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Abstract

We examine the effects of broadband on establishment births for five spatial scales, six industries and two speed levels. Econometric results indicate that broadband has a positive effect in larger, medium and small urban centers and in periurban areas but has little or no impact in rural areas. Moreover, in non-central areas broadband can foster establishment births in basic (retail, tourist services), but also in selected knowledge-intensive and “creative” industries. Finally, there are no great difference between the impact of basic and fast broadband, except in larger urban centers with the necessary skilled workforce able to use sophisticated applications.

Key words: broadband; establishment births; urban gradient

JEL classification: O18, O52, R11

1. Introduction

While the Internet can create new opportunities for non-central areas, the idea that it will put an end to distance (Cairncross, 2001) remains an exaggeration (Camagni and Capello, 2005; Polèse and Shearmur, 2004). As well-known, greater market integration often harms peripheral areas with little prior exposure to competition. Moreover, while the Internet is a substitute for certain types of agglomeration economies, it is complementary to face-to-face interactions (Büchel and Ehrlich, 2020; Leamer and Storper, 2014). Therefore, while it may lead to the dispersion of some economic activities, the Internet may strengthen the concentration of others, and in particular that of knowledge-intensive activities.

Until now, little empirical work has been carried out, however, to understand the complexity of the spatial impact of the Internet on establishment births and several issues remain unresolved. First, to our knowledge, no study has examined the impacts of the Internet across the entire urban hierarchy, taking into account both the size and location (urban proximity) of areas¹. Second, a key issue is whether broadband provision generates different sectoral effects across locations and, in particular, whether it may foster the dispersion not only of low-skilled and low-paid activities to non-central areas, but also that of (selected) knowledge-intensive activities. Third, the literature remains silent on whether costly ultrafast broadband generates additional benefits compared to lower-speed technologies (Abrardi and Cambini, 2019). In particular, we may wonder whether ultrafast technologies, needed for more sophisticated digital tools, are really worthwhile in non-central areas given their limited absorptive capacity (Salemink et al., 2017). This issue is relevant given that many public broadband programs are specifically designed to promote fast broadband coverage in less densely populated areas.

This paper provides a comprehensive study on the effect of broadband on establishment births by analyzing how impacts vary across locations, industries, and speed levels. To assess whether effects vary according to the size of areas and their proximity to urban centers, we identify five types of areas: larger urban centers, small and middle urban centers, periurban areas, urban-influenced rural areas, and isolated rural areas. Moreover, broadband effects are estimated for six different industries, including basic nontradable industries (e.g., construction), basic tradable (e.g., retail) and knowledge-intensive services (e.g., high-order services). In

¹ A notable exception is Mack (2015) who uses seven different classifications of US counties to take into account both their population and proximity to large urban centers.

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3 addition, we test whether impacts vary according to speed level by comparing the effect of basic
4 (3-30 Mbps) and fast broadband (>30 Mbps) provision.
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6 The empirical analysis is carried out for 34,766 municipalities (“*communes*”) in France
7 from 2013 to 2017. Compared to a more aggregated analysis, the municipal level allows
8 capturing broadband dispersion effects to smaller municipalities and periurban areas. The time
9 period also matters for our study, as it corresponds to the implementation of the French Very
10 High-Speed Broadband Plan, which has led to substantial broadband provision in all parts of
11 the country². The effect of broadband access on establishment births is estimated using a
12 negative binomial model. To mitigate endogeneity issues, we provide falsification tests.
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19 The paper is organized as follows. The following section identifies the main channels
20 by which broadband can affect establishment births and highlights how impacts are likely to
21 vary across locations, industries, and speed levels. The methodology is presented in the third
22 section and data in the fourth section. Econometric results are analyzed in the fifth section,
23 followed by conclusions.
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30 **2. Broadband and establishment births**

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32 Broadband can affect establishment births in a given area in two ways. First, it can
33 enable - or deter - new individuals from entering the market (effect on local entrepreneurship).
34 Second, it can weaken locational constraints, leading to a change in location choices of
35 incumbent and new establishments (effect on firm location determinants).
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39 *2.1. Broadband and entrepreneurship*

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41 The Internet may affect business startups by creating new market opportunities,
42 lowering entry barriers, and enhancing entrepreneurial capabilities.
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45 *Entrepreneurial opportunities*

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47 By allowing online trade, broadband increases market reach and thus the profitability of
48 setting up new businesses. However, market openness goes both ways and only favors locations
49 with comparative advantages. In isolated areas, increased market integration often harm
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55 ² The plan was adopted in 2010, with the objective of covering 100% of homes by 2022. Since 2013, two
56 complementary networks have been deployed. Private operators provide optical fiber in densely populated
57 municipalities (approximately 3550 municipalities). In less densely populated areas, infrastructure is constructed
58 by public authorities.
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3 retailers serving local markets, as they now find themselves in direct competition with online
4 sellers offering more diversified product lines and lower-priced products (Cumming and Johan,
5 2010; Freathy and Calderwood, 2016). Negative effects have also been found for finance,
6 insurance and real estate as ICT allow many tasks to be carried out centrally, and thus, lead to
7 the shutdown of small local agencies in remote areas (Duvivier et al., 2018; Kandilov and
8 Renkow, 2010; Shideler and Badasyan 2012). On the contrary, positive effects have been
9 observed in rural areas close to urban agglomerations or with a preexisting cluster of activities
10 (Cumming and Johan, 2010; Kim and Orazem, 2017; Mack, 2014-a).

11
12 The importance of online trade varies across industries. Broadband only generates new
13 business opportunities for industries producing services or products tradable online, such as
14 wholesale trade, and retail trade (excluding perishable items)³. On the other hand, we would
15 expect few changes for manufacturing, construction and for most consumer and producer
16 services. While the latter are often “technically” deliverable online, such activities (e.g.,
17 finance, legal and accounting activities) often imply the exchange of uncodified information
18 and trust, which strongly restricts their exchange potential online.

19 *Lower entry barriers*

20
21 Broadband may also foster entrepreneurship by reducing the costs associated with
22 information access, communication, business coordination and training (Audretsch et al., 2015;
23 Lamie et al., 2011). It can also lower fixed cost entry barriers, which sometimes constitute a
24 major impediment for new entrants. First, banks are more likely to grant higher credit to firms
25 that use more intensively ICT as it helps banks obtain better information on borrowers and
26 constitutes a positive signal on firms quality and creditworthiness (Dalla Pelegrina et al., 2017).
27 Second, good broadband access allows firms to use sophisticated digital tools, such as cloud
28 computing, which can reduce capital expenditures and sunk costs. In this case, ultrafast
29 broadband access, instead of lower-speed first-generation technologies, is likely to provide
30 benefits for businesses, as sophisticated digital applications require high-speed levels (Nicoletti
31 et al., 2020). This may explain why some studies find that ultrafast broadband access has a more
32 beneficial impact on establishments than lower speed technologies (Canzian et al., 2019;
33 Lapointe, 2015; McCoy et al., 2018; Mack, 2014-b; Prieger et al., 2017; Whitacre et al., 2014).
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57 ³ In addition, even if tourist services are not deliverable online, broadband provision can increase entrepreneurial
58 opportunities for this sector by allowing tourist operators to gain visibility and facilitating distant reservations
59 (Duvivier et al., 2018).
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3 Such advantages should primarily apply to industries where new firms require
4 considerable financial outlays to enter the market, such as manufacturing and wholesale
5 (Lofstrom et al., 2014). Broadband is also likely more beneficial for technology-intensive
6 industries, which use sophisticated digital tools. Thus, for manufacturing, empirical studies
7 indicate high broadband effects on firm births in the high-tech manufacturing sector (Audretsch
8 et al., 2015; Mc Coy et al., 2018) but only small or insignificant effects on manufacturing as a
9 whole (Kim and Orazem, 2017; Mack and Wentz, 2017).

15 *Entrepreneurial capabilities*

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18 Broadband can also raise entrepreneurial capabilities (Audretsch et al., 2015). The
19 Internet fosters access to information and exchange of ideas, raises interactions with distant
20 partners, and helps establish business contacts. By enabling information and coordination,
21 broadband helps individuals to better understand market conditions and to conceive good ideas
22 and products (e.g., creation of new market niches). Here, again, access to ultrafast broadband
23 should provide additional benefits for businesses, as it allows high-resolution real-time
24 collaboration and better access to information (faster file transfers, access to high-quality videos
25 for online training) (Ezell et al., 2009).

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28 Some authors expect broadband returns to be stronger in rural areas, where
29 establishments need more digital tools to resolve their greater information and coordination
30 issues (Forman et al., 2005; Mack, 2014-b). However, broadband access by itself is often not
31 sufficient for creating a good entrepreneurial context in remote rural areas where structural
32 deficiencies (e.g., lack of skilled labor) may hinder new business creation (Cumming and Johan,
33 2010; Galloway, 2007). Therefore, the highest broadband returns are expected in “intermediate
34 areas” that face high information and coordination issues but, at the same time, also offer
35 relatively good initial conditions. In particular, small-connected peripheral cities, which are
36 often service centers for surrounding rural areas and thus concentrate a minimum amount of
37 professional and public services (Meijers and Burger, 2017), could become good locations for
38 entrepreneurship.

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41 Broadband could raise entrepreneurial capabilities more intensely in information-
42 intensive industries, such as computer services, where interacting with other programmers and
43 software developers is essential to obtain information and develop new ideas (Audretsch et al.,
44 2015). However, while most studies find a positive link between broadband and knowledge-
45 intensive business services (KIBS) creation (Mack et al., 2011; Mack and Wentz, 2017), the
46 impact does not appear to be stronger in this sector than in other sectors (Mack, 2015). This
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3 most likely arises from the fact that KIBS mainly relies on uncodified information and
4 knowledge, which cannot be easily exchanged online.
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6 7 2.2. *Broadband and firms' location choices*

8 9 *Broadband access: a location factor on its own*

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11 As broadband can raise firms' productivity⁴ (Canzian et al., 2019), locations endowed
12 with broadband benefit from a competitive advantage over others and thus enjoy a higher
13 number of establishment births. However, as positive productivity effects have mainly been
14 identified for industries employing highly skilled labor (Akerman et al., 2015), broadband
15 availability is likely to be a location determinant only for these specific industries.
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20 21 *Broadband effects on firms' location choices*

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23 By fostering information flows, interactions with partners, and access to customers and
24 labor, broadband may be seen as a substitute for agglomeration economies. In this way,
25 establishments can be located at increasing distances from large urban centers and still enjoy a
26 wide range of agglomeration externalities, including good access to labor (de Vos et al., 2020),
27 metropolitan functions (Meijers et al., 2016), and customers and information (Phelps et al.,
28 2001). Internet-connected small cities close to large urban centers are likely to become
29 particularly attractive places for firms because they can enjoy agglomeration economies while
30 retaining the advantages of small cities⁵ (Dijkstra et al., 2013). While this "borrowed size"
31 effect (Alonso, 1973) existed well before broadband, new technologies are likely to reinforce it
32 by leading to an ever-increased integration between locations (de Vos et al., 2020; Dijkstra et
33 al., 2013; Hesse, 2016).
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42 Two kinds of areas are likely to "borrow size" and to become particularly attractive
43 destinations: areas close to major urban centers (de Vos et al., 2020; Phelps et al., 2001) and
44 small and medium-sized cities benefiting from good communication network connectivity
45 (Hesse, 2016; Meijers et al., 2016).
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49 In addition, periurban areas and connected small cities are likely to become attractive
50 destinations for some industries but not for others. Although virtual contacts can replace
51 "conversations", the Internet is more a complement for "handshakes" and face-to-face
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56 ⁴ Broadband impact on productivity is, however, debated (e.g., de Stefano et al., 2018).
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58 ⁵ Once again, stronger integration can also lead to competition effects, especially in the smallest cities (Meijers
59 and Burger, 2017; Meijers et al., 2016).
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interactions (Büchel and Ehrlich, 2020; Leamer and Storper, 2014). Therefore, the need for face-to-face interactions often causes knowledge-intensive services to increasingly settle in large urban locations and city centers (Duvivier and Polèse, 2018; Polèse and Shearmur, 2004), and not in periurban areas and connected small cities.

Creative industries (e.g., artists, recording studios) may be one exception⁶. Compared to other KIBS, they can more easily deliver their services online, provided a high-speed connection (Mack, 2014-b; Townsend et al., 2017), and are more sensitive to good quality of life and inspiring working environment (Anderson et al., 2016; Townsend et al., 2017). Therefore, as broadband weakens location constraints, creative industries are increasingly expected to settle in non-central locations with high-speed connections.

Borrowed-size effects are also likely to reinforce the deconcentration of basic, low-skilled and low-paid activities to periurban and connected small cities. In particular, broadband is likely to accelerate the decentralization of back-office activities and land-consuming firms (e.g., wholesale trade), a trend that began well before the Internet.

3. Methodology

3.1. Estimation of broadband effects

The dependent variable in the model – the number of establishment births – is a nonnegative integer with a high frequency of zeros⁷. Thus, we estimate a count-data model and, more precisely, a negative binomial model, as the distribution of the dependent variable shows signs of overdispersion (variance greater than the mean).

The model, estimated by the maximum likelihood, assumes that the number of establishment births (y_{it}) in municipality i at year t depends on broadband provision (BB_{it-s}) and on a set of K characteristics (X_{kit-s}) of this municipality:

$$y_{it} = f(BB_{it-s}, X_{kit-s}, \text{Region}_i, \text{Year}_t) \text{ with } s=1;2$$

We proceeded in four steps. In a first step, we estimate broadband effects assuming homogeneous impacts across locations and industries. To do that, we regress the total number of establishment births in municipality i in year t on our indicator of broadband (BB_{it-s}) and

⁶ See Table A.1 in the appendix for a definition of creative industries.

⁷ The proportion of municipalities with zero creation varies between 18% and 75%, depending on the industry and year.

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3 on a set of control variables (X_{kit-s}). BB_{it-s} measures the share of premises with access to
4 broadband of at least 3 Mbps and is lagged by one or two years to reduce endogeneity. We also
5 control for a set of characteristics of municipalities described in Section 4. All control variables
6 are lagged by one or two years to reduce reverse causality. We also introduce regional dummy
7 ($Region_i$) and time fixed effects ($Year_t$)⁸.
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12 In a second step, we test for heterogeneous broadband effects across locations by
13 introducing interactive terms between the indicator of broadband (BB_{it-s}) and dummy
14 variables for the five categories of areas: larger urban centers; small and middle urban centers;
15 periurban areas; urban-influenced rural areas; and isolated rural areas.
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19 In a third step, we investigate whether the impact varies across industries by estimating
20 the two previously described models (steps 1 and 2) separately for the following six industries:
21 manufacturing, construction, wholesale trade, retail trade, food and accommodation, and high-
22 order services.
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26 In a fourth step, to test whether broadband speed matters, we estimate the models
27 described previously by splitting our broadband measure into two indicators (basic and fast
28 broadband).
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31 32 33 34 3.2. *Endogeneity and spatial effects*

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36 Endogeneity and spatial effects are two major potential issues when estimating the
37 economic effects of broadband access. Endogeneity can arise from both reverse causality
38 (private operators are more likely to build infrastructures in municipalities with a higher number
39 of firms, as it means a higher demand for broadband) and omitted variables (private operators
40 are more likely to invest in economically dynamic municipalities, which are also more attractive
41 to firms).
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47 Previous studies have proposed different solutions to limit endogeneity. Some have
48 employed instrumental variables, with the slope of terrain, household density and pre-existing
49 telecommunication networks used as instruments (Kolko, 2012; Mack et al., 2011). However,
50 finding convincing instruments remains challenging. Some authors warn that these instruments
51 may be poorly correlated with broadband access (weak instruments) and may have a direct
52 impact on establishment births, in addition to their effect through broadband access (non-
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59 ⁸ We do not include municipal fixed-effects because in count data models, areas with no establishment creation
60 over the period are dropped from the analysis. See below.

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3 exogenous instruments). Other studies have used a fixed effects estimator to control for time-
4 invariant unobserved heterogeneity (e.g., Lapointe, 2015). However, identification in fixed
5 effects models is difficult for studies carried out over a limited period of time, as within-location
6 variation in broadband over time is generally low (Kim and Orazem, 2017). Using fixed effects
7 in the case of nonlinear count data models is even more problematic, as areas with no
8 establishment creation over the period are dropped from the analysis⁹.
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13 In this study, we use several solutions to limit potential endogeneity. First, we restrict
14 our analysis to establishment births and use lagged values of broadband availability (1- and 2-
15 year lagged values). Second, following McCoy et al. (2018), we estimate a series of models,
16 including random effects models with regional and year fixed effects. Finally, to ensure that the
17 results obtained arise from a causal relationship and not from unobserved heterogeneity, we
18 undertake falsification tests. The test consists of randomly redistributing broadband coverage
19 values across municipalities and then re-estimating the model using the permuted broadband
20 variable. The operation is repeated 999 times. Finally, the estimated coefficient based on actual
21 data (the original data set) is compared to the distribution of the 999 coefficients associated
22 with the randomly redistributed broadband variable. If the coefficient associated with the
23 “original” broadband variable is significantly different from the distribution of the 999
24 coefficients (i.e., belongs to the bottom or the top 5% of the distribution), we can conclude that
25 the findings are most likely causal and not spurious. Note that the falsification tests are
26 undertaken only to test for the robustness of the significant coefficients. This kind of
27 falsification test is increasingly used in empirical analyses (e.g., Komarek, 2018; Oliveira et al.,
28 2015).
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41 Spatial autocorrelation is another potential issue. To account for spatial effects, we
42 estimate an SLX model for two reasons. First, estimating an SLX model seems the best option
43 when there is no consistent economic argument justifying the use of a specific spatial model
44 (Halleck Vega and Elhorst, 2015). Second, spatial econometric tools are still poorly developed
45 in the case of count data models (Glaser, 2017). To date, most studies have used SLX models,
46 as they can be estimated using standard econometric estimators. Spatial autoregressive models
47 (SAR) and spatial-error models are much less developed. For example, while some SAR models
48 exist (e.g., Lambert et al., 2010), they are not available for negative binomial distribution and
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58 ⁹ In our case, estimating a fixed effects count data model leads to the removal of between 3% and 49% of the
59 observations, depending on the industrial sector.
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3 for panel data. In this paper, we thus account for spatial effects by introducing several spatially
4 lagged independent variables (see the next section).
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10 **4. Data and descriptive statistics**

11 The study was carried out at the municipal level in France between 2013 and 2017.
12 Focusing on municipalities (“*communes*”), the smallest unit of analysis for which broadband
13 and establishment data are publicly available, allows us to take into account most of the
14 heterogeneity in broadband access across areas. More importantly, compared to more
15 aggregated levels, municipal-level studies can better capture broadband dispersion effects (e.g.,
16 from the urban core to periurban areas), which are of first interest here. Following previous
17 studies, we exclude the three largest municipalities (Paris, Marseille, and Lyon) to limit the
18 influence of outliers (Mc Coy et al., 2018; Hasbi, 2020). Ultimately, our sample is composed
19 of a panel of 34,766 municipalities.
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22 To account for differences in broadband effects across locations, we use the “2010
23 division into urban areas” (“*zonage en aires urbaines*”) established by the French Institute of
24 Statistics (INSEE). The major advantage of this classification is that it allows us to take into
25 account both the size and the integration of municipalities within larger urban centers. More
26 precisely, the classification was elaborated in two steps: (i) by identifying urban centers
27 (according to the number of jobs) and (ii) by defining the sphere of influence of each urban
28 center. A municipality is considered to be under the influence of an urban center if at least 40%
29 of its residents with a job work in neighboring urban center(s). Compared to other commonly
30 used categorizations, it is not exclusively based on density or land cover criteria but takes into
31 account the integration of municipalities within larger urban centers^{10,11}. This approach is thus
32 particularly relevant, given that broadband effects are expected to vary according to both size
33 and urban influence.
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48 Following Détang-Dessendre and Piguet (2016), we classify municipalities into five
49 classes based on the 2010 division of urban areas:
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52 ¹⁰ The “municipal density classification”, which is the other common classification, distinguishes between four
53 types of municipalities based on their population density but does not take into account urban influence. To check
54 the robustness of results, this other classification will also be used; see Section 5.
55

56 ¹¹ Broader-based definitions are also commonly used. For example, the OECD definition of functional urban areas
57 distinguishes between urban cores, their surrounding areas and peripheral places. The “2010 division into urban
58 areas” proposes a more disaggregated classification, distinguishing between three types of peripheral areas (small
59 and medium cities, urban-influenced rural areas, and remote rural areas).
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- Larger urban centers (>10,000 jobs),
- Periurban areas (municipalities with at least 40% of their residents working in neighboring larger urban centers),
- Small and middle urban centers (1,500-10,000 jobs),
- Urban-influenced rural areas (municipalities with at least 40% of their residents working in neighboring small and middle urban centers),
- Isolated rural areas.

Figure 1 shows the spatial distribution of municipalities across the five classes, with totals given for each.

[Figure 1]

Broadband data are from the observatory of the French Very High-Speed Broadband Plan, led by the French Digital Agency. The data provide the share of premises (homes, businesses, and public sites) that have access to the following four speed levels: at least 3 Mbps, 8 Mbps, 30 Mbps, and 100 Mbps. Based on these data, we create several indicators. First, we calculate, for each municipality, the share of premises that have access to at least 3 Mbps. Second, to investigate whether the effects vary according to the speed level, we split this variable into two parts: the share of premises that have access to basic broadband (3-30 Mbps) and the share that have access to fast broadband (>30 Mbps). These thresholds of broadband speeds correspond to those of the European Commission (European Commission, 2010) and are used in almost all European countries.

Unlike other studies, which often use measures of “availability” (e.g., a dummy indicating whether there are at least some broadband connections), our measure of “coverage” allows us to take into account the share of the municipality that truly benefits from broadband provision. This is particularly relevant here, given that broadband availability is often limited in rural municipalities. A drawback of the data, however, is that it gives information only on fixed broadband networks, a common feature in the literature¹² (Bertschek et al., 2015). This limitation is unfortunate, given that considerable hope has been placed in wireless broadband, especially in rural areas, and that an increasing number of agents use only mobile broadband

¹² We obtained data on mobile broadband coverage (3G and 4G) from the French Electronic Communications, Postal and Print media distribution Regulatory Authority (Arcep). However, the data, delivered by private operators largely overestimates real coverage, especially in rural areas. As a result, we choose to not control for mobile broadband.

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3 (Manlove and Whitacre, 2019). The lack of data on mobile broadband could underestimate
4 broadband benefits for rural areas.
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7 Figure 2 displays the evolution of municipal broadband coverage between 2013 and
8 2017. The share of premises with access to at least 3 Mbps has increased over the period, from
9 59% to 69%, and has accelerated since 2015. Turning to the different speed levels, basic
10 broadband coverage has slightly decreased (from 51% to 45%), whereas fast broadband
11 coverage has increased (from 8% to 24%). This outcome is a direct consequence of the French
12 Very High-Speed Broadband Plan, whose objective is to generalize access to fast broadband.
13 Thus, the plan has produced both a provision of fast broadband to unserved areas as well as a
14 replacement of first-generation broadband networks with next-generation technologies in
15 already covered areas.
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22 Figures 3, 4 and 5 show the evolution of broadband coverage across areas. As expected,
23 broadband coverage varies across areas, with urban centers benefiting from better coverage
24 than periurban areas, which in turn have more coverage than urban-influenced and isolated rural
25 areas (Figure 3). The spatial digital divide has, however, decreased over time, with the
26 difference between the most and the least covered areas decreasing from 35 to 25 percentage
27 points. The reduction in the digital divide arises from the faster broadband provision in rural
28 areas compared to urban centers. However, while access to at least 3 Mbps is quite stable over
29 time in urban centers (Figure 3), these areas have benefited from a sustained increase in fast
30 broadband over the period (Figure 4). Thus, in these already well-covered areas, broadband
31 provision has consisted mainly of replacing basic broadband networks with next-generation
32 technologies. Finally, there is a spatial digital divide in terms of both basic and fast broadband,
33 with the gap being slightly more pronounced in terms of fast broadband (Figures 4 and 5).
34 While urban-rural differences have slightly decreased over time for both speed levels, they
35 remained quite important in 2017 (16 percentage points for basic broadband and 20 for fast
36 broadband).
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50 [Figure 2]

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58 Regarding establishment births, we use annual data on the number of firms and
59 establishments created (INSEE, REE/Sirene), disaggregated by industry (Aggregated
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3 Classification NAF rev. 2), which is available for all nonagricultural firms. We consider
4 establishment births instead of the total number of existing establishments for two reasons.
5 First, the creation of establishments is expected to suffer less from reverse causality (Mc Coy
6 et al., 2018). Second, as broadband is a recent phenomenon, its effects are better identified using
7 a sample of recently created establishments, which might have chosen their location because of
8 broadband access. In addition, we choose to focus on establishments, not firms, to study the
9 location choices of production units, whether or not they are decision-making units.

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15 Based on the standardized European concept, creation of establishments includes three
16 cases: (i) “ex nihilo creations”, (ii) reactivations (after a break of more than one year), and (iii)
17 take overs (with a change in at least two of the three following components: the legal decision-
18 making unit, economic activity and/or location). The latter category, which, it can be argued,
19 are not really births, allows capturing the potential effect of broadband on the relocation of
20 existing establishments.
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26 We carry out econometric estimations for all establishments and separately for the
27 following six industries: manufacturing¹³, construction, wholesale trade, retail trade, food and
28 accommodation (a proxy for tourism), and high-order services. In some models, the latter are
29 further disaggregated into three categories: creative industries; finance, insurance and real estate
30 (FIRE); and other knowledge-intensive business services (other KIBS). The codes and
31 descriptions of the industries are given in Table A.1 in the appendix. These industries account
32 for almost all economic activities, with the exception of agriculture, transport, public
33 administration, education, human health and social work activities. Table A.2 in the appendix
34 provides descriptive statistics on establishment births by area and industry. As expected, births
35 are highly concentrated in urban areas, especially in the largest urban centers and for high-order
36 services.
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45 In addition to broadband and establishment data, we use variables to characterize the
46 socioeconomic conditions in each municipality. Specifically, we use annual data on the total
47 number of jobs, total population, percentage of the population aged over 60, and percentage of
48 individuals who have a university degree. In addition to these variables, we also control for
49 annual travel time to the nearest railway station and to the nearest municipality with at least
50 20,000 inhabitants. Dummies are also introduced to control for the type of area (larger urban
51 centers, small and middle urban centers, etc.) and for the 22 regions (corresponding to the
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58 ¹³ In a previous version of the study, we further distinguished between low-tech and high-tech manufacturing but
59 no differences were found between the two.
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3 NUTS 2 level). Regional dummies allow us to control for time-invariant unobserved regional
4 factors, such as local economic policies. Finally, we introduce three spatially lagged
5 independent variables: the number of jobs, the number of inhabitants, and the number of
6 university graduates in municipalities that share a common border. Overall, the total set of
7 control variables allows controlling for market opportunities, labor market conditions and
8 population structure, as advised by Duvivier's (2019) meta-analysis of broadband and firm
9 location. Table 1 provides a description of the variables.
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17 [Table 1]
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22 5. Results

23 5.1. *Baseline results*

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28 Table 2 shows the estimation results for the baseline model, in which the broadband
29 effect is assumed to be homogeneous across areas. Four equations are estimated, depending on
30 the model used (pooling or random effects) and the lag between the dependent and independent
31 variables (one or two years). The explanatory power of the models is satisfactory, with a
32 pseudo- R^2 of 0.35 for the pooled regressions. The over-dispersion parameter (α) is statistically
33 significant, indicating that the negative binomial model fits the data better than the Poisson
34 model.
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40 Overall, the control variables have the expected sign. Establishment births are more
41 numerous in municipalities with more educated residents and higher employment and
42 population levels. Births are also influenced by the characteristics of neighboring
43 municipalities, which confirms the relevance of estimating an SLX model. Specifically,
44 proximity to more populated and educated municipalities tends to favor births, probably due to
45 better market access and ease of access to an educated labor force. In contrast, being close to
46 municipalities with high employment levels has a negative impact, perhaps because of the
47 spatial competition between neighboring municipalities in terms of firm location. More
48 surprisingly, none of the two accessibility variables displays a consistent effect, and the share
49 of seniors in the population is positively associated with establishment births. The results by
50 industry (Table A.7. in the appendix) help illuminate this last result: an older population is
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3 positively associated with retail trade and food and accommodation, most likely because seniors
4 are important customers for consumer-related industries.
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6 Turning to the broadband variable, the estimated coefficient is significantly positive and
7 similar for all four equations. The incidence rate ratio¹⁴ of broadband is equal to approximately
8 1.03, i.e., an increase of 1% of broadband coverage raises the rate of establishments births by
9 1.03. The evidence of a positive effect of broadband on establishment births is in line with most
10 previous studies (Audretsch et al., 2015; Lapointe, 2015; McCoy et al., 2018; Parajuli and
11 Haynes, 2017; Prieger et al., 2017).
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17 [Table 2]

18 [Table 3]
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22 Table 3 shows that the effect of broadband availability varies greatly across areas
23 (complete results reported in Table A.3 in the appendix).
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25 First, while higher coverage leads to significantly more establishment births in both
26 urban and periurban areas, we find no robust relation between broadband availability and
27 establishment creation in rural areas. Alternatively, classifying municipalities according to
28 density confirms that broadband access has little effect in the least densely populated areas
29 (Table A.4. in the appendix). This result is in line with the (scant) literature that compare the
30 effects of broadband between urban and rural areas, and concludes that broadband availability
31 is more beneficial for urban areas (Conley and Whitacre, 2016; Duvivier, 2019).
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37 Second, we find significantly higher coefficients for middle and small urban centers
38 compared to larger urban centers and periurban areas (see Wald tests in Table A.5). Thus,
39 broadband effects vary not only between urban and rural areas but also along the whole urban-
40 rural gradient. These results are consistent with Mack (2015), who finds that intermediate areas
41 are the main beneficiaries of broadband.
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46 Before turning to industry-level results, we proceed to the falsification tests to check
47 that our findings are not driven by omitted variables. Recall that the test only allows us to verify
48 that *significant* coefficients do not capture a spurious correlation. As such, we carry out these
49 tests to check the sensitivity of the broadband availability coefficients for all areas, larger urban
50 centers, small and medium urban centers, and periurban areas but not for rural areas. As the
51 calculations are very long (the tests require estimating each model 999 times), falsification tests
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58 ¹⁴ The incidence rate ratio is equal to the exponent of the coefficient.
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3 are performed only for our preferred specification, namely, random effects with one year-lagged
4 broadband variable¹⁵. Table 4 presents the results. The broadband coefficients estimated in our
5 baseline models are reported in Column (1). Column (2) reports the 95% confidence interval of
6 the distribution of the 999 “permuted” coefficients. As shown in the table, in each of the four
7 cases, the estimated coefficient based on actual data belongs to the top 2.5% of the distribution,
8 indicating that unobserved heterogeneity does not drive our results.
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11 As the results are robust across the different models, the following results are estimated
12 with a random effects model with independent variables lagged by one year.
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18 [Table 4]
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21 22 23 24 5.2. *Effects across industries* 25

26 Table 5 reports broadband estimates by industry, assuming homogeneous broadband
27 effects across areas (complete results in Table A.6 in the appendix). Most of our results confirm
28 previous findings. Broadband has a significantly positive impact in most industries, with the
29 highest effects for services consistent with Audretsch (2015) and Shideler and Badasyan (2012).
30 Moreover, broadband does not appear to have a stronger impact on high-order services than on
31 other services. There are at least two possible reasons. First, establishments in these technology-
32 intensive activities are likely to be sensitive to fast broadband, and thus, the threshold used here
33 (>3 Mbps) might not be high enough to act as a relevant factor in their location. Second, high-
34 order services include various activities, which could be impacted differently by broadband
35 access (Duvivier et al., 2019).
36

37 We also find a significant effect on construction, similar to Hasbi (2020) and Parajuli
38 and Haynes (2017). Note that in addition to these short-run effects (broadband provision
39 induces substantial infrastructure work), in the longer run, broadband access may also affect
40 household location (Deller and Whitacre, 2019) and thus the construction of new homes.
41

42 However, our estimates suggest that higher broadband coverage actually leads to
43 significantly lower establishment births in manufacturing. Although some studies highlight that
44 broadband has low, or even insignificant, effects on establishment births in manufacturing (Kim
45 and Orazem, 2017; Mack and Wentz, 2017), no study to our knowledge has found evidence of
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¹⁵ This model allows both controlling for individual effects and keeping the highest number of observations.

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3 negative effects. A first possible explanation is that broadband fosters establishment births in
4 higher-paying information-based industries, resulting in a crowding-out of manufacturing. The
5 positive effect of broadband on high-order services (Column 6) provides support for this
6 mechanism. Another likely explanation is that higher broadband coverage leads to stronger
7 competition from online businesses, which may adversely affect establishments that serve the
8 local market. While this kind of negative effect has only been highlighted to date for retail trade
9 and FIRE (see Section 2), it can also apply to manufacturing, where almost 90% of firms sell
10 goods on the local or regional market in France (compared to 94% for trade and 87% for finance
11 and insurance)¹⁶. We expect this effect to apply mainly to rural areas, where small
12 establishments cannot compete effectively with larger and more diversified online rivals. The
13 following table validates this interpretation.
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24 [Table 5]
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29 Table 6 presents the results for the six industries, assuming heterogeneous broadband
30 effects across areas (complete results in Table A.7). First, the positive impact estimated for
31 urban areas (see Table 3) arises from the fact that broadband significantly stimulates
32 establishment births in services: retail trade, high-order services (only for middle and small
33 centers), and food and accommodation. Note that larger centers are the only class for which
34 broadband has no significant effect on high-order services, likely because what matters for these
35 activities, in larger centers, is accessing fast broadband. This issue will be further investigated
36 in the next section.
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42 Second, broadband coverage tends to foster quite different industries in periurban areas,
43 where there is a positive effect (although significant only at the 10% level) for construction and
44 wholesale trade. Thus, it seems that broadband allows land-intensive establishments to relocate
45 to periurban areas, where land prices are lower and may still benefit from easy access to larger
46 centers. In addition, broadband also appears to favor the creation of high-order services in
47 periurban areas.
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53 Turning to rural areas, although we estimated that broadband effects were insignificant
54 for both remote and urban-influenced rural areas (Table 3), the sectoral analysis brings out
55 different patterns. On the one hand, few industries are impacted in urban-influenced areas, with
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59 ¹⁶ See the 2016 Community Innovation Survey (<http://insee.fr/fr/statistiques/3597633?sommaire=3597637>).
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3 broadband only significantly fostering high-order services. On the other hand, remote areas are
4 differentially impacted, with some sectors positively affected and others negatively, which
5 explains the global none-significant effect estimated in Table 3. More specifically, we find a
6 negative effect on wholesale trade and, most of all, on manufacturing. The fact that broadband
7 access negatively affects manufacturing in remote rural areas supports our previous explanation
8 that local producers face increased competition from online sellers. However, the negative
9 coefficient associated with wholesale trade suggests an additional explanation for
10 manufacturing. By negatively affecting local wholesalers, broadband can lead to a loss of
11 customers for local manufacturers, a non-negligible effect given that wholesaling and
12 manufacturing are often closely linked in rural areas (food-processing industry) and that the
13 food-processing industry is often one of the mainstays of local manufacturing.
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16 In contrast, broadband has a positive effect in retail trade, tourism, and high-order
17 services in remote areas. The positive impact of broadband availability on retail trade and
18 tourist-based establishments in rural areas is in line with previous findings (Duvivier et al.,
19 2018; Kandilov and Renkow, 2010).
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22 Finally, the effect of broadband access on high-order services across areas is interesting.
23 As broadband has a positive impact in almost every area outside larger centers, this suggests
24 that broadband provision may favor the dispersion of these highly concentrated activities,
25 especially in areas offering a good quality of life (Malecki, 2003).
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39 [Table 6]
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46 5.3. *Effects according to speed level*

47 We further test whether broadband effects vary according to speed level by
48 distinguishing between basic and fast broadband. Table 7 displays the results (complete results
49 in Table A.8). Overall, there appears to be no great difference between the impact of basic and
50 fast broadband. There are even some sectors (construction, food and accommodation) for which
51 basic broadband has a higher impact. The only sector for which access to high-speed broadband
52 has a significantly higher impact are high-order services and, more precisely, other knowledge-
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intensive business services (which includes the software development sector), which use rather sophisticated broadband applications.¹⁷

Table 8 presents broadband effects disaggregated by speed level and type of areas (complete results in Table A.10). When considering all industries (Column 1), faster speed levels matter more for areas that are higher up in the urban hierarchy. Indeed, in larger centers, only fast broadband has a significant impact, whereas in periurban areas only access to basic broadband matters. Small and medium centers are in an intermediate position, as both basic and fast broadband matter. This result show that high-speed connections are most likely to foster establishment births in locations with the necessary skilled workforce able to use and take advantage of advanced broadband.

Interestingly, high-speed connection also shows a positive (although weak) link with establishment births in creative industry in rural areas, suggesting that attracting creators to these locations requires fast broadband provision. In addition, mapping rural municipalities with the highest number of births in creative industry points to the role of natural amenities (Figures A.1 and A.2 in the appendix). Indeed, new creators overwhelmingly locate in rural communities with adequate broadband services provided they have a good access to natural amenities (coastal, mountainous and wildest areas). On the contrary, rural municipalities with high-speed connections in northeastern France, with an industrial history and a less pleasant climate, does not appear to attract creators. Thus, while high-speed broadband can stimulate growth in knowledge-intensive activities in non-central locations, it is not expected to alter existing trends (in particular, the quest for natural amenities). In addition, broadband does not foster the dispersion of other high-order services (FIRE and other KIBS) to rural locations.

[Table 7]

[Table 8]

6. Conclusion

¹⁷ Wald tests of equality between coefficients reported in Table A.9.

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3 This paper examines the effect of the Internet on establishment births across locations,
4 industries and speed levels. The empirical analysis is carried out for French municipalities over
5 a period of significant broadband growth using count data models.
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8 Considering overall establishment births, we find that broadband has a positive effect in
9 larger urban centers, small and medium urban centers, and periurban areas but has no significant
10 impact in rural areas (whether urban-influenced or isolated). In addition, industry-level results
11 reveal that, in non-central areas, broadband can foster establishment births in basic (retail,
12 tourism) but also in some knowledge-intensive industries (creative industry).
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17 However, broadband impact on knowledge-intensive activities in non-central areas
18 should not be overestimated. Mapping results suggest that broadband overwhelmingly
19 stimulates creative activities in rural locations with favorable fundamentals, especially as
20 regards natural amenities. Moreover, broadband has no significant impact on other knowledge-
21 intensive activities (FIRE, other KIBS) in non-central areas.
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25 Finally, there appears to be no great difference between the impact of basic and high-
26 speed broadband connections, suggesting that basic broadband (3-30 Mbps) is sufficient in most
27 cases. There are, however, two exceptions. First, fast broadband has a significantly stronger
28 effect in larger urban centers with, we may assume, the necessary skilled workforce able to use
29 sophisticated digital applications. Second, fast broadband shows a positive link with creative
30 industries in rural areas. This points to the role of high-speed connection for attracting creative
31 activities in areas with good quality of life.
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37 Overall, the results suggest that while the digital revolution is unlikely to lead to major
38 changes in the spatial distribution of economic activity, it can favor dispersion in some places
39 (small and mi-sized centers, periurban areas, rural areas with good quality of life) and some
40 industries (retail, tourism, creative businesses).
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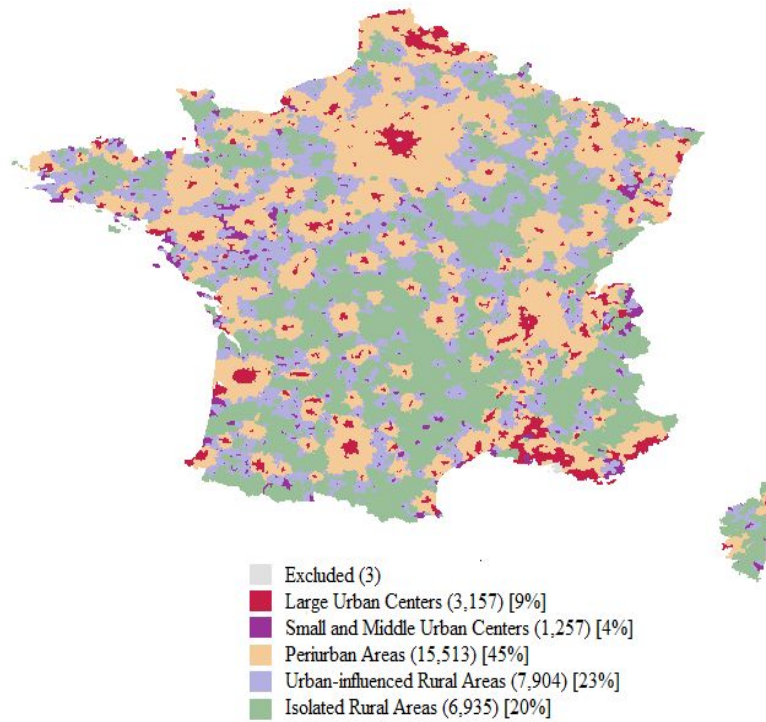
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For Peer Review

Figure 1. Classification of Municipalities



Note: the number of municipalities is given in parentheses; the share of municipalities in brackets

Figure 2. Broadband Coverage – All Areas

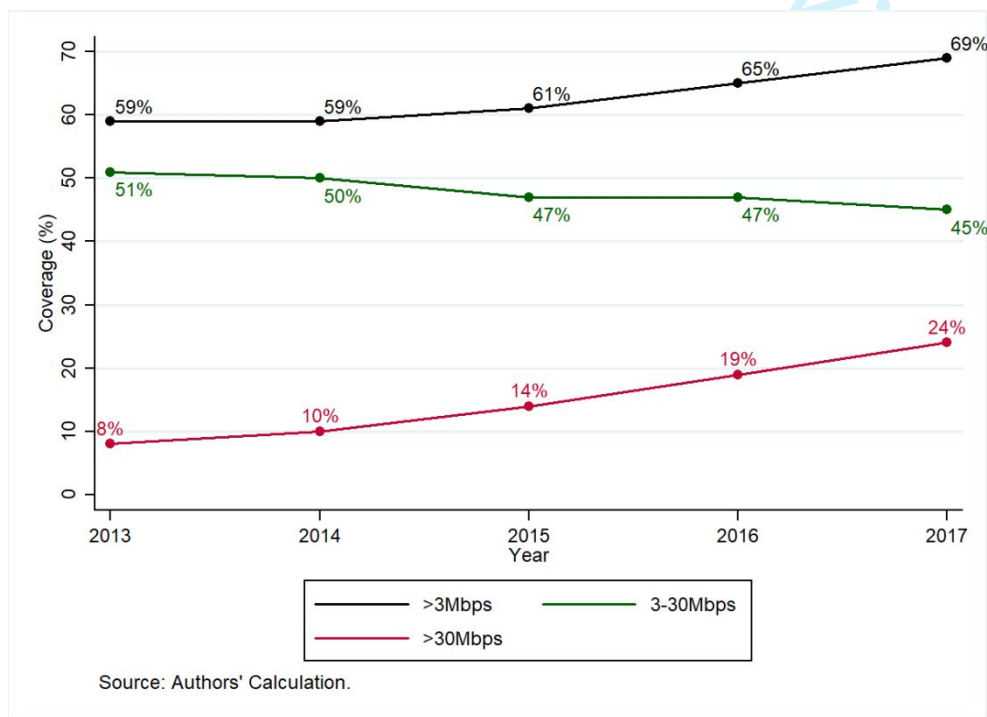


Figure 3. Broadband Coverage (>3 Mbps) – By Areas

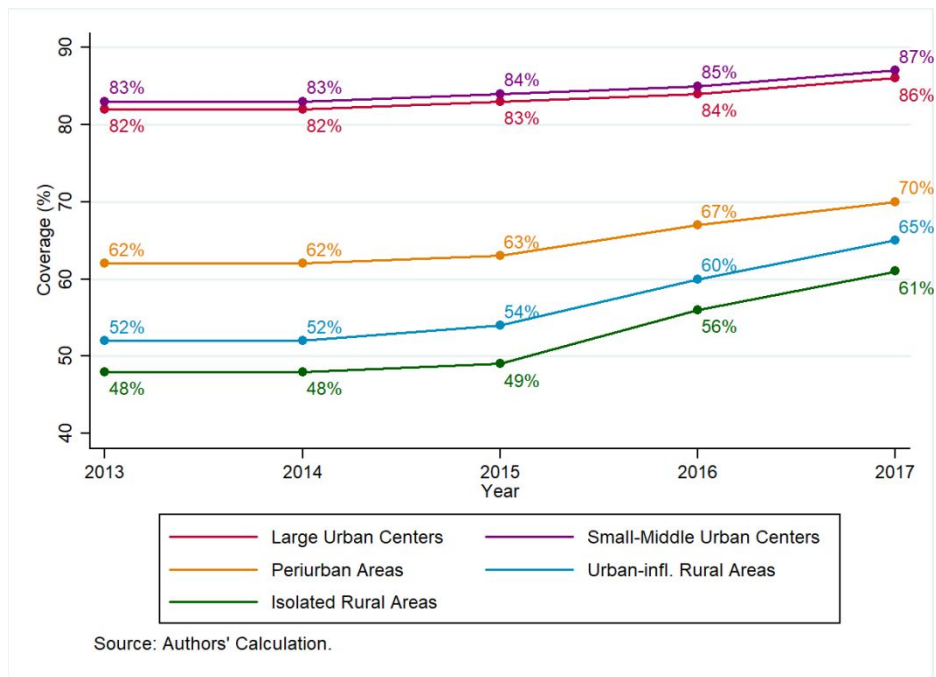


Figure 4. Fast broadband Coverage (>30 Mbps) – By Areas

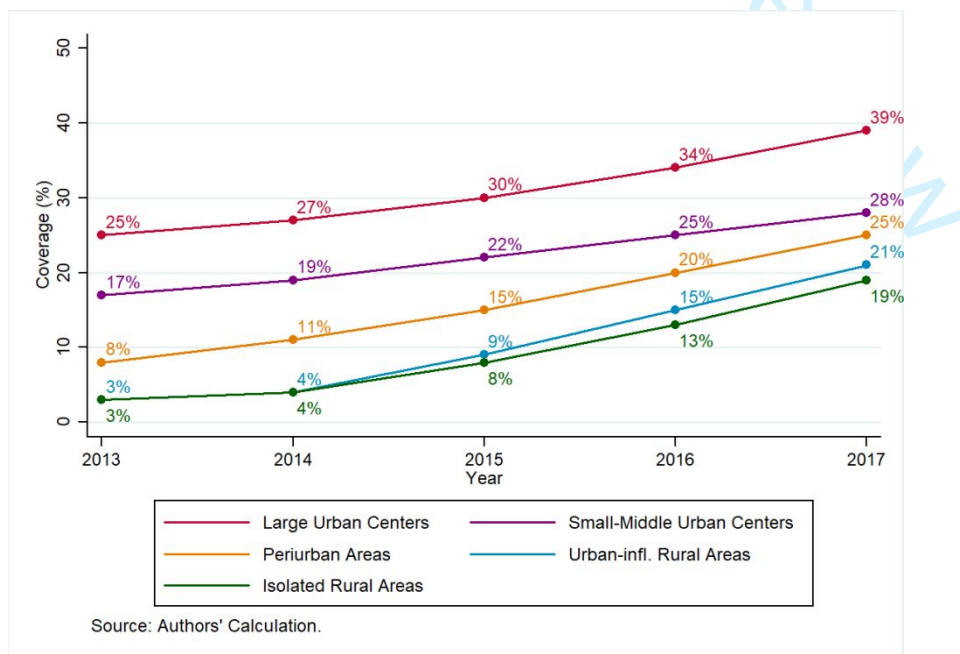


Figure 5. Basic broadband Coverage (3-30 Mbps) – By Areas

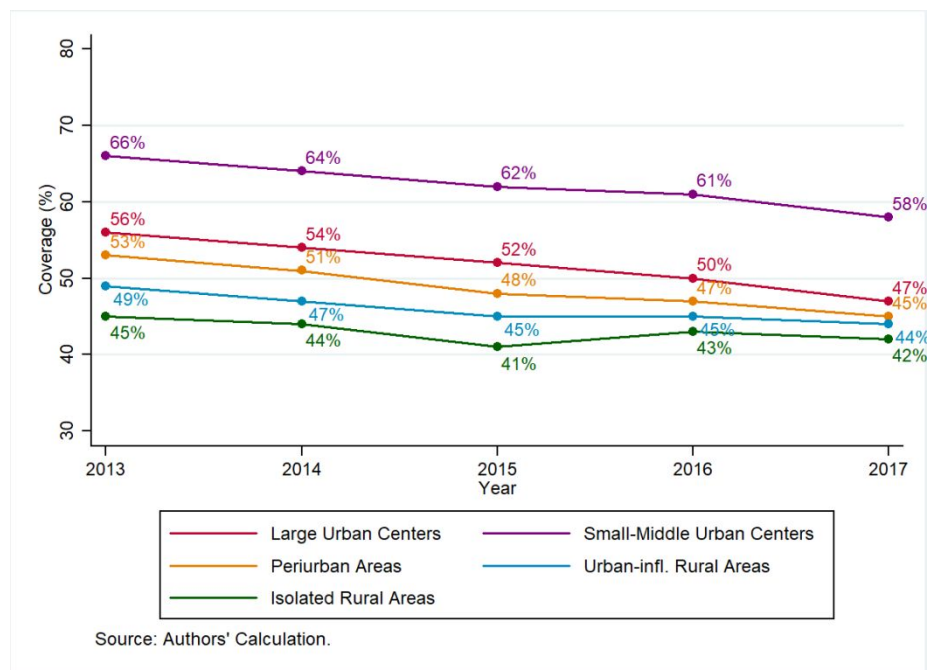


Table 1. Definition of Variables

Variable	Definition	Source
Dependent Variables		
All Sectors	Total number of establishment births	REE/Sirene, Insee, 2013-2017
Manufacturing	Number of establishment births in manufacturing	REE/Sirene, Insee, 2013-2017
Construction	Number of establishment births in construction	REE/Sirene, Insee, 2013-2017
Wholesale Trade	Number of establishment births in wholesale trade	REE/Sirene, Insee, 2013-2017
Retail Trade	Number of establishment births in retail trade	REE/Sirene, Insee, 2013-2017
Food-Accommodation	Number of establishment births in food and accommodation	REE/Sirene, Insee, 2013-2017
High-order Services	Number of establishment births in high-order services	REE/Sirene, Insee, 2013-2017
Creative Industries	Number of establishment births in creative industries	REE/Sirene, Insee, 2013-2017
FIRE	Number of establishment births in finance, insurance, and real estate	REE/Sirene, Insee, 2013-2017
Other KIBS	Number of establishment births in other knowledge-intensive services	REE/Sirene, Insee, 2013-2017
Independent Variables		
BB	Share of premises with an access of at least 3 Mbps	Observatory of the French Very High-Speed Broadband Plan, Digital Agency, 2013-2017
BasicBB	Share of premises with an access between 3 and 30 Mbps	Observatory of the French Very High-Speed Broadband Plan, Digital Agency, 2013-2017
FastBB	Share of premises with an access of at least 30 Mbps	Observatory of the French Very High-Speed Broadband Plan, Digital Agency, 2013-2017
Employment	Total number of jobs (ln)	Census of population, Insee, 2012-2016
Population	Total population (ln)	Census of population, Insee, 2012-2016
Seniors	Percentage of the population aged 60+	Census of population, Insee, 2012-2016
University	Percentage of individuals that have a university degree	Census of population, Insee, 2012-2016
Time_20,000+	Travel time by road network to the nearest city with at least 20,000 inhabitants	Census of population, Insee, 2012-2016. Calculations performed with Odomatrix*
Time_railway	Travel time by road network to the nearest railway station	Base permanente des équipements, Insee, 2012-2016. Calculations performed with Odomatrix*
WPopulation	Average of the neighboring municipalities' population	Census of population, Insee, 2012-2016
WEmployment	Average of the neighboring municipalities' number of jobs	Census of population, Insee, 2012-2016
WUniversity	Average of the neighboring municipalities' rate of university graduates	Census of population, Insee, 2012-2016
LargerCenters	Dummy variable ; 1 if the municipality is belongs to a larger urban center	2010 division into urban areas, Insee
SmallMiddleCenters	Dummy variable ; 1 if the municipality is belongs to a small or medium urban center	2010 division into urban areas, Insee
Periurban	Dummy variable ; 1 if the municipality is located in a periurban area	2010 division into urban areas, Insee
UrbanInfluencedRural	Dummy variable ; 1 if the municipality is located in an urban-influenced rural area	2010 division into urban areas, Insee
Isolated	Dummy variable ; 1 if the municipality is located in an isolated rural area	2010 division into urban areas, Insee

Table 2. Homogeneous Effects across Areas - All industries

	(1)	(2)	(3)	(4)
	Pooling (.1)	Random Effects (.1)	Pooling (.21)	Random Effects (.21)
BB	0.036*** (0.005)	0.026*** (0.006)	0.036*** (0.006)	0.032*** (0.007)
Employment	0.025*** (0.007)	0.021*** (0.008)	0.022** (0.008)	0.013 (0.009)
Employment_sq	0.014*** (0.001)	0.013*** (0.001)	0.014*** (0.001)	0.014*** (0.001)
Population	0.923*** (0.018)	0.916*** (0.021)	0.937*** (0.022)	0.952*** (0.024)
Population_sq	-0.008*** (0.001)	-0.007*** (0.002)	-0.009*** (0.002)	-0.010*** (0.002)
Seniors	0.370*** (0.029)	0.244*** (0.032)	0.369*** (0.034)	0.306*** (0.035)
University	1.326*** (0.035)	1.164*** (0.041)	1.379*** (0.042)	1.240*** (0.047)
Time_20,000+	0.007** (0.003)	0.009** (0.003)	0.003 (0.003)	-0.002 (0.004)
Time_railway	0.005*** (0.002)	-0.005*** (0.002)	0.004** (0.002)	-0.003 (0.002)
WPopulation	0.002*** (0.000)	-0.003*** (0.000)	0.003*** (0.001)	0.001** (0.001)
WEmployment	-0.000*** (0.000)	0.000*** (0.000)	-0.000*** (0.000)	-0.000* (0.000)
WUniversity	0.459*** (0.045)	0.810*** (0.057)	0.512*** (0.054)	0.772*** (0.063)
LargerCenters	-0.085*** (0.008)	-0.074*** (0.010)	-0.087*** (0.009)	-0.084*** (0.011)
SmallMiddleCenters	-0.078*** (0.009)	-0.080*** (0.011)	-0.084*** (0.010)	-0.085*** (0.011)
Periurban	-0.076*** (0.007)	-0.084*** (0.008)	-0.079*** (0.008)	-0.084*** (0.008)
UrbanInfluencedRural	-0.091*** (0.007)	-0.092*** (0.008)	-0.093*** (0.008)	-0.094*** (0.008)
Constant	-4.908*** (0.052)	-2.941*** (0.069)	-4.959*** (0.060)	-3.080*** (0.077)
Regional dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
lnalpha	-2.710*** (0.018)		-2.670*** (0.021)	
ln_r		4.904*** (0.029)		4.877*** (0.033)
ln_s		2.998*** (0.018)		2.969*** (0.020)
Observations	139,064	139,064	104,298	104,298
Pseudo R ²	0.347		0.346	
AIC	591,432.17	577,076.55	442,781.81	433,294.02
BIC	591,845.56	577,499.79	443,173.56	433,695.33

Note: standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01. Columns (1) and (2): broadband variable lagged by one year. Columns (3) and (4): broadband variable lagged by two years.

Table 3. Heterogeneous Effects across Areas - All industries

	(1)	(2)	(3)	(4)
	Pooling (.1)	Random Effects(.1)	Pooling(.21)	Random Effects(.21)
BB_LargerCenters	0.049*** (0.014)	0.068*** (0.019)	0.041** (0.016)	0.048** (0.021)
BB_SmallMiddleCenters	0.149*** (0.031)	0.122*** (0.038)	0.146*** (0.036)	0.122*** (0.041)
BB_Periorban	0.030*** (0.007)	0.020** (0.009)	0.033*** (0.008)	0.029*** (0.009)
BB_UrbanInfluencedRural	0.031*** (0.011)	0.019 (0.013)	0.027** (0.013)	0.021 (0.015)
BB_Isolated	0.033** (0.013)	0.013 (0.014)	0.038** (0.015)	0.031* (0.016)
Observations	139,064	139,064	104,298	104,298
Pseudo R ²	0.347		0.346	

Note: standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01. Columns (1) and (2): broadband variable lagged by one year. Columns (3) and (4): broadband variable lagged by two years.

Table 4. Falsification Tests

	(1)	(2)
	"True" coefficient	95% Confidence Interval
All areas	0.026	[-0.006; 0.006]
Larger Urban Centers	0.068	[-0.011; 0.012]
Small and Medium Urban Centers	0.122	[-0.016; 0.018]
Periorban Areas	0.020	[-0.008; 0.007]

Note: "Coefficient" refers to the coefficient estimated in the baseline model with random-effects and broadband lagged by one year (column (2) in tables 3 and 4

Table 5. Homogeneous Effects across Areas - By industry

	(1)	(2)	(3)	(4)	(5)	(6)
	Manufacturing	Construction	Wholesale trade	Retail trade	Food-Accommodation	High-order services
BB	-0.078***	0.027**	0.006	0.073***	0.062***	0.041***
	(0.016)	(0.013)	(0.017)	(0.016)	(0.020)	(0.011)
Observations	139,064	139,064	139,064	139,064	139,064	139,064

Note: standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 6. Heterogeneous Effects across Areas - By industry

	(1)	(2)	(3)	(4)	(5)	(6)
	Manufacturing	Construction	Wholesale Trade	Retail Trade	Food-Accommodation	High-order services
BB_LargerCenters	0.015	-0.001	-0.006	0.150***	0.157***	0.040
	(0.051)	(0.035)	(0.041)	(0.041)	(0.061)	(0.028)
BB_SmallMiddleCenters	-0.086	0.058	0.067	0.345***	0.298***	0.158**
	(0.093)	(0.073)	(0.095)	(0.084)	(0.112)	(0.064)
BB_Periorban	-0.042*	0.030*	0.039*	0.025	0.021	0.030**
	(0.023)	(0.017)	(0.023)	(0.021)	(0.030)	(0.015)
BB_UrbanInfluencedRural	-0.038	0.020	-0.029	0.038	0.045	0.051**
	(0.032)	(0.027)	(0.038)	(0.033)	(0.041)	(0.026)
BB_Isolated	-0.240***	0.046	-0.090**	0.154***	0.079**	0.054*
	(0.033)	(0.032)	(0.046)	(0.036)	(0.038)	(0.029)
Observations	139,064	139,064	139,064	139,064	139,064	139,064

Note: standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 7. Effects by Speed Level – Homogeneous across Areas

	(1)	(2)	(3)	(4)	(5)
	All Sectors	Manufacturing	Construction	Wholesale Trade	Retail Trade
BasicBB	0.026*** (0.007)	-0.080*** (0.017)	0.040*** (0.013)	0.009 (0.018)	0.079*** (0.016)
FastBB	0.026***	-0.070***	-0.001	0.001	0.062***
Observations	139,064	139,064	139,064	139,064	139,064

Table 7. (Continued)

	(6)	(7)	(8)	(9)	(10)
	Food-Accommodation	High-order Services	Creative Industries	FIRE	Other KIBS
BasicBB	0.072*** (0.021)	0.034*** (0.012)	0.041* (0.023)	0.044** (0.022)	0.030* (0.015)
FastBB	0.038 (0.025)	0.053*** (0.013)	0.066*** (0.024)	0.018 (0.024)	0.063*** (0.017)
Observations	139,064	139,064	139,064	139,064	139,064

Note: standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 8. Effects by Speed Level – Heterogeneous Effects across Areas

	(1)	(2)	(3)	(4)	(5)
	All Sectors	Manufacturing	Construction	Wholesale Trade	Retail Trade
BasicBB_LargerCenters	0.028 (0.021)	0.035 (0.055)	0.019 (0.038)	0.001 (0.045)	0.165*** (0.045)
FastBB_LargerCenters	0.075*** (0.019)	0.007 (0.052)	-0.014 (0.036)	-0.009 (0.042)	0.142*** (0.041)
BasicBB_SmallMiddleCenters	0.140*** (0.042)	-0.133 (0.104)	0.126 (0.080)	0.200* (0.106)	0.324*** (0.092)
FastBB_SmallMiddleCenters	0.104** (0.041)	-0.048 (0.101)	-0.011 (0.079)	-0.033 (0.102)	0.355*** (0.089)
BasicBB_Periurban	0.032*** (0.009)	-0.045* (0.025)	0.046** (0.018)	0.030 (0.025)	0.043* (0.023)
FastBB_Periurban	-0.001 (0.011)	-0.036 (0.030)	-0.004 (0.022)	0.048* (0.028)	-0.006 (0.027)
BasicBB_UrbanInfluencedRural	0.019 (0.014)	-0.069** (0.035)	0.030 (0.029)	-0.028 (0.042)	0.035 (0.035)
FastBB_UrbanInfluencedRural	0.016 (0.020)	0.050 (0.051)	-0.018 (0.042)	-0.035 (0.057)	0.040 (0.049)
BasicBB_Isolated	0.016 (0.015)	-0.213*** (0.035)	0.031 (0.034)	-0.077 (0.050)	0.140*** (0.038)
FastBB_Isolated	-0.002 (0.021)	-0.315*** (0.054)	0.074 (0.048)	-0.123* (0.066)	0.181*** (0.050)
Observations	139,064	139,064	139,064	139,064	139,064

Table 8. (Continued)

	(6)	(7)	(8)	(9)	(10)
	Food- Accommodation	High-order Services (HOS)	HOS: Creative Industries	HOS: FIRE	HOS: Other KIBS
BasicBB_LargerCenters	0.136** (0.066)	0.008 (0.031)	0.009 (0.051)	0.023 (0.052)	0.003 (0.036)
FastBB_LargerCenters	0.157** (0.061)	0.051* (0.028)	0.046 (0.047)	-0.045 (0.049)	0.081** (0.033)
BasicBB_SmallMiddleCenters	0.285** (0.123)	0.142** (0.071)	0.340** (0.135)	0.094 (0.120)	0.095 (0.090)
FastBB_SmallMiddleCenters	0.295** (0.118)	0.173** (0.068)	0.357*** (0.128)	0.089 (0.113)	0.116 (0.086)
BasicBB_Periurban	0.066** (0.032)	0.034** (0.016)	0.043 (0.031)	0.030 (0.030)	0.035* (0.021)
FastBB_Periurban	-0.059 (0.038)	0.025 (0.018)	0.026 (0.035)	0.035 (0.033)	0.023 (0.023)
BasicBB_UrbanInfluencedRural	0.028 (0.044)	0.043 (0.028)	0.061 (0.056)	0.044 (0.053)	0.046 (0.038)
FastBB_UrbanInfluencedRural	0.074 (0.061)	0.071* (0.038)	0.130* (0.075)	0.094 (0.069)	0.052 (0.051)
BasicBB_Isolated	0.088** (0.040)	0.044 (0.032)	-0.000 (0.063)	0.079 (0.059)	0.054 (0.043)
FastBB_Isolated	0.031 (0.056)	0.077* (0.042)	0.152* (0.082)	0.101 (0.074)	0.053 (0.057)
Observations	139,064	139,064	139,064	139,064	139,064

Note: standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.