0.008)
Male x DI expenditure $t-1$				-0.000 (0.008)
<i>B. Controls for other expenditures added</i>				
DI expenditure t	0.009*** (0.003)	0.008 (0.005)	0.009** (0.004)	0.008 (0.005)
DI expenditure $t-1$	0.010*** (0.003)	0.010** (0.005)	0.010* (0.006)	0.010** (0.005)
Male x DI expenditure t				0.001 (0.007)
Male x DI expenditure $t-1$				-0.001 (0.009)
Observations	43,736	24,981	18,755	43,736

Notes: In this model, employment refers to either paid employment or self-employment (opposed to non-employment). Digital infrastructure (DI) expenditure is measured in £10 per capita. Standard errors (presented in parentheses) are clustered at the local authority (LA) level. All regressions control for the number of adults in the household, the numbers of children aged 0-2, 3-4, 5-11, and 12-15 in the household, an indicator for *not* having own children in the household, the interactions of the numbers of children of different ages with the indicator for *not* having own children in the household, wave, year, and individual-LA effects. In column (4) all control variables are interacted with male dummy. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4. Impact of all expenditure categories on employment, FE LPM estimates

	All (1)	All (2)	
Digital infrastructure <i>t</i>	0.0088***	(0.0032)	0.0082 (0.0051)
Digital infrastructure <i>t-l</i>	0.0098***	(0.0032)	0.0103** (0.0050)
Planning/development <i>t</i>	-0.0002	(0.0003)	0.0000 (0.0004)
Planning/development <i>t-l</i>	-0.0002	(0.0004)	-0.0007 (0.0005)
Education <i>t</i>	-0.0001	(0.0004)	-0.0002 (0.0006)
Education <i>t-l</i>	-0.0010	(0.0006)	-0.0013 (0.0008)
Transport <i>t</i>	-0.0006**	(0.0003)	-0.0007* (0.0004)
Transport <i>t-l</i>	0.0004*	(0.0002)	0.0005* (0.0003)
Social care <i>t</i>	0.0009**	(0.0004)	0.0012** (0.0005)
Social care <i>t-l</i>	0.0006	(0.0006)	0.0012 (0.0008)
Public health <i>t</i>	-0.0011	(0.0019)	-0.0010 (0.0025)
Public health <i>t-l</i>	-0.0014	(0.0017)	-0.0025 (0.0023)
Housing <i>t</i>	0.0002	(0.0002)	0.0004 (0.0003)
Housing <i>t-l</i>	0.0003*	(0.0001)	0.0001 (0.0002)
Culture <i>t</i>	0.0001	(0.0005)	0.0001 (0.0009)
Culture <i>t-l</i>	0.0002	(0.0007)	0.0002 (0.0011)
Environment/regulation <i>t</i>	-0.0015**	(0.0006)	-0.0010 (0.0009)
Environment/regulation <i>t-l</i>	0.0004	(0.0007)	-0.0005 (0.0012)
Central services <i>t</i>	-0.0011***	(0.0003)	-0.0015*** (0.0004)
Central services <i>t-l</i>	-0.0002	(0.0003)	-0.0005 (0.0004)
Other <i>t</i>	-0.0002	(0.0003)	0.0001 (0.0004)
Other <i>t-l</i>	0.0003	(0.0002)	0.0002 (0.0002)
Male x Digital infrastructure <i>t</i>			0.0011 (0.0072)
Male x Digital infrastructure <i>t-l</i>			-0.0008 (0.0086)
Male x Planning/development <i>t</i>			-0.0006 (0.0007)
Male x Planning/development <i>t-l</i>			0.0011* (0.0007)
Male x Education <i>t</i>			0.0004 (0.0009)
Male x Education <i>t-l</i>			0.0007 (0.0009)
Male x Transport <i>t</i>			0.0001 (0.0004)
Male x Transport <i>t-l</i>			-0.0003 (0.0005)
Male x Social care <i>t</i>			-0.0008 (0.0008)
Male x Social care <i>t-l</i>			-0.0012 (0.0012)
Male x Public health <i>t</i>			-0.0003 (0.0032)
Male x Public health <i>t-l</i>			0.0025 (0.0033)
Male x Housing <i>t</i>			-0.0004 (0.0003)
Male x Housing <i>t-l</i>			0.0003 (0.0002)
Male x Culture <i>t</i>			-0.0001 (0.0013)
Male x Culture <i>t-l</i>			0.0002 (0.0014)
Male x Environment/regulation <i>t</i>			-0.0013 (0.0014)
Male x Environment/regulation <i>t-l</i>			0.0022 (0.0019)
Male x Central services <i>t</i>			0.0007 (0.0005)
Male x Central services <i>t-l</i>			0.0006 (0.0005)
Male x Other <i>t</i>			-0.0006 (0.0006)
Male x Other <i>t-l</i>			0.0001 (0.0003)

Notes: Sample includes 43,736 observations. Local authority (LA) expenditures are measured in £10 per capita. Standard errors (presented in parentheses) are clustered at the LA level. All regressions control for the number of adults in the household, the numbers of children aged 0-2, 3-4, 5-11, and 12-15 in the household, an indicator for *not* having own children in the household, the interactions of the numbers of children of different ages with the indicator for *not* having own children in the household, wave, year, and individual-LA effects. In column (2) all control variables are interacted with male dummy.*** p<0.01, ** p<0.05, * p<0.1.

Table 5. Effect of local DI expenditure on employment: Sensitivity checks

	All		Women		Men	
	(1)		(2)		(3)	
<i>A. LA-specific trends added</i>						
DI expenditure t	0.009**	(0.004)	0.010*	(0.005)	0.007	(0.005)
DI expenditure $t-1$	0.011***	(0.003)	0.011**	(0.005)	0.011	(0.007)
Observations	43,736		24,981		18,755	
<i>B. Leads added</i>						
DI expenditure t	0.005*	(0.003)	0.007	(0.005)	0.003	(0.004)
DI expenditure $t+1$	-0.003	(0.005)	-0.003	(0.006)	-0.001	(0.006)
Observations	44,346		25,303		19,043	
<i>C. LAs with no DI expenditure in 2019-24 excluded</i>						
DI expenditure t	0.009***	(0.003)	0.009*	(0.005)	0.010**	(0.004)
DI expenditure $t-1$	0.010***	(0.003)	0.010**	(0.005)	0.010*	(0.006)
Observations	37,539		21,434		16,105	
<i>D. Quartiles of DI expenditure</i>						
DI expenditure t : 2nd quartile	0.000	(0.006)	0.004	(0.008)	-0.006	(0.008)
DI expenditure t : 3rd quartile	-0.004	(0.006)	-0.001	(0.008)	-0.007	(0.008)
DI expenditure t : 4th quartile	0.010	(0.007)	0.010	(0.009)	0.009	(0.010)
DI expenditure $t-1$: 2nd quartile	0.007	(0.006)	0.002	(0.010)	0.014	(0.009)
DI expenditure $t-1$: 3rd quartile	0.010	(0.006)	0.002	(0.009)	0.019**	(0.008)
DI expenditure $t-1$: 4th quartile	0.012**	(0.006)	0.008	(0.009)	0.017**	(0.008)
Observations	43,736		24,981		18,755	
<i>E. LA and individual FEs added separately</i>						
DI expenditure t	0.009***	(0.003)	0.008	(0.005)	0.009**	(0.004)
DI expenditure $t-1$	0.010***	(0.003)	0.010**	(0.005)	0.010*	(0.006)
Observations	43,736		24,981		18,755	
<i>F. Expenditures normalised by population in 2019</i>						
DI expenditure t	0.009***	(0.003)	0.008	(0.005)	0.009**	(0.004)
DI expenditure $t-1$	0.010***	(0.003)	0.011**	(0.005)	0.010*	(0.006)
Observations	43,024		24,572		18,452	
<i>G. Education added as control</i>						
DI expenditure t	0.008**	(0.003)	0.007	(0.005)	0.009**	(0.004)
DI expenditure $t-1$	0.010***	(0.003)	0.010*	(0.005)	0.010*	(0.006)
Observations	42,922		24,504		18,418	

Notes: Digital infrastructure (DI) expenditure is measured in £10 per capita. Standard errors (presented in the parentheses) are clustered at the local authority (LA) level. All regressions control for the number of adults in household, the numbers of children aged 0-2, 3-4, 5-11, and 12-15 in the household, an indicator for *not* having own children in the household, the interactions of the numbers of children of different ages with the indicator for *not* having own children in the household, wave and year effects. Regressions in panels A and C-G additionally control for other expenditure categories in financial years t and $t-1$. Regressions in panel B additionally control for other expenditure categories in financial years t and $t+1$. Regressions in panels A-D and F-G additionally control for individual-LA effects, and regressions in panel D for individual and LA effects. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6. Effect of local DI expenditure on employment: Heterogeneity analysis

	All		Women		Men	
	(1)		(2)		(3)	
<i>A. Age</i>						
DI expenditure t	0.008	(0.005)	0.005	(0.008)	0.011	(0.007)
DI expenditure $t-1$	0.009*	(0.005)	0.011	(0.007)	0.005	(0.009)
Age ≥ 47 x DI expenditure t	0.001	(0.007)	0.006	(0.012)	-0.004	(0.009)
Age ≥ 47 x DI expenditure $t-1$	0.002	(0.007)	-0.004	(0.010)	0.009	(0.009)
<i>B. Children</i>						
DI expenditure t	0.010***	(0.004)	0.010*	(0.005)	0.009	(0.006)
DI expenditure $t-1$	0.009**	(0.004)	0.009	(0.007)	0.010	(0.007)
Children x DI expenditure t	-0.005	(0.007)	-0.009	(0.011)	-0.001	(0.008)
Children x DI expenditure $t-1$	0.001	(0.005)	0.002	(0.009)	-0.002	(0.008)
<i>C. Partner</i>						
DI expenditure t	0.008	(0.008)	0.009	(0.010)	0.006	(0.011)
DI expenditure $t-1$	0.008	(0.007)	0.008	(0.011)	0.008	(0.010)
Partner x DI expenditure t	0.001	(0.010)	-0.002	(0.012)	0.005	(0.013)
Partner x DI expenditure $t-1$	0.003	(0.010)	0.004	(0.015)	0.002	(0.010)
<i>D. Long-term illness</i>						
DI expenditure t	0.010***	(0.004)	0.008	(0.006)	0.010*	(0.005)
DI expenditure $t-1$	0.007*	(0.004)	0.004	(0.005)	0.010	(0.007)
Long-term illness x DI expenditure t	-0.001	(0.007)	-0.002	(0.008)	0.002	(0.009)
Long-term illness x DI expenditure $t-1$	0.011	(0.008)	0.019**	(0.009)	0.001	(0.010)
<i>E. 2020-21 vs 2022-24</i>						
DI expenditure t	0.013***	(0.004)	0.011*	(0.006)	0.015***	(0.005)
DI expenditure $t-1$	0.014**	(0.005)	0.015*	(0.008)	0.012	(0.008)
2022-24 x DI expenditure t	-0.009*	(0.005)	-0.007	(0.008)	-0.012	(0.007)
2022-24 x DI expenditure $t-1$	-0.003	(0.006)	-0.006	(0.010)	-0.000	(0.009)

Notes: Sample size is 43,736. DI (digital infrastructure) expenditure is measured in £10 per capita. Standard errors (presented in the parentheses) are clustered at the local authority (LA) level. All regressions control for other contemporaneous and lagged expenditures listed in Table 4, wave, year, and individual-LA effects. Regressions in panels A-B and D-E additionally control for the number of adults in the household. Regressions in panels A and C-E additionally control for the numbers of children aged 0-2, 3-4, 5-11, and 12-15 in the household, an indicator for *not* having own children in the household, the interactions of the numbers of children of different ages with the indicator for *not* having own children in the household. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7. Effect of local DI expenditures on paid work and work hours

	(1)		(2)	
<i>A. Has paid job</i>				
DI expenditure t	0.006	(0.004)	0.009	(0.006)
DI expenditure $t-1$	0.003	(0.004)	-0.001	(0.006)
Male x DI expenditure t			-0.008	(0.008)
Male x DI expenditure $t-1$			0.009	(0.010)
Observations	43,355		43,355	
<i>B. Work hours per week</i>				
DI expenditure t	0.153	(0.140)	0.240	(0.178)
DI expenditure $t-1$	0.013	(0.140)	-0.096	(0.215)
Male x DI expenditure t			-0.206	(0.305)
Male x DI expenditure $t-1$			0.270	(0.392)
Observations	42,591		42,591	

Notes: Digital infrastructure (DI) expenditures are measured in £10 per capita. Standard errors (presented in parentheses) are clustered at the local authority (LA) level. All regressions control for the other contemporaneous and lagged expenditures listed in Table 4, the number of adults in the household, the numbers of children aged 0-2, 3-4, 5-11, and 12-15 in the household, an indicator for *not* having own children in the household, the interactions of the numbers of children of different ages with the indicator for *not* having own children in the household, wave, year, and individual-LA effects. In column (2) all control variables are interacted with male dummy. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 8. Effect of local DI expenditures on income and wellbeing

	All		All	
	(1)		(2)	
<i>A. Individual income, £</i>				
DI expenditure <i>t</i>	10.74	(14.77)	43.01**	(18.52)
DI expenditure <i>t-1</i>	2.55	(21.54)	8.02	(22.42)
Male x DI expenditure <i>t</i>			-74.21**	(30.01)
Male x DI expenditure <i>t-1</i>			-11.89	(48.97)
Observations	43,732		43,732	
<i>B. Physical health</i>				
DI expenditure <i>t</i>	0.003	(0.008)	-0.006	(0.012)
DI expenditure <i>t-1</i>	0.021**	(0.009)	0.026**	(0.011)
Male x DI expenditure <i>t</i>			0.023	(0.015)
Male x DI expenditure <i>t-1</i>			-0.011	(0.018)
Observations	42,309		42,309	
<i>C. Mental health</i>				
DI expenditure <i>t</i>	0.014*	(0.008)	0.015	(0.013)
DI expenditure <i>t-1</i>	-0.007	(0.010)	-0.018	(0.013)
Male x DI expenditure <i>t</i>			-0.004	(0.019)
Male x DI expenditure <i>t-1</i>			0.025	(0.016)
Observations	42,309		42,309	
<i>D. Overall life satisfaction</i>				
DI expenditure <i>t</i>	0.007	(0.011)	0.001	(0.013)
DI expenditure <i>t-1</i>	0.009	(0.012)	-0.006	(0.012)
Male x DI expenditure <i>t</i>			0.014	(0.016)
Male x DI expenditure <i>t-1</i>			0.035**	(0.017)
Observations	42948		42948	
<i>E. Satisfaction with leisure</i>				
DI expenditure <i>t</i>	0.003	(0.011)	-0.010	(0.012)
DI expenditure <i>t-1</i>	-0.008	(0.010)	-0.030**	(0.012)
Male x DI expenditure <i>t</i>			0.028*	(0.017)
Male x DI expenditure <i>t-1</i>			0.048**	(0.024)
Observations	0.007	(0.011)	0.001	(0.013)

Notes: Digital infrastructure (DI) expenditures are measured in £10 per capita. Standard errors (presented in parentheses) are clustered at the local authority (LA) level. All regressions control for the other contemporaneous and lagged expenditures listed in Table 4, the number of adults in the household, the numbers of children aged 0-2, 3-4, 5-11, and 12-15 in the household, an indicator for *not* having own children in the household, the interactions of the numbers of children of different ages with the indicator for *not* having own children in the household, wave, year, and individual-LA effects. In column (2) all control variables are interacted with male dummy. *** p<0.01, ** p<0.05, * p<0.1.

Table 9. Effect of local DI expenditure on job quality

	All		All	
	(1)		(2)	
<i>A. Job flexibility</i> ^{a,b}				
DI expenditure <i>t</i>	-0.066*	(0.039)	-0.053	(0.045)
DI expenditure <i>t-1</i>	-0.053	(0.037)	-0.092	(0.060)
Male x DI expenditure <i>t</i>			-0.028	(0.076)
Male x DI expenditure <i>t-1</i>			0.057	(0.105)
Observations	7,492		7,492	
<i>B. Work autonomy</i> ^a				
DI expenditure <i>t</i>	0.014	(0.016)	0.012	(0.022)
DI expenditure <i>t-1</i>	-0.010	(0.022)	-0.018	(0.037)
Male x DI expenditure <i>t</i>			0.002	(0.028)
Male x DI expenditure <i>t-1</i>			0.023	(0.048)
Observations	8,882		8,882	
<i>C. Job satisfaction</i>				
DI expenditure <i>t</i>	-0.007	(0.014)	-0.008	(0.016)
DI expenditure <i>t-1</i>	-0.002	(0.010)	-0.001	(0.019)
Male x DI expenditure <i>t</i>			0.003	(0.025)
Male x DI expenditure <i>t-1</i>			-0.000	(0.029)
Observations	30,356		30,356	
<i>D. Job-related mental health</i> ^a				
DI expenditure <i>t</i>	0.008	(0.021)	0.035	(0.030)
DI expenditure <i>t-1</i>	0.001	(0.032)	-0.027	(0.048)
Male x DI expenditure <i>t</i>			-0.061*	(0.034)
Male x DI expenditure <i>t-1</i>			0.058	(0.059)
Observations	8,842		8,842	
<i>E. Insecure employment</i> ^{a,b}				
DI expenditure <i>t</i>	-0.003	(0.013)	-0.018	(0.015)
DI expenditure <i>t-1</i>	-0.004	(0.011)	-0.019	(0.017)
Male x DI expenditure <i>t</i>			0.032**	(0.014)
Male x DI expenditure <i>t-1</i>			0.031	(0.024)
Observations	7,492		7,492	

Notes: Digital infrastructure (DI) expenditure is measured in £10 per capita. Standard errors (presented in parentheses) are clustered at the local authority (LA) level. All regressions control for the other contemporaneous and lagged expenditures listed in Table 4, the number of adults in the household, the numbers of children aged 0-2, 3-4, 5-11, and 12-15 in the household, an indicator for *not* having own children in the household, the interactions of the numbers of children of different ages with the indicator for *not* having own children in the household, wave, year, and individual-LA effects. In column (2) all control variables are interacted with male dummy. ^a Asked in waves 12 and 14 only. ^b Asked to employees only. *** p<0.01, ** p<0.05, * p<0.1.

Table 10. Exploration of mechanisms

	All		Women		Men	
	(1)		(2)		(3)	
A.						
<i>Employed outside home</i>						
DI expenditure t	1.038	(0.062)	1.068	(0.093)	1.001	(0.072)
DI expenditure $t-1$	1.007	(0.075)	0.966	(0.082)	1.171	(0.164)
<i>Employed at home</i>						
DI expenditure t	1.152**	(0.083)	1.135	(0.145)	1.042	(0.092)
DI expenditure $t-1$	1.121	(0.088)	1.140	(0.140)	1.099	(0.191)
Observations	15,901		8,964		6,937	
B.						
<i>Employed not in gig economy</i>						
DI expenditure t	0.956	(0.125)	0.883	(0.151)	0.983	(0.133)
DI expenditure $t-1$	1.007	(0.075)	0.890	(0.095)	1.076	(0.128)
<i>Employed in gig economy</i>						
DI expenditure t	0.846	(0.145)	1.226	(0.322)	0.773	(0.164)
DI expenditure $t-1$	1.321**	(0.146)	1.440*	(0.289)	1.286*	(0.179)
Observations	9186		5131		4055	

Notes: Digital infrastructure (DI) expenditure is measured in £10 per capita. Presented figures are exponentiated FE MNL coefficients, interpreted as relative risk ratios (where relative risk is measured as the probability of the outcome j relative to the probability of base outcome, which is evaluated at $x + 1$ and x) and their standard errors clustered at the local authority (L)A level (in the parentheses). Regressions control for the numbers of adults and own children in the household, wave, year, and individual-LA effects. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 11. Effect of local DI expenditure on employment: Heterogeneity by previous IT experience

	All (1)	Women (2)	Men (3)	All (4)
DI expenditure t	0.009** (0.004)	0.007 (0.005)	0.011** (0.004)	0.007 (0.005)
DI expenditure $t-1$	0.011*** (0.004)	0.010* (0.006)	0.011** (0.005)	0.010* (0.006)
IT experience x DI expenditure t	-0.026** (0.012)	-0.058** (0.025)	-0.015 (0.012)	-0.058** (0.025)
IT experience x DI expenditure $t-1$	-0.004 (0.013)	0.068*** (0.025)	-0.026* (0.015)	0.068*** (0.025)
Male x DI expenditure t				0.004 (0.007)
Male x DI expenditure $t-1$				0.001 (0.008)
Male x IT experience x DI expenditure t				0.043 (0.028)
Male x IT experience x DI expenditure $t-1$				-0.094*** (0.031)
Observations	36,332	20,383	15,949	36,332

Notes: Occupation and industry are measured in the pre-analysis period (2009-19). Digital infrastructure (DI) expenditure is measured in £10 per capita. Standard errors (presented in parentheses) are clustered at the local authority (LA) level. All regressions control for the other contemporaneous and lagged expenditures listed in Table 4, the number of adults in the household, the numbers of children aged 0-2, 3-4, 5-11, and 12-15 in the household, an indicator for *not* having own children in the household, the interactions of the numbers of children of different ages with the indicator for *not* having own children in the household, wave, year, and individual-LA effects. In column (4) all control variables are interacted with male dummy. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

ONLINE APPENDIX (Not for publication)

Table A1. Investigation of attrition

	Not in sample (1)	In sample (2)	Difference (3)	t-statistic (4)
Self-employed	0.088	0.091	-0.004	-1.655
Employed	0.625	0.655	-0.030	-8.385
Unemployed	0.069	0.054	0.015	8.640
Not in labour force	0.219	0.201	0.018	6.013
Female	0.560	0.571	-0.011	-3.122
Age	40.463	44.726	-4.263	-43.350
Number of adults in the HH	2.536	2.571	-0.035	-3.755
Own children in household	0.299	0.329	-0.031	-8.877
Children aged 0-2 in household	0.091	0.076	0.015	7.172
Children aged 3-4 in household	0.068	0.062	0.005	2.838
Children aged 5-11 in household	0.196	0.208	-0.012	-3.889
Children aged 12-15 in household	0.159	0.172	-0.013	-4.742
Unitary authority	0.266	0.270	-0.004	-1.150
Shire district	0.350	0.334	0.016	4.530
Metropolitan district	0.232	0.237	-0.005	-1.572
London borough	0.152	0.159	-0.007	-2.671
Digital infrastructure expenditure	0.297	0.325	-0.028	-6.959
Education expenditure	70.599	69.009	1.590	9.694
Social care expenditure	60.235	58.546	1.688	20.861
Transport expenditure	26.075	25.833	0.242	1.700
Housing expenditure	19.833	18.761	1.071	5.653
Environment expenditure	11.355	11.155	0.201	7.130
Central services expenditure	10.069	9.839	0.229	4.286
Planning/development expenditure	7.886	7.832	0.054	0.985
Public health expenditure	6.993	7.094	-0.101	-4.962
Culture expenditure	6.788	6.684	0.105	2.960
Other expenditure	2.859	3.132	-0.273	-4.294
Total expenditure	222.997	218.210	4.787	10.001
Observations	31,010	43,736		

Notes: Columns (1) and (2) present the means for UKHLS respondents from England, aged 18-64 and interviewed in 2020-24 financial years who *are not in the analysis sample and who are in the analysis sample*, respectively. Column (3) presents the differences in the means, and column (4) t-statistics for the test of the mean difference.

Table A2. Impact of local DI expenditure on employment status, MNL estimates with Mundlak correction

	All		Women		Men	
	(1)		(2)		(3)	
A. Relative risk ratios						
<i>Employee</i>						
DI expenditure t	1.045**	(0.018)	1.025	(0.026)	1.080**	(0.036)
DI expenditure $t-1$	1.061***	(0.020)	1.058**	(0.029)	1.077	(0.050)
<i>Self-employed</i>						
DI expenditure t	1.095***	(0.031)	1.124**	(0.064)	1.084***	(0.033)
DI expenditure $t-1$	1.065*	(0.034)	1.026	(0.040)	1.117*	(0.069)
B. Average marginal effects						
<i>Employee</i>						
DI expenditure t	0.004	(0.003)	0.000	(0.005)	0.008	(0.005)
DI expenditure $t-1$	0.008**	(0.004)	0.011**	(0.005)	0.005	(0.006)
<i>Self-employed</i>						
DI expenditure t	0.005**	(0.002)	0.006*	(0.003)	0.002	(0.002)
DI expenditure $t-1$	0.002	(0.002)	-0.001	(0.002)	0.006	(0.004)
Non-employed						
DI expenditure t	-0.008***	(0.003)	-0.006	(0.005)	-0.010**	(0.004)
DI expenditure $t-1$	-0.010***	(0.003)	-0.010**	(0.005)	-0.011*	(0.006)
Observations	43,736		24,981		18,755	

Notes: Digital infrastructure (DI) expenditure is measured in £10 per capita. Presented figures are based on a MNL model that controls for individual-local-authority-specific averages of time varying variables. Regressions also control for other contemporaneous and lagged expenditures listed in Table 4, the numbers of adults and children in the household, quadratic function of age, wave, and year effects. Figures in Panel A are exponentiated coefficients, interpreted as relative risk ratios (where relative risk is measured as the probability of the outcome j relative to the probability of base outcome, which is evaluated at $x + 1$ and x). Figures in panel B average marginal effects. Standard errors (clustered at local authority level) are presented in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A3. Impact of the substitution between DI and other expenditures on employment

	All		Women		Men	
	(1)		(2)		(3)	
Planning/development t	0.009***	(0.003)	0.008	(0.005)	0.010**	(0.004)
Planning/development $t-1$	0.010***	(0.003)	0.011**	(0.005)	0.009	(0.006)
Education t	0.009***	(0.003)	0.008	(0.005)	0.009**	(0.004)
Education $t-1$	0.011***	(0.003)	0.012**	(0.005)	0.010*	(0.006)
Transport t	0.009***	(0.003)	0.009*	(0.005)	0.010**	(0.004)
Transport $t-1$	0.009***	(0.003)	0.010*	(0.005)	0.009	(0.006)
Social care t	0.008**	(0.003)	0.007	(0.005)	0.009*	(0.005)
Social care $t-1$	0.009***	(0.003)	0.009*	(0.005)	0.010	(0.006)
Public health t	0.010***	(0.004)	0.009	(0.006)	0.011**	(0.005)
Public health $t-1$	0.011***	(0.004)	0.013**	(0.006)	0.010	(0.006)
Housing t	0.009***	(0.003)	0.008	(0.005)	0.009**	(0.004)
Housing $t-1$	0.010***	(0.003)	0.010**	(0.005)	0.009	(0.006)
Culture t	0.009***	(0.003)	0.008	(0.005)	0.009**	(0.004)
Culture $t-1$	0.010***	(0.003)	0.010**	(0.005)	0.009	(0.006)
Environment/regulation t	0.010***	(0.003)	0.009*	(0.005)	0.012**	(0.005)
Environment/regulation $t-1$	0.009***	(0.003)	0.011**	(0.005)	0.008	(0.006)
Central services t	0.010***	(0.003)	0.010*	(0.005)	0.010**	(0.005)
Central services $t-1$	0.010***	(0.003)	0.011**	(0.005)	0.009	(0.006)
Other t	0.009***	(0.003)	0.008	(0.005)	0.010**	(0.004)
Other $t-1$	0.010***	(0.003)	0.010**	(0.005)	0.009	(0.006)

Notes: Each panel presents estimates from a separate regression that includes contemporaneous and lagged DI expenditure, total expenditure, and all other contemporaneous and lagged expenditures except for the (contemporaneous and lagged) expenditure indicated by the row headings. So, the coefficients are interpreted as the effects of increasing the expenditure on DI and decreasing the expenditure on this category holding all other expenditures fixed. All regressions also control for the number of adults in HH, the numbers of children aged 0-2, 3-4, 5-11, and 12-15 in the HH, an indicator for *not* having own children in the HH, the interactions of the numbers of children of different ages with the indicator for *not* having own children in the HH, wave, year, and individual-local-authority effects. Local expenditures are measured in £10 per capita. Standard errors (presented in the parentheses) are clustered at the local authority level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A4. Impact of local government expenditure on self-employment, FE LPM estimates

	All (1)	All (2)
Digital infrastructure <i>t</i>	0.0060** (0.0023)	0.0078* (0.0041)
Digital infrastructure <i>t-1</i>	0.0020 (0.0025)	-0.0010 (0.0024)
Planning/development <i>t</i>	-0.0000 (0.0002)	-0.0000 (0.0002)
Planning/development <i>t-1</i>	0.0002 (0.0002)	-0.0001 (0.0002)
Education <i>t</i>	0.0003 (0.0002)	-0.0003 (0.0002)
Education <i>t-1</i>	-0.0002 (0.0003)	-0.0001 (0.0004)
Transport <i>t</i>	-0.0001 (0.0001)	0.0000 (0.0002)
Transport <i>t-1</i>	-0.0001 (0.0001)	-0.0002 (0.0002)
Social care <i>t</i>	0.0001 (0.0002)	0.0003 (0.0003)
Social care <i>t-1</i>	-0.0004 (0.0003)	-0.0000 (0.0003)
Public health <i>t</i>	0.0014 (0.0010)	0.0021** (0.0010)
Public health <i>t-1</i>	0.0007 (0.0008)	0.0009 (0.0011)
Housing <i>t</i>	-0.0000 (0.0001)	-0.0000 (0.0001)
Housing <i>t-1</i>	-0.0001 (0.0001)	-0.0001 (0.0001)
Culture <i>t</i>	0.0001 (0.0004)	0.0002 (0.0005)
Culture <i>t-1</i>	0.0006* (0.0003)	0.0006 (0.0005)
Environment/regulation <i>t</i>	-0.0005 (0.0003)	-0.0002 (0.0004)
Environment/regulation <i>t-1</i>	-0.0008** (0.0004)	-0.0008 (0.0007)
Central services <i>t</i>	-0.0002 (0.0002)	-0.0000 (0.0002)
Central services <i>t-1</i>	0.0002 (0.0001)	0.0000 (0.0002)
Other <i>t</i>	-0.0002* (0.0001)	0.0001 (0.0001)
Other <i>t-1</i>	-0.0001 (0.0001)	0.0000 (0.0001)
Male x Digital infrastructure <i>t</i>		-0.0043 (0.0051)
Male x Digital infrastructure <i>t-1</i>		0.0070* (0.0040)
Male x Planning/development <i>t</i>		-0.0001 (0.0004)
Male x Planning/development <i>t-1</i>		0.0008* (0.0004)
Male x Education <i>t</i>		0.0014*** (0.0005)
Male x Education <i>t-1</i>		-0.0002 (0.0006)
Male x Transport <i>t</i>		-0.0002 (0.0003)
Male x Transport <i>t-1</i>		0.0002 (0.0003)
Male x Social care <i>t</i>		-0.0004 (0.0005)
Male x Social care <i>t-1</i>		-0.0008 (0.0005)
Male x Public health <i>t</i>		-0.0016 (0.0019)
Male x Public health <i>t-1</i>		-0.0004 (0.0019)
Male x Housing <i>t</i>		0.0000 (0.0002)
Male x Housing <i>t-1</i>		0.0001 (0.0002)
Male x Culture <i>t</i>		-0.0003 (0.0009)
Male x Culture <i>t-1</i>		0.0000 (0.0007)
Male x Environment/regulation <i>t</i>		-0.0006 (0.0007)
Male x Environment/regulation <i>t-1</i>		-0.0001 (0.0010)
Male x Central services <i>t</i>		-0.0005 (0.0003)
Male x Central services <i>t-1</i>		0.0005 (0.0004)
Male x Other <i>t</i>		-0.0006** (0.0003)
Male x Other <i>t-1</i>		-0.0002 (0.0002)

Notes: Sample includes 43,736 observations. Local authority (LA) expenditures are measured in £10 per capita. Standard errors (presented in parentheses) are clustered at the LA level. All regressions control for the number of adults in the household, the numbers of children aged 0-2, 3-4, 5-11, and 12-15 in the household, an indicator for *not* having own children in the household, the interactions of the numbers of children of different ages with the indicator for *not* having own children in the household, wave, year, and individual-LA effects. In column (2) all control variables are interacted with male dummy. *** p<0.01, ** p<0.05, * p<0.1.

Table A5. Effect of local DI expenditure on employment: Heterogeneity by the type of LA

	All		Women		Men	
	(1)		(2)		(3)	
DI expenditure t	0.009***	(0.003)	0.012*	(0.007)	0.006	(0.008)
DI expenditure $t-1$	0.013***	(0.004)	0.009	(0.008)	0.019***	(0.005)
Unitary x DI expenditure t	-0.004	(0.008)	-0.007	(0.014)	0.002	(0.011)
Shire x DI expenditure t	0.007	(0.013)	0.008	(0.017)	0.011	(0.018)
Metropolitan x DI expenditure t	0.003	(0.009)	0.001	(0.011)	0.005	(0.016)
Unitary x DI expenditure $t-1$	-0.008	(0.006)	-0.003	(0.011)	-0.014	(0.011)
Shire x DI expenditure $t-1$	0.004	(0.012)	0.015	(0.018)	-0.011	(0.012)
Metropolitan x DI expenditure $t-1$	0.006	(0.010)	0.013	(0.016)	-0.005	(0.014)
Observations	43,736		24,981		18,755	

Notes: Local digital infrastructure (DI) expenditure is measured in £10 per capita. Standard errors (presented in the parentheses) are clustered at the local authority (LA) level. All regressions control for other contemporaneous and lagged expenditures listed in Table 4, the number of adults in HH, the numbers of children aged 0-2, 3-4, 5-11, and 12-15 in the HH, an indicator for *not* having own children in the HH, the interactions of the numbers of children of different ages with the indicator for *not* having own children in the HH, wave, year, and individual-LA effects. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.