Impact of Very High-Speed Broadband on Local Economic Growth: Empirical Evidence*

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Abstract

I use micro-level panel data on almost 5,000 municipalities in metropolitan France covering 75% of the population over the period 2010-2015 to estimate the impact of very high-speed broadband networks on some measures of local economic growth in France. I use a count modeling approach with time- and municipal-fixed effects to estimate whether the local presence of a very high-speed broadband network has an impact on business location, in terms of establishment creation. I show that municipalities with a very high-speed broadband network tend to be more attractive for companies, with a positive effect on establishment creation. However, this positive impact is only significant for new establishments created within the tertiary sector: in the commerce service and transport sub-sector. In addition, municipalities with a very high-speed broadband network provide a more favorable environment for entrepreneurship, as it has a positive effect on the creation of sole proprietorships.

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1 Introduction

Very high-speed broadband networks are seen as a key enabler for socio-economic development. Their roll-out has been made a priority worldwide and is considered as an investment for the future. Over the last few years, many countries, such as the US,[1] Australia,[2] Japan[3] and Mexico[4] have adopted a national broadband plan to ensure the whole coverage of their territory. In the European Union, the Commission has defined in 2013 a Digital Agenda for Europe, with the objective to provide by 2020 every household with access to at least a 30 Mbps connection and half of the households with a subscription at 100 Mbps.[5] The Digital Agenda for Europe distinguishes different ranges of broadband speeds: basic broadband (between 256 Kbps and 30 Mbps), fast broadband (above 30 Mbps and up to 100 Mbps) and ultra fast broadband (above 100 Mbps). Very high-speed broadband includes both fast and ultra-fast broadband with speed above 30 Mbps. In September 2016, the Commission reiterated its vision to turn Europe into a Gigabit Society by 2025.[6]

Higher connection speeds would allow all users, households, businesses and administrations, regardless of their size or geographic location, to benefit from enhanced and more efficient broadband services. It shapes the way companies do business, enhancing their capacities and broadening their markets. It improves households' online experience, allowing them to use multiple connected devices at the same time, benefit from faster download speeds and carry on online transactions.

[1] "Connecting America: The National Broadband Plan, Federal Communications Commission," March 2010.
[2] "The National Broadband Network" April 2009, modified in 2013.
[3] "E-Japan Strategy" 2001.
[4] "Mexican Digital Agenda" 2011.
[5] "A Digital Agenda for Europe," European Commission, COM(2010) 245.
[6] "State of the Union 2016: Towards a Better Europe - A Europe that Protects, Empowers and Defends".

The contribution of this paper is to analyze whether very high-speed broadband availability has a causal impact on measures of local economic growth. Specifically, I investigate whether very high-speed broadband networks have an effect on the creation of new businesses of all non-farm market sectors operating locally. I highlight the impact of these networks on entrepreneurship, with a specific focus on the creation of sole proprietorships. I adopt a technology neutral approach by including all technologies delivering very high-speed services: fiber optical network (Fiber to the Home; FttH) and upgraded cable (Fiber to the Last Amplifier; FttLA). To the best of my knowledge, this is the first paper to estimate the impact of very high-speed broadband networks on economic growth at a granular local level. The results provide policymakers with better insights on the impact of very high-speed broadband on the local economy.

This study relies on panel data covering 4,933 municipalities located in metropolitan France, representing approximately 75% of the population, over 6 years, from 2010 to 2015. Panel data allow to control for municipal- and time-specific heterogeneity. The three French largest cities, Paris, Lyon and Marseille are excluded from the analysis. These cities are attractive by themselves for companies and households. They are the three largest municipalities in terms of population and are the only one decomposed into arrondissements (districts), with their own mayor and municipal council. In addition, only municipalities with at least 2,000 inhabitants are included in the database.

To estimate the impact of very high-speed broadband networks on local economic growth, I use a count modeling framework with fixed effects. I also use matching estimators and difference-in-differences techniques as robustness checks. These evaluation methods are commonly used to estimate the average effect of a treatment or policy intervention.

I find evidence of the benefits of very high-speed broadband networks for local economic growth. They enhance municipalities attractiveness for new establishments from the tertiary sector, which rely more on ICTs. In addition, municipalities with a very high-speed broadband networks provide a more favorable environment for entrepreneurship, as it has a positive effect on the creation of sole proprietorships. However, I don't find any significant effect on the creation of new businesses in the industry or in the construction sectors.

The remainder of the paper is organized as follows. Section **??** discusses the relevant literature on the effect of broadband on economic growth and deployment. Section **??** presents the data. Section **??** introduces the econometric framework. Section **??** presents the estimation results. Finally, Section **??** concludes.

2 Literature Review

There is a substantial literature on the effect of ICT on GDP and more generally on economic growth at the national and regional level (see Czernich et al. (2014) and Kretschmer (2012) for literature reviews). It is widely accepted that, at the national level, ICT adoption has a positive effect on productivity. However, ICT is a fairly large category regrouping basic equipments along with different types of Internet connections from narrowband to broadband of all speeds and more advanced fiber-optical broadband technologies.

With the steadily growing international enthusiasm for broadband deployment and today for the roll-out of high-speed broadband networks, researchers are becoming more interested in evaluating the role of broadband on economic growth. There is an extensive range of macro-level studies which bring empirical evidence on the positive impact of broadband adoption on

economic growth (see Bertschek et al. (2013), Greenstein et al. (2011) and Holt et al. (2009) for comprehensive literature reviews). Gruber et al. (2014) evaluate the net economic benefits that would derive from the achievement of the objectives of the 2020 Digital Agenda for Europe. They find that the economic benefits outweigh the costs of investment. Besides, they show that the economic benefits are only marginally appropriable by firms, as they mostly spill over to users and to the national economy. This result confirms other studies which found a positive impact of broadband availability on consumer surplus (see for example Crandall et al. (2001) and Dutz et al. (2009)). Thus, Gruber et al. (2014) show that there is a rationale for public subsidies in the roll-out of broadband networks. Other studies for the US have found a positive relation between broadband availability and employment (Crandall et al. (2007), Gillett et al. (2006)). However, there is limited empirical evidence of the effect of broadband availability on economic growth at the local level, especially in rural areas.

Usually, studies realized at the local-level assess the impact of ICT on variables of local economic growth (see, for example, Kolko (2012)). There are only few papers focusing specifically on the effect of broadband adoption on local economic growth. Czernich (2011 and 2014) for German municipalities and Jayakar et al. (2013) for eight States in the US find no evidence that broadband availability reduces the unemployment rate. On the contrary, Whitacre et al. (2014) find that broadband adoption, availability and download speeds have an impact on economic growth in rural areas. They use a propensity score matching estimator on local-level data for non-metropolitan US counties for the years 2001 to 2010. They highlight a positive impact on unemployment reduction and on median household income. They also show that rural areas with high levels of download speeds tend to attract more creative class workers and to have a

lower poverty level.

As far as firms are concerned, the literature focuses on the impact of broadband on productivity. Haller et al. (2015) show that on average more productive firms are more likely to have a DSL broadband connection, but they find no evidence of an impact of broadband adoption on firms' productivity or on productivity growth. Similarly, Bertschek et al. (2013) find no effect on labor productivity, but they find a positive effect on firms' innovation activities. Akerman et al. (2015) show that broadband availability and adoption increases the productivity of skilled workers, acting as a skill complement and lowers the productivity of unskilled workers, acting as a substitute for routine tasks.

Only few studies analyze the effect of broadband on the attractiveness of a territory for firms. In her analysis, Mack (2014) evaluates the correlation between broadband speed and the establishment presence in Ohio. She finds a positive impact of broadband speed for agricultural and rural companies. However, she does not establish any causal relationship. Using local-level data, McCoy et al. (2016) analyze the impact of local infrastructure and of broadband networks on new business creation in Ireland, excluding the Dublin city region. They find that on average areas covered by broadband are more attractive for firms.

This paper is related to the latter stream of literature. However, most of the studies on the impact of broadband on local economic growth focus on the impact of old generation broadband technologies, such as DSL or co-axial cable technologies and ignore the new high-speed broadband technologies. I attempt to fill this gap by assessing the impact of very high-speed broadband technologies, including fiber optical technology (Fiber to the Home) and upgraded cable technology (DOCSIS 3.0 or Fiber to the Last Amplifier or FttLA). Besides, though realized

at the local level, most of the studies are performed at a more aggregated level, which is either the State or the county. I use data on 4,933 municipalities over 6 years, from 2010 to 2015. To the best of my knowledge, this is the first paper, which at such a granular local level, analyzes the impact of very high-speed broadband network on local economic growth. I specifically focus on the effect of very high-speed broadband networks on the number of firms operating locally, on the creation of new businesses.

3 Data

The data used in this analysis come from a wide range of sources covering a period which spans from 2006 to 2015. Descriptive statistics are reported in the Annex.

3.1 Dependent Variables

Data on the number of establishment creations come from INSEE, the French National Institute for Statistics and Economics Studies. They have been collected for each municipality for the years 2008 to 2015. For each year, I have information for the three main non-farm market sectors: the industrial sector, the construction sector and the tertiary sector.

The construction sector is essentially an activity of deployment, installation or maintenance on the customer's work-site. The industrial sector is also implicated in network deployments, but to a lower extent than companies from the construction sector. The industrial sector regroups all activities combining factors of production (facilities, supplies, work, knowledge) to produce material goods intended for the market.

The tertiary sector encompasses a vast field of activities, ranging from commerce to adminis-

tration, via transport, financial and real estate activities, services to business, personal services, education, health and social services. Therefore, I collected data for three sub-sectors of the tertiary sector: the commerce, transport and services; the provision of services to companies and the provision of services to households.

3.2 Very high-speed Broadband Networks

I also use a panel dataset on fiber deployment in metropolitan France (Corsica excluded) over 9 years, from 2006 to 2014. The data have been extracted from Orange's Information System, SFR's website and Free users' community websites. Orange is the historical fixed-line incumbent. It owns the legacy copper network, which is used to provide DSL broadband services. SFR and Free are alternative operators which do not possess their own copper network. They provide broadband services by leasing access to the incumbent's local access network via local loop unbundling (LLU).[7] All data on fiber deployments provide information at the municipal level, with each municipality identified by a unique geographic code (the INSEE code). I have information on 36,036 French municipalities out of the 36,192 municipalities counted in metropolitan France in 2014. For each municipality, I know whether Orange and/or SFR has deployed an FttH network.[8]

Regarding Free, the data have been extracted on an unofficial website updated by Free's users community.[9] The data are consistent with information gathered on other websites, as well as with Free's Annual Reports. For each municipality, I know whether there are active fiber

[7] Orange, SFR and Free are also the main competitors on the mobile market.

[8] The database used in this study is similar to the one used in Bourreau, Grzybowski and Hasbi "Unbundling the Incumbent and Entry into Fiber: Evidence from France". Further details upon the database construction and data collection provided on request.

[9] See http://francois04.free.fr/ and http://serge.31.free.fr/.

connections from Free.

Data on cable upgrade to FttLA have been extracted from Numericable's website for the years 2010 to 2014. Numericable is the French cable-operator.[10] For each municipality, I know whether Numericable has upgraded its cable network to provide very high-speed broadband services.

3.3 Explanatory Variables and Controls

This dataset has been completed with two other sources. First, socio-demographic characteristics come from INSEE. I have economic data such as the unemployment rate at the municipal level for the years 2006 to 2013. Information on the different socio-professional groups and diplomas have also been collected for the years 2006 to 2013. Some other municipality characteristics have also been extracted from INSEE databases, such as population density, number of households, number of housing or the municipal urbanization degree. These informations have all been collected by INSEE for the years 2006 to 2012.

Second, data on the average fiscal income per municipality has been collected from the General Direction of Public Finance's website (Gouvernment Taxes Services, DGFIP) for the years 2007 to 2014. The average fiscal income is measured in the previous year, as people pay taxes on the year before. In other words, the amount of taxes paid for the year 2015 is calculated on the income received in 2014.

[10] Numericable's cable network covers 30% of the population, living mostly in urban areas.

4 Econometric Strategy

The choice of a location for a new company to operate is a fundamental decision, key to its success. Companies incur a fixed cost when settling down. The choice of the company is driven by cost factors, such as the tax regime in the locality, the availability of infrastructures, such as transportation infrastructures, broadband infrastructures, but also by the cost and availability of human capital. In addition, companies consider the potential demand in the market for their products or services.

4.1 Empirical Approach

The empirical literature on business location decisions is generally based on two approaches: discrete choice modeling and count modeling. The first discrete choice modeling approach is based on the analysis of business location decision as a function of firm characteristics, including the size and the industry sector, and alternative local characteristics, including population, human capital and infrastructures.[11] The unit of analysis is the company, whereas in the second count modeling approach, the unit of analysis is the territory. In this latter approach, the analysis consists in assessing how location characteristics can influence business location in the form of the count of businesses in each territorial unit.[12] The underlying assumption is that the number of new establishments that settle in a locality over a time period is determined by an equilibrium condition between a stochastic supply function representing the willingness of a company to start its business in the territory and a stochastic demand function for new firms in

[11] See Arauzo-Carod (2008) and Arauzo-Carod and Manjon-Antolin (2012) for a thorough discussion. For recent studies, see Alama-Sabater et al. (2011) and Siedschlag et al. (2013)

[12] See Jofre-Monseny et al. (2011) and Bhat et al. (2014).

the territory.[13]

Given the type of data available, I implement a count model to address my main question, which is whether very high-speed broadband networks have a causal effect on some socio-demographical variables of policy relevance: the number of new establishments created locally for each year, disaggregated into the three main non-farm market sectors of the economy: the construction sector, the industrial sector and the tertiary sector. I also estimate whether the presence of these networks has an impact on entrepreneurship, with the creation of sole proprietorships.

I follow the econometric literature by using a fixed effects model to eliminate potential endogeneity stemming from time-varying and time-unvarying regressors. The count of new companies operating in a municipality for each time period are modeled as a function of the local characteristics, with municipal- and time-fixed effects.

Then, I have,

$$Y_{it+1} = \alpha + \delta\ superfastbb_{it} + \beta\ X_{it-2} + \gamma\ Z_{it-2} + year + \eta_i + \epsilon_{it}. \tag{1}$$

Where :

$$Y_{it+1} = 0, 1, 2, ... \tag{2}$$

Y_{it+1} is the count (or number) of new establishments operating in municipality i at time $t+1$. The variable of interest consists in a dummy variable, denoted $superfastbb_{it}$, which indicates

[13]Following Becker and Henderson (2000), the equilibrium condition can be represented by a reduced form stochastic distribution for the count of new businesses.

whether a very high-speed broadband network has been deployed in municipality i at time t. I adopt a technology neutral approach by including all technologies through which very high-speed broadband services can be delivered: fiber optical network (FttH) and upgraded cable network (FttLA).[14]

X_{it-2} is a matrix of location characteristics for municipality i at time $t-2$ and Z_{it-2} a matrix of labor market characteristics for municipality i at time $t-2$. η_i is a time unvarying fixed effect describing the influence of specific municipal characteristics, which may affect the attractiveness of the municipality and therefore bias the outcome of interest.[15] For example, this can include a specific tax regime to attract companies, lower costs of capital, different regulations applying to real-estate, the presence of a specific regional policy. *year* is a dummy variable for each year capturing year specific fixed effects. Finally, ϵ_{it} is an i.i.d. standard error clustered at the municipal level, capturing unobserved factors.

4.2 Potential Endogeneity

As highlighted in the literature, there is a potential endogenous effect of broadband networks on company creation and more generally on economic activity, see, for example, Kolko (2012), Mack et al. (2011) and McCoy et al. (2016)). Economic activities are more likely to thrive in areas with enhanced broadband infrastructures. In the meantime, areas with better broadband infrastructures are more likely to attract economic activities. Therefore, this effect materializes mostly as reverse causality between the number of companies operating locally and very high-

[14] Due to data constraints, I estimate the effect of very high-speed broadband networks at time t on the number of new establishments at time $t+1$. The latest data available for establishment creation is 2015. I estimate here a short-term effect. With longer dataset, it could be possible to estimate a medium or long-term effect.

[15] Due to data constraints, I estimate the effect of Z at time $t-2$ on the number of new establishments at time $t+1$. The latest data available for some variables included in matrix Z is 2012.

speed broadband availability.

In their analysis of the impact of local broadband infrastructures on new business establishment, McCoy and al. (2016) argue that the endogenous relationship that exists between broadband networks and companies is more likely to affect the stock of existing companies rather than the flow of company creations. Operators would rather decide to roll-out a broadband network in areas with a large number of companies and companies would rather settle down in areas with improved broadband infrastructures.

To mitigate this endogeneity problem, they restrict their analysis to new firm in each year and control for the pre-existing employment levels for each area and for each time period. Similarly, to lessen this problem of endogenous relationship, I follow their argument and I estimate the impact of very high-speed broadband networks on the number of new establishments created in each year, instead of the total number of establishments operating locally. I also control for pre-existing level of companies for each area and each year using a 2 years lagged variables. Nevertheless, I assume that my estimation results would likely suffer from an upward bias.

In addition, the local labor market variables may also suffer from reverse causality. It includes the proportion of people with a third-level diploma, the number of people from the different socio-professional groups and the unemployment rate. Households could choose to locate in areas with better job prospects and companies in areas in which they could higher their labor forces.

To alleviate this concerns, I use 2 years lagged variables. I conduct robustness checks with lags of 3 years and 1 year, which give similar qualitative results. Besides, I estimate the impact of very high-speed broadband on local economic growth with other modeling approaches as

robustness checks.

Moreover, omitted variables may also be a potential source of endogeneity. For example, operators may have higher incentive to deploy a very high-speed broadband network in areas in which they can benefit from a more favorable tax regime or in which there is higher demand for faster broadband services. To mitigate this problem, I follow the econometric literature by using time-varying and time-unvarying fixed effects.

4.3 Empirical Models

In their decision to settle in a locality, I expect firms to be influenced by the potential market size and the quality of demand, in terms of expected purchasing power. In addition, I expect that firms take into account the level of education and the composition of the population, in terms of qualification. I use lag variables of two years to control for potential issues of reverse causality.[16]

The model is estimated using a sub-dataset, which excludes the three main French agglomerations, Paris, Lyon and Marseille. They are the three largest municipalities in terms of population and are the only one decomposed into arrondissements (districts), with their own mayor and municipal council.[17] In addition, only municipalities with at least 2,000 inhabitants are included in the database. It is rather unlikely that private operators deploy a very high-speed broadband network in a municipality with less than 2,000 inhabitants. Therefore, the database includes 4,933 municipalities over 6 years, from 2010 to 2015.

[16] For all specifications different lags have been estimated, results are qualitatively similar.

[17] Population in 2013: Paris: 2.2 millions inhabitants, Marseille: 855,393 inhabitants, Lyon: 500,715 inhabitants, the fourth largest is Toulouse with 458,298 inhabitants, but there is no arrondissement in Toulouse.

For the number of establishment creations,[18]

$$\begin{aligned} ln\_new\_establishment_{it+1} = \ & \alpha + \ \delta \ superfastbb_{it} + \ \beta_1 \ establishment_{it-2} \\ & + \beta_2 \ ln\_households_{it-2} + \ \beta_3 \ density_{it-2} + \ \beta_4 \ income_{it-2} + \ \gamma_1 \ unempl_{it-2} \\ & + \gamma_2 \ perc\_uni\_diploma_{it-2} + \ \gamma 3 \ socio\_professional\_groups_{it-2} + \ year + \ \eta_i + \ \epsilon_{it}, \end{aligned} \tag{3}$$

where $ln\_new\_establishment_{it+1}$ represents the number of new companies (in log) that have been created in municipality i at time $t+1$ and $establishment_{it-2}$ represents the number of establishments operating in municipality i at time $t-2$. As a matter of fact, the number of establishment in a locality is highly correlated with the number of establishment in the previous years. I control for firm characteristics by disaggregating the establishment into the three non-farm market sectors of the economy: the construction sector, the industrial sector and the tertiary sector.

The tertiary sector is the one which is predicted to benefit the most from the presence of very high-speed broadband. However, this sector is quite large and includes activities ranging from commerce, transportation, services and administration. It is however possible to disentangle the effects of very high-speed broadband networks on the creation of establishments from three sub-sectors: the commerce, transport and services; the provision of services to companies and the provision of services to households.

I also add the number of households (in log) in municipality i at time $t-2$, which is a proxy for the market size, as well as the population density in municipality i at time $t-2$. Besides, I add the average fiscal income and the unemployment rate in municipality i at time $t-2$. Both

[18] I use log-transformation for better interpretation. Few municipalities have 0 establishment creation, I set this number to 1. Results are qualitatively similar in terms of signs and significance.

variables are approximations for the quality of demand, in terms of purchasing power.

As education plays a role on the decision of firms to operate locally, I add the percentage of inhabitants with a diploma from superior education in municipality i at time $t-2$, as well as, the number of inhabitants of the different socio-professional groups in municipality i at time $t-2$, which are a proxy for the qualification of the population. There are 6 socio-professional groups: Farmers (group 1), craft workers, retailers, and business owners (group 2), intermediate occupations (group 3), white collars (group 4), employees (group 5) and blue collars (group 6).

In a second specification, I make a specific focus on entrepreneurship, by assessing the impact of very high-speed broadband networks on the creation of sole proprietorships, i.e. the creation of companies owned and run by one individual:

$$\begin{aligned} ln\_new\_proprietorship_{it+1} = \ & \alpha + \ \delta \ superfastbb_{it} + \ \beta_1 \ establishment_{it-2} \\ & + \beta_2 \ ln\_households_{it-2} + \ \beta_3 \ density_{it-2} + \ \beta_4 \ income_{it-2} \\ & + \gamma_1 \ unempl_{it-2} + \ \gamma_2 \ perc\_uni\_diploma_{it-2} + \ \gamma 3 \ perc\_no\_diploma_{it-2} \\ & + \gamma 4 \ socio\_professional\_groups_{it-2} + \ year + \ \eta_i + \ \epsilon_{it}, \end{aligned} \tag{4}$$

where $ln\_new\_proprietorship_{it+1}$ represents the number of new sole proprietorships (in log) that have been created in municipality i at time $t+1$. I add in the set of explanatory variables, the percentage of inhabitants with no diploma in municipality i at time $t-2$. As during a time of unemployment, some people which face difficulties to find a job, may decide to create their own business. This has been observed with the 2008 economic crisis, with an increase in the number of sole proprietorships (see descriptive statistics).

Nevertheless, I also estimate all specifications without the number of establishments oper-

ating in municipality i at time $t-2$ to ensure that this variable does not impact or hide the significance of others. Results are qualitatively similar in terms of sign and significance, they also display coefficients of similar amplitudes.[19] The same exercise has been made without the different socio-professional groups; results are also qualitatively similar.

I expect to find a positive average effect of very high-speed broadband networks on local economic growth. Municipalities would appear more attractive for companies, especially for those operating in the tertiary sector, in which most of the businesses using ICTs belong. This sector has been predicted to benefit the most from very high-speed broadband networks in the long-term, thanks to the creation of indirect jobs.

On the short-term, it is also expected that the roll-out of very high-speed broadband networks enhances activities in the construction sector. The increase in the number of companies from the construction sector could be the result of the construction of the infrastructure itself. The roll-out of a network may imply the creation of direct jobs, such as technicians, manual workers as civil engineering represents the major part of the work. Unlike companies from the construction sector which in the short-term encounter an increase in their workload, companies from the industrial sector have a more stable production pace. Therefore, I don't expect to find any significant effect of the presence of a very high-speed broadband network on the creation of these companies.

[19] Results are available upon request.

5 Estimation Results

Tables **??** shows the estimation results of the impact of very high-speed broadband on establishments creation and new proprietorships.

I find that the deployment of very high-speed broadband networks favors local economic development by increasing the number of new establishment created locally. Table **??** shows that the number of new establishments increases by an average of 2.8% with the presence of a very high-speed broadband network.

To better capture the effect of very high-speed broadband on the local economy, the establishments are disaggregated into the three main categories of the non-farm market sector: the industrial sector, the construction or building sector and the tertiary sector.

As expected, municipalities benefit from the spill over of the local presence of very high-speed broadband networks, helping them to maintain and develop a healthy economic sector. However, the presence of very high-speed broadband networks does not have an impact on the creation of all types of establishments of the non-farm market sector. I find a positive and significant impact only for the creation of establishments from the commerce service and transportation sector, in which firms rely more on ICT to conduct their business. In this sub-sector, the number of new establishments increases by almost 6%.

Not surprisingly, I don't find any significant effect on the creation of establishments of any of the other two tertiary sub-sectors, i.e. the provision of services to companies and to households. Besides, very high-speed broadband networks do not have any significant impact on establishment creation in the industry sector and in the construction sector.

I also highlight the existence of a positive impact of very high-speed broadband networks on

the creation of sole proprietorships, with an increase in new companies created by one individual by roughly 2%.

Estimation results tend to confirm the findings of McCoy et al. (2016), which highlight that on average areas covered by broadband are more attractive for firms. Besides, the estimation results are also in line with the empirical literature, especially the study from Gruber (2014), which shows that economic benefits from the achievement of the 2020 Digital Agenda for Europe mostly spill over to users and to the national economy.

5.1 Robustness Checks

In order to test the robustness of my results, I first conduct estimations on the same database as previously using the nearest neighbor (difference-in-differences) matching estimator method (Model 1). Table **??** shows covariate balance statistics and assesses the balance between treatment groups in the means and in the variances. Estimation results are provided in Tables **??** and **??**.

In addition, I estimate the same panel data model with fixed effects (Model 2) on a subsample, keeping only municipalities in which a very high-speed broadband network has been deployed in 2013 and municipalities in which no very high-speed broadband network has been deployed between 2010 and 2014. On the subsample, I also estimate a difference-in differences model (Model 3). Lag variables are used to attenuate potential endogeneity problems.[20]

Tables **??** shows results for the panel data model with fixed effects for deployments in 2013; Table **??** provides estimation results for the difference-in-differences model for deployments in

[20]For all specifications, different lags have been estimated and results are qualitatively similar. Besides, all specifications for Model 2 and Model 3 have been estimated without the number of establishments in municipality i at time $t-2$ and results are qualitatively similar.

2013. Figures **??** to **??** show the parallel trends assumption between the treated and the control group for some variables of local economic growth.

Table **??** provides an overview of the estimation results for all models.

5.2 Matching Estimator

Matching techniques are non-parametric estimators used to estimate average treatment effect (ATE). ATE are commonly used to measure the average impact of a treatment or a program intervention, by measuring the difference in outcome between a treated group and a control group (Rosenbaum and Rubin (1983)).

$Y_{it+1}(1)$, $(Y_{it+1}(0))$ denotes an outcome which is realized at time $t+1$ if municipality i receives (doesn't receive) at time t a treatment $d_{it} = 1$ $(d_{it} = 0)$.

The outcome of interest could either be the number of new establishments created locally or the number of new sole proprietorships. The treatment variable consists in a dummy variable indicating whether a treatment has been applied, i.e. whether a very high-speed broadband network is deployed in municipality i at time t. The control group consists in otherwise similar municipalities in terms of observable characteristics.

Then, the average treatment effect on the treated (ATT), which represents the average gain from the treatment for those who actually were treated, writes as follows

$$ATT = E(\Delta Y_{it+1}(1) \mid d_{it} = 1) - E(\Delta Y_{it+1}(0) \mid d_{it} = 1). \tag{5}$$

The first term represents the expected value of the outcome of interest, at time $t+1$, in municipalities in which a treatment has been received at time t, which is observable. However,

the second term in Eq.(6) is non-observable. It represents the expected value of the outcome of interest, at time $t+1$, for the control group, had a treatment been received at time t. When evaluating the impact of a policy, or here of an investment decision, the researcher faces an identification issue. Besides, the treatment distribution may suffer from a selection bias. Considering the high costs of deployment, operators will select the municipalities in which to invest first depending on their return prospects. To alleviate these issues, matching estimators seek to reproduce the treatment group among the non-treated group using observable characteristics. Then, the key parameter is to identify the relevant set of matches. Besides, to avoid reverse causality, I use lag variables of two years.

The set of relevant matches is:

$$ln\_households_{it-2},\ density_{it-2},\ income_{it-2},\ unempl_{it-2},\ perc\_estab\_commserv_{it},\ year. \quad (6)$$

The key variables for the matching are the number of households (in log), the population density, the average fiscal income and the unemployment rate, all in municipality i at time $t-2$. In addition, to match municipalities with the same type of economy, I introduce the percentage of companies from the commerce and service sector in municipality i at time t.

I expect to find slightly higher effects than with the previous model, as the average effects are estimated on the treated population.

Table **??** provides a table of distributional test statistics for the means, variances and skewness of key variables included in the matching process. By comparing the distribution of the different variables between the treated and control group, I ensure that the two groups are similar in terms of observable characteristics. Besides, I assess the balance between the treatment

groups in the means, by using the standardized difference, and in the variances, by using the variance ratio. Table **??** shows that the control group created through the matching is similar to the treated group, in terms of households number, population density, income, unemployment rate. The percentage of inhabitants with no diploma is slightly higher in the control group, while the percentage of inhabitants with a diploma from the superior is slightly higher in the treated group.

Table **??** confirms the results obtained with the panel data model. I find that the number of new establishments increases by an average of 5% with the presence of a very high-speed broadband network. Unlike in the previous estimation, I find a positive average impact on the creation of establishments in the industry sector, which increases by 9%. However, the impact of very high-speed broadband networks on the number of new establishments from the construction sector is still not significant.

Similarly, I find that municipalities in which a very high-speed broadband network has been deployed are more attractive for establishments from the commerce service and transport sector. The creation of new establishments in this sub-sector increases by an average of 4.6%. Besides, unlike in the previous estimation, I find a positive effect of very high-speed broadband networks on the creation of establishments providing services to companies. Their number increases by an average of 5%.

Table **??** also confirms results from the panel data estimation as regard the creation of sole proprietorships. Municipalities in which a very high-speed broadband network has been deployed seem to favor entrepreneurship, with an average increase in the number of new sole proprietorships of 3.6%.

5.3 Panel Data Model with Fixed Effects and Difference-in-Differences for Deployments in 2013

A second robustness check has been conducted using the main model, but on a subsample (model 2). I still use the count modeling approach to estimate the impact of very high-speed broadband network on the creation of establishments and of sole proprietorships. Estimation results are displayed in logs for better interpretation.

As previously, only municipalities with more than 2,000 inhabitants are included in the database. However, only municipalities in which a very high-speed broadband network has been deployed in 2013 and municipalities without a very high-speed broadband network between 2010 and 2014 are included in the sample in order to have the same structure as for model 3. In 2013, very high-speed broadband networks have been rolled-out in 430 municipalities, corresponding to 30% of the municipalities in the subsample. With the modification of the regulatory framework, private operators have intensified the deployment for this year compared to the years before, which is why the robustness check has been conducted for this time period. I use similar covariates as for the main econometric models, except for model 3 where the socio-professional variables are excluded for more coherence with the model structure.[21]

On this subsample, I run a third robustness check using a difference-in-differences model (model 3) for deployments occurring in 2013.[22] This model is estimated to validate the results obtained with the panel data model with fixed effects. Model 3 aims at comparing the outcome of interest, i.e., the number of establishment creation or the number of new sole proprietorships,

[21] Estimations have also been run including the socio-professional groups. The results are qualitatively similar, with slightly higher coefficients.

[22] There were not enough municipalities in which a network has been deployed in 2010, 2011 to set up alternative specifications using the difference-in-differences methods. Besides, I lack data for the year 2015 to define an additional specification for the year 2014.

in the treated group (where a very high-speed broadband network has been deployed) and in the control group.

$$ln\_Y_{it+1} = \alpha + \theta\, after_t + \delta\, (after_t * superfastbb_i) + \beta\, X_{it-2} + \gamma\, Z_{it-2} + year + \eta_i + \epsilon_{it}, \tag{7}$$

where $superfastbb_i$ indicates municipalities in which a very high-speed broadband network has been deployed and $after_t$ the time period after the deployment (after 2013). Therefore, δ represents the differences in outcome, which is due to the presence of a very high-speed broadband network. As previously, X_{it-2} is a matrix of location characteristics for municipality i at time $t-2$ and Z_{it-2} a matrix of labor market characteristics for municipality i at time $t-2$, η_i is a time unvarying fixed effect, $year$ a time fixed effect and ϵ_{it} an iid standard error, clustered at the municipal level.

The key assumption in the difference-in-differences methods is that the treated and the control groups follow a parallel trend in the pre-treatment period. Absent treatment, both groups would have evolved the same way. Therefore, the difference in the outcome variable in the post-treatment period is assumed to be due to the treatment effect. Figures **??** to **??** show the parallel trends assumption for the number of new establishments, the number of new establishments from the commerce service and transport sector, as well as for the number of new sole proprietorships.

I also observe from Figure **??** a small change in trends for the number of new sole proprietorships in the year following the treatment.

Considering the dataset used in the subsample, I expect to find slightly higher effects than with the main model.

I find that with the presence of a very high-speed broadband network, the number of new establishments increases by an average of 5% for model 2 and 5.5% for model 3. Having a look at the different non-farm market sectors, I show that the number of establishment creation increases by an average of 4.5% (model 2) in the industry sector; it is not significant for model 3. However, there is no significant impact of very high-speed broadband networks on establishment creation in the construction sector for both models.

As regards the tertiary sector, I observe a large effect of very high-speed broadband networks on establishment creation in the commerce, service and transportation sector, which increases by an average of 10% (for both model 2 and model 3). However, there is no significant effects on the other sub-sectors. Very high-speed broadband networks also have a positive impact on the number of new sole proprietorships which increases by an average of 4.1% (model 2) and 5.6% (model 3).

Estimation results from the difference-in-differences model confirm the results obtained with the panel data model with fixed effects.

Table **??** provides a summary of the effects of very high-speed broadband networks on local economic growth for each model and specification.

Table **??** shows a convergence in the estimation results of the different models. As expected, coefficients are slightly higher for the matching estimator model (Model 1), compared to the main model, as the average effect is estimated on the treated group. Coefficients for the panel data model with deployment in 2013 are slightly higher than for the main model (including all

time periods), as deployment mostly occurred from 2013. Finally, coefficients for model 2 and 3 are similar as run on the same sub sample.

6 Conclusion

Very high-speed broadband networks are considered by policy makers to be a significant factor of economic growth in many sectors of the economy. There is a large consensus among economists to support the benefits of infrastructure investment for the national economy. Many countries worldwide have adopted a national broadband plan, in which they set ambitious objectives for broadband availability.

This paper analyzes whether the presence of a very high-speed broadband network has a causal impact on local economic growth. I adopt a technology neutral approach to estimate whether very high-speed broadband networks, either fiber optical network (Fiber to the Home; FttH) and upgraded cable (Fiber to the Last Amplifier; FttLA) have an impact on the creation of new local businesses of all non-farm market sectors and on the creation of sole proprietorships.

This study relies on micro-level panel data covering almost 5,000 municipalities located in metropolitan France, representing approximately 75% of the population, over 6 years, from 2010 to 2015. The three French largest cities, Paris, Lyon and Marseille are excluded from the analysis. These cities are attractive by themselves for companies and households. They are the three largest municipalities in terms of population and are the only one decomposed into arrondissements (districts), with their own mayor and municipal council. In addition, only municipalities with at least 2,000 inhabitants are included in the database.

As infrastructure investment produces spillovers, it affects all sectors of the national economy.

However, the economic benefits vary significantly across sectors. The estimation results confirm that the presence of very high-speed broadband networks enhances municipality attractiveness for the creation of new businesses. As foreseen by policy makers and economic analysts, very high-speed broadband networks have on average a positive impact on the creation of establishments operating in the commerce, service and transport sector, where indirect jobs requiring ICT skills are mostly found. However, I don't find any significant effect on establishment creation in the construction and industry sectors.

I observe a positive effect on the creation of sole proprietorships. Municipalities in which a very high-speed broadband network has been deployed seem to provide a favorable environment for the creation of companies owned by one individual.

A limitation of this paper, though, is that the causal relation I attend to estimate between the presence of very high-speed broadband networks and the number of establishments operating locally and more generally economic activity may be subject to endogeneity. I try to mitigate this problem by using the number of establishment creation instead of the total number of establishments operating locally. Besides, I use lagged variables to control for this effect. Therefore, the estimation results may suffer from an upward bias with coefficients being overestimated.

Another limitation of the paper is that the deployment of very high-speed network is fairly new. As a result, it is only possible, at this stage, to estimate the short-term effects of their presence on local economic growth. However, it fills a gap in the literature by providing empirical evidence on the impact on next generation broadband technologies on economic growth at the local level.

Thus, this paper highlights the benefits of very high-speed broadband networks on local

economic growth, providing further grounds for policy makers to stimulate investments from private operators. Besides, local government may also consider subsidizing or deploying their own very high-speed broadband networks to bring their benefits in areas were private investment is unlikely to occur. By financially supporting the deployment of broadband networks in areas which are not attractive for private operators, local government may help to open up small or medium municipalities, contributing to their economic development.

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Appendix

Table 1: Data sources

Data	time-period	Source
Fibre deployment by Orange	2010-2014	Orange's information system
Fibre deployment by SFR	2010-2014	SFR's website
Fibre deployment by Free	2010-2014	Free users' community + Free annual Reports
Cable upgrade to FttLA	2010-2014	Numericable's website
Copper upgrade to VDSL	2010-2014	Orange's information system
Population and population density	2006-2012	INSEE
Number of establishments	2009-2015	INSEE
Number of new establishments	2008-2015	INSEE
Number of new establishments per sector	2008-2015	INSEE
Number of new individual companies	2009-2015	INSEE
Unemployment rate (employment zone)	2010-2015	INSEE
Unemployment rate (municipality)	2006-2013	INSEE
Socio-professional groups	2006-2013	INSEE
Diploma	2006-2013	INSEE
Average fiscal income	2008-2015	DGFIP

Table 2: Summary Statistics

superfastbb		new estab	new ind	new construction	comm serv transp	serv firm	serv hh	self-employment
0	number	40136	30503	30503	30503	30503	30503	30507
	mean	53.74798	3.164476	7.954234	17.03232	15.43491	12.37249	35.521
	sd	93.84598	5.056969	13.81333	30.31258	28.87787	19.6356	58.23732
	min	0	0	0	0	0	0	0
	max	2854	154	422	684	1140	650	1675
1	number	4556	4456	4456	4456	4456	4456	4456
	mean	291.8479	11.22195	35.08954	80.13106	97.59358	58.62118	170.6194
	sd	582.0718	22.13058	78.23895	150.4043	214.3319	122.598	355.2885
	min	2	0	0	0	0	0	2
	max	6895	272	1382	1781	2629	1519	4609
Total	number	44692	34959	34959	34959	34959	34959	34963
	mean	78.02041	4.19151	11.413	25.07512	25.90715	18.26751	52.73915
	sd	218.2463	9.588983	32.06984	64.24479	85.63102	49.89729	145.1681
	min	0	0	0	0	0	0	0
	max	6895	272	1382	1781	2629	1519	4609

Table 3: Evolution of company creations in France

	2002-2008	2008-2010	2010-2011	2011-2015
Industry	23%	124.5%	-15.7%	-12.3%
Construction	61.5%	65.6%	-11.5%	-21.8%
Commerce (retail)	50.1%	81.1%	-13.2%	-21.3%
Commerce (wholesale)	9.3%	10.4%	-13%	-2.3%
Accommodation restaurant	45.5%	33.5%	-5.8%	10.2%
Transportation	33.5%	27.2%	-1.9%	127.8%
Information and communication	59.1%	138.3%	-13%	-2.1%
Services to households	109.7%	212.5%	-22.8%	-28.9%
		2009-2010	2010-2011	2011-2015
Sole proprietorships		7.9%	-16.8%	-5.7%

Sources: INSEE

Figures **??** to **??** show that for all these variables, the parallel trend assumption is respected in the pre-treatment period. I also highlight a small change in the number of establishment creation after 2013, which increases slightly in the treated group, compared to the control group in which the number of establishment creation seems to be stable.

Figure **??** shows the same change in trends after 2013 for the number of new establishments from the commerce, service and transport sector created in treated municipalities.

Table 4: Panel data estimation with fixed effects: establishment creation and new sole proprietorships

	new establishment	new ind	new construction	comm serv transp	service firms	service hh	self employment
superfastbb	0.0277***	0.0011	0.0180	0.0611***	0.0012	0.0142	0.0183**
	(0.007)	(0.018)	(0.017)	(0.013)	(0.012)	(0.013)	(0.008)
establishment	-0.0005***	-0.0002	-0.0003***	-0.0006***	-0.0005***	-0.0004***	-0.0004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
households	0.2285***	0.1945*	-0.0851	0.0566	0.5211***	0.2864***	0.2665***
	(0.058)	(0.116)	(0.114)	(0.099)	(0.096)	(0.097)	(0.061)
density	0.1914***	0.3075**	0.2831**	0.1254**	0.1324	0.2872***	0.1633***
	(0.038)	(0.125)	(0.113)	(0.049)	(0.090)	(0.070)	(0.038)
income	0.0049***	0.0048	0.0126***	-0.0006	0.0089**	0.0105***	0.0045**
	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)
unemployment	-0.0048*	-0.0010	0.0025	-0.0032	-0.0100**	-0.0111**	0.0026
	(0.002)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
diploma superior	0.0014	-0.0009	0.0048	-0.0007	0.0054*	0.0007	0.0056**
	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
no diploma							0.0064***
							(0.002)
craft workers	-0.0069**	-0.0008	-0.0257***	-0.0068	0.0026	-0.0057	-0.0064*
	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)
intermediate	-0.0030	-0.0023	-0.0049	-0.0031	-0.0071	-0.0017	-0.0026
	(0.002)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)
white collars	0.0010	0.0064*	-0.0056	0.0027	-0.0017	0.0045	0.0035
	(0.002)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.002)
employees	-0.0016	0.0031	0.0003	-0.0059*	0.0010	-0.0033	0.0009
	(0.002)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)
blue collars	-0.0003	0.0046	0.0021	-0.0011	0.0015	-0.0017	0.0005
	(0.002)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)
y2011	0.0211***	0.0155	0.0378***	0.0100	-0.0230**	0.0763***	0.0221***
	(0.004)	(0.011)	(0.010)	(0.009)	(0.009)	(0.009)	(0.006)
y2012	-0.0446***	-0.0029	-0.0701***	-0.0269**	-0.1131***	-0.0073	-0.0223***
	(0.006)	(0.014)	(0.014)	(0.012)	(0.012)	(0.012)	(0.008)
y2013	-0.0408***	-0.0121	-0.0938***	-0.0251*	-0.0939***	0.0158	-0.0151*
	(0.007)	(0.016)	(0.016)	(0.014)	(0.014)	(0.014)	(0.009)
y2014	-0.1117***	-0.1000***	-0.2889***	-0.0876***	-0.1242***	-0.0360**	-0.1347***
	(0.008)	(0.018)	(0.018)	(0.016)	(0.016)	(0.016)	(0.010)
Constant	3.3730***	0.2270	1.3267***	2.4758***	1.6433***	1.5830***	2.4108***
	(0.093)	(0.211)	(0.202)	(0.175)	(0.180)	(0.181)	(0.169)
Observations	24,674	24,674	24,674	24,674	24,674	24,674	24,672
R-squared	0.038	0.007	0.054	0.008	0.009	0.008	0.040
Municipality	4,935	4,935	4,935	4,935	4,935	4,935	4,935

Standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5: Covariate for Balance Test

	Treated			Control			Balance	
	Mean	Variance	Skewness	Mean	Variance	Skewness	Std-diff	Var-ratio
estab_commserv_perc	75.21778	104.3786	-0.4576889	71.88156	138.2795	-0.2382086	0.3028814	0.7548383
density	1.554482	6.703896	4.604425	0.2931954	0.1079544	3.56288	0.6834334	62.09933
households	1.201067	1.140388	0.767097	0.4358008	0.2875645	1.008727	0.9056709	3.965679
income	27.20733	67.94514	2.029876	23.89279	33.44573	2.024548	0.4655204	2.031504
unemployment	8.284171	9.454508	0.7606926	8.118084	8.388977	0.7826971	0.0556047	1.127016
no diploma	31.80636	64.66283	0.2513526	36.16033	75.80631	0.1488637	-0.51953	0.8530006
diploma superior	26.98883	102.6883	0.8918325	20.5735	56.69682	1.082169	0.7186378	1.811183

Figure 1: Parallel lines assumption: number of new establishments

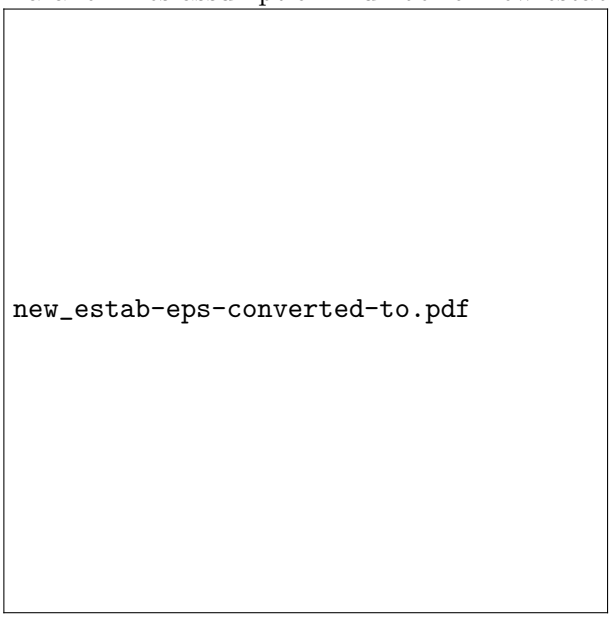

Table 6: Average treatment effect on the treated: establishment creation, new establishments in the industry and construction sectors

	new establishments	new ind	new construction
superfastbb	0.0490**	0.0898**	0.0169
	(0.020)	(0.036)	(0.026)
Observations	24,674	24,674	24,674

Standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 7: Average treatment effect on the treated: establishment creation in the tertiary sector and new sole proprietorships

	comm serv transp	service firms	service households	self-employment
superfastbb	0.0457*	0.0519**	0.0147	0.0358*
	(0.024)	(0.024)	(0.020)	(0.019)
Observations	24,674	24,674	24,674	24,672

Standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Figure 2: Parallel lines assumption: number of new establishments from the commerce service and transport sector

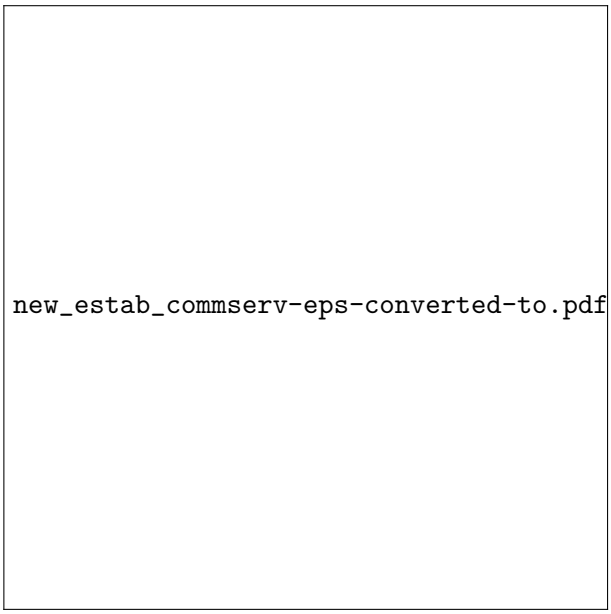

Figure 3: Parallel lines assumption: number of new sole proprietorships

Table 8: Model 2 - Panel data estimation with fixed effects: establishment creation and new sole proprietorships, deployments in 2013

	new establishment	new ind	new construction	comm serv transp	service firms	service hh	self employment
superfastbb	0.0485***	0.0456*	0.0018	0.0939***	0.0096	0.0202	0.0411***
	(0.010)	(0.027)	(0.026)	(0.020)	(0.017)	(0.020)	(0.012)
establishment	-0.0015***	-0.0010**	-0.0012***	-0.0018***	-0.0016***	-0.0011***	-0.0013***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
households	0.3157***	0.1647	0.0464	0.1904	0.6503***	0.3613***	0.3746***
	(0.080)	(0.177)	(0.143)	(0.134)	(0.134)	(0.133)	(0.080)
density	0.5334***	0.6519	1.0284***	0.6525***	0.4227*	0.4701	0.4559**
	(0.153)	(0.526)	(0.340)	(0.240)	(0.250)	(0.325)	(0.212)
income	0.0074***	0.0130*	0.0160***	0.0039	0.0089*	0.0125**	0.0060*
	(0.002)	(0.007)	(0.006)	(0.005)	(0.005)	(0.005)	(0.003)
unemployment	-0.0035	0.0093	0.0083	-0.0039	-0.0087	-0.0100*	0.0024
	(0.003)	(0.008)	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)
diploma superior	-0.0001	-0.0024	-0.0030	-0.0032	0.0036	0.0019	0.0040
	(0.002)	(0.005)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)
no diploma							0.0055**
							(0.002)
craft workers	-0.0059*	0.0041	-0.0203***	-0.0037	0.0045	-0.0106	-0.0056
	(0.003)	(0.009)	(0.008)	(0.006)	(0.007)	(0.007)	(0.004)
intermediate	-0.0043	-0.0048	-0.0002	-0.0037	-0.0085	-0.0052	-0.0020
	(0.003)	(0.007)	(0.006)	(0.005)	(0.005)	(0.006)	(0.003)
white collars	0.0017	0.0121**	-0.0095**	0.0045	-0.0039	0.0056	0.0025
	(0.002)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)
employees	-0.0007	0.0049	-0.0006	-0.0005	-0.0010	-0.0029	0.0016
	(0.002)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
blue collars	-0.0023	0.0152***	0.0015	-0.0032	-0.0038	-0.0004	-0.0012
	(0.002)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.002)
y2011	0.0152***	0.0142	0.0348***	0.0045	-0.0278**	0.0657***	0.0157**
	(0.006)	(0.016)	(0.013)	(0.011)	(0.012)	(0.012)	(0.007)
y2012	-0.0582***	-0.0040	-0.0857***	-0.0488***	-0.1327***	-0.0203	-0.0376***
	(0.008)	(0.021)	(0.018)	(0.015)	(0.016)	(0.016)	(0.010)
y2013	-0.0642***	-0.0695***	-0.1058***	-0.0613***	-0.1137***	0.0053	-0.0407***
	(0.009)	(0.024)	(0.021)	(0.018)	(0.019)	(0.018)	(0.012)
y2014	-0.1372***	-0.1229***	-0.2941***	-0.1274***	-0.1414***	-0.0556***	-0.1593***
	(0.010)	(0.027)	(0.023)	(0.020)	(0.021)	(0.020)	(0.013)
Constant	3.0798***	-0.2733	0.9948***	1.8980***	1.5512***	1.3651***	2.2122***
	(0.123)	(0.355)	(0.273)	(0.219)	(0.219)	(0.244)	(0.215)
Observations	16,329	13,269	15,405	16,329	16,329	16,329	16,327
R-squared	0.041	0.008	0.049	0.012	0.010	0.008	0.039
Number of codgeo	3,266	3,257	3,265	3,266	3,266	3,266	3,266

Robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 9: Difference-in-Difference: establishments creation, deployments in 2013

	new establishments	new ind	new construction	comm serv transp	service firms	service hh	self employment
_diff	0.0552***	0.0508	0.0285	0.1061***	0.0110	0.0224	0.0556**
	(0.021)	(0.033)	(0.037)	(0.033)	(0.032)	(0.031)	(0.023)
establishment	0.0024***	0.0033***	0.0033***	0.0025***	0.0024***	0.0017***	0.0021***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
households	0.8588***	0.5447***	0.6752***	0.9417***	0.9321***	0.9657***	0.8415***
	(0.007)	(0.011)	(0.013)	(0.011)	(0.011)	(0.011)	(0.008)
density	-0.0700***	-0.1455***	-0.0426***	-0.0705***	-0.0504***	-0.0943***	-0.0588***
	(0.005)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.006)
income	-0.0017*	-0.0164***	-0.0173***	0.0030**	0.0105***	-0.0109***	-0.0054***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
unemployment	0.0299***	-0.0008	0.0210***	0.0609***	0.0114***	0.0134***	0.0422***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
no diploma							-0.0098***
							(0.001)
diploma superior	0.0279***	0.0152***	0.0258***	0.0136***	0.0403***	0.0342***	0.0220***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
y2011	-0.0143	0.0101	0.0121	-0.0319**	-0.0644***	0.0465***	-0.0209**
	(0.009)	(0.014)	(0.016)	(0.014)	(0.014)	(0.014)	(0.010)
y2012	-0.1076***	0.0310**	-0.0779***	-0.1315***	-0.1900***	-0.0464***	-0.1014***
	(0.010)	(0.015)	(0.017)	(0.015)	(0.014)	(0.014)	(0.010)
y2013	0.0988***	0.0646***	0.2037***	0.0981***	0.0545***	0.0853***	0.0000
	(0.009)	(0.014)	(0.016)	(0.014)	(0.014)	(0.014)	(0.000)
y2014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.1544***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.010)
time	-0.2452***	-0.0807***	-0.3350***	-0.2862***	-0.2603***	-0.1310***	-0.1452***
	(0.010)	(0.015)	(0.018)	(0.015)	(0.015)	(0.015)	(0.011)
treated	-0.0606***	-0.0847***	0.0006	-0.0632***	-0.0477**	-0.1063***	-0.0471***
	(0.016)	(0.024)	(0.028)	(0.024)	(0.024)	(0.023)	(0.017)
Constant	2.1966***	0.4477***	0.7158***	0.7981***	0.3164***	0.8338***	2.2306***
	(0.022)	(0.033)	(0.038)	(0.033)	(0.032)	(0.031)	(0.044)
Observations	16,329	16,329	16,329	16,329	16,329	16,329	16,327
R-squared	0.792	0.440	0.517	0.661	0.688	0.647	0.761
Mean control t(0)	2.197	0.448	0.716	0.798	0.316	0.834	2.231
Mean treated t(0)	2.136	0.363	0.716	0.735	0.269	0.728	2.183
Diff t(0)	-0.0606	-0.0847	0.000632	-0.0632	-0.0477	-0.106	-0.0471
Mean control t(1)	1.951	0.367	0.381	0.512	0.0562	0.703	2.085
Mean treated t(1)	1.946	0.333	0.410	0.555	0.0195	0.619	2.094
Diff t(1)	-0.00543	-0.0339	0.0292	0.0430	-0.0367	-0.0839	0.00854

Robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 10: Summary of effects

	Panel FE	ATT	Panel FE 2013	diff_2013
	Main model	Model 1	Model 2	Model 3
new estab	2.8%	4.9%	4.9%	5.5%
new industry	X	9%	4.6%	X%
new construction	X	X	X	X%
new comm serv transp	6.1%	4.6%	9.4%	10.6%
new service firms	X	5.2%	X	X
new service households	X	X	X	X
new individual_comp	1.8%	3.6%	4.1%	5.6%

X: results are not significant