



Toolkit

Broadband

Public Provision

## What is it and what does it aim to do?

Public provision involves government funding for the construction of broadband internet, either through direct provision or public-private partnerships (PPPs).<sup>1</sup> Both types of provision are commonly carried out at the municipality level.

For direct provision, the government establishes a municipally or state-owned company that builds the necessary infrastructure and often provides broadband services. In this case, the costs are entirely borne by the public sector. In contrast, with PPPs, broadband expansion is outsourced to private companies. Costs are shared between public and private entities depending on the extent to which the private company owns the infrastructure and provides services.

## How effective is it?

The sub-national evidence suggests that public provision is effective at increasing firm and household adoption at the local level. Three out of four sub-national studies find positive effects on adoption. Only one of these three looked at broadband adoption by firms.

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<sup>1</sup> Both kinds of provision are feasible in the UK, even while the UK remains a member of the EU, because the UK's National Broadband Scheme is given a concession in the EU's state-aid laws.

The cross-country evidence is more mixed. Of the three cross-country studies, one finds a positive effect, one finds no effect and one finds a negative effect. This set of more mixed results might be explained by the fact that direct provision tends to be done locally, so may be hard to pick up using national-level data.

Evidence from one study suggests that PPPs are more effective at increasing household adoption when the government retains ownership of the infrastructure and when countries are starting from low levels of broadband penetration. Another study finds greater effects on household adoption when public provision is combined with public education and digital literacy programmes, compared to public provision alone.

The evidence is inconclusive on the effect of public provision (PPPs or direct provision) on internet speed or price. The only study to consider them finds a negative effect of public provision on speed (fibre optic share) and no effect on price.

Evidence from one study of firms in rural Italy suggests that public provision (a PPP) may have a positive effect on firm sales and value added but has no effect on employment.

Evidence from one Norwegian study suggests that public provision increases wages and employment of skilled workers, but decreases wages and has no effect on employment for unskilled workers.

Our [Broadband Evidence Review](#) also examines economic outcomes such as value added and employment for both public and private provision. Overall, the evidence on the effect of public provision is based on too few studies to allow a meaningful comparison of differences in effectiveness relative to private provision.

## How secure is the evidence?

This toolkit summarises the available ex-post (i.e. after introduction) evaluations of the effect of public provision of broadband. The majority of the existing literature uses case study approaches or qualitative interview techniques, often involving small numbers of participants to assess the impacts of broadband provision. This toolkit does not consider this evidence. Instead, we focus on evaluations that identify effects which can be attributed, with some degree of certainty, to the support provided. (More details and discussion of our inclusion criteria are covered in the annex.)

We found 8 evaluations that meet our minimum evidence standards. There are four sub-national studies that examine five different programmes, three in the US, one in Italy and one in Norway. There are three cross-country studies that look at public provision across OECD countries.

No studies evaluating UK policies or support mechanisms met the evidence standards for inclusion in this toolkit.

## Is public provision cost effective?

Two of these studies provided information that allowed figures for cost effectiveness in terms of pound spent per additional household broadband connection.

The first study examines the US BTOP programme (which includes direct provision policies as well as others),

which disbursed £3.6 billion to 289 projects.<sup>2</sup> The programme benefits suggest that the BTOP programme involved a cost of £404 per additional household subscription.

The second study evaluates the US Community Connect programme run in three rural communities. The programme made use of both direct provision and PPPs. In one community the programme had no effect, so the programme was not cost-effective. In the remaining two communities the cost per additional broadband subscription was £791 and £5,091, respectively. The far larger cost for the second community is a result of weaker impacts for a smaller number of households, combined with similar programme costs.

Overall, these two studies suggest that the cost effectiveness of public provision may vary quite substantially depending on both the impact and scale of the programme.

The studies do not help to determine the cost effectiveness of direct provision relative to PPPs. However, it is important to note that PPPs are not necessarily a cheap option. In many cases they require considerable public investment plus additional private investment, meaning that the social costs may be just as high as with direct provision.

## Things to consider

- What are realistic policy aims for public provision?** The evidence suggests that public provision may increase both household and firm adoption. Evidence from our [Broadband review](#) shows that household broadband takeup may have positive effects on house prices, female labour market participation, employment, firm growth, and economic growth. Household adoption is also strongly linked to firm adoption. Increasing adoption may also be desirable for other reasons (if fast internet access for all is seen as a right, or if spreading access to particular communities is a priority).
- Should public provision be implemented together with complementary policies?** Evidence from two studies support the idea that public provision may be more effective when combined with skills programmes. One study finds that public provision only has employment and wage benefits for skilled workers. A second study finds greater effects on household adoption when public provision is combined with public education and digital literacy programmes.
- When designing a PPP, should the government retain ownership of the broadband infrastructure or not?** Evidence from one study suggests that PPPs are more effective at increasing household adoption of broadband when the government (instead of a private company) retains ownership of the infrastructure. However, government ownership of infrastructure comes at a higher public cost than private ownership, so it is unclear whether this approach is cost-effective.
- What should be considered when deciding which local areas to target with public provision programmes?** One study finds that public provision is most effective in countries with low levels of existing broadband penetration. This could imply that regions with low levels of broadband penetration will benefit more from provision programmes. Consistent with this, a second study suggests that there are cases where public provision may crowd out private investment. Accordingly, public provision may avoid crowding out if it is undertaken in areas where private infrastructure investment is not profitable for private telecoms companies (for example, some rural communities). However, while this kind of policy targeting may be most effective in increasing adoption per se, our broadband review suggests that the further impact on economic growth may be lower in such areas than other areas.

## Annex: Evidence on Public Provision of Broadband

Public provision involves government funding for the construction of broadband internet. In the case of **direct provision**, the government establishes a municipally or state-owned company that builds the necessary infrastructure and often provides broadband services. In this case, the costs are entirely borne by the public sector. Alternatively, governments may use **Public-private partnerships (PPPs)**, entailing the hiring of private telecoms companies to undertake broadband expansion. Depending on the extent to which the private company owns the infrastructure and provides services, this type of policy often entails cost sharing between public and private entities. Both types of provision are commonly carried out at the municipality level. Both kinds of provision are feasible in the UK, even while the UK remains a member of the EU, because the UK's National Broadband Scheme is given a concession in the EU's state-aid laws.

We looked for evidence on the effect of public provision (either direct or PPP) on local economic growth outcomes. We included studies that examined the impact of public provision on firm outcomes (e.g. productivity or employees), broadband outcomes (e.g. speed or price) or on the adoption of broadband by firms or households. Evidence from our [Broadband review](#) shows that household adoption may have positive effects on house prices, female labour market participation, employment, firm growth, and economic growth. Broadband takeup by households has also been shown to be highly correlated with firms' broadband adoption.<sup>3</sup>

We focused on evidence from the OECD, in English. We considered any study that provided before-and-after comparisons or cross-sectional studies that control for differences between supported and unsupported areas or firms. We also included more robust studies that compared changes for supported areas or firms with a control group, or that used a source of randomness in broadband provision to estimate a causal effect. [See The Maryland Scientific Methods Scale \(SMS\)](#). In summarising the evidence, we place greater emphasis on studies with stronger methods. We also distinguish between sub-national and cross-country studies, placing more emphasis on the former – since (i) public provision is usually at a local scale – effects may not be measurable at the national level, and (ii) there are typically many more 'confounding factors' when looking at policy differences across countries.

Using these criteria, we found eight studies that looked at the effects of public provision.

### The evidence

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**The sub-national evidence suggests that public provision is effective at increasing firm and household adoption at the local level. Three out of four sub-national studies find positive effects on adoption. One of the studies reporting positive results is the only one to examine the impact on firm adoption.**

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Study 620 (SMS 4 – sub-national) evaluates the impact of direct broadband provision on firm adoption in Norway. The policy involved the establishment of a state-owned telecoms company, Telenor, which provided broadband service and infrastructure throughout the country. Using firm-level data, the study finds that a ten percentage-point increase in broadband availability in a municipality leads to an increase of 2.3 additional firm broadband subscribers.

Study 420 (SMS 3 – sub-national) evaluates the impact of provision on number of broadband connections in the United States. The Broadband Technology Opportunities Program (BTOP) gave over four billion dollars via 289 grants for projects that aimed to increase broadband use. These projects were undertaken by municipalities and private firms, and ranged from directly providing broadband infrastructure, to providing

computers, to increasing digital literacy. Since the study evaluates all types of policies in tandem, it is not possible to disentangle the effect of subsidies from direct provision. Nonetheless, using county-level data, the study finds that a one per cent increase in total BTOP spending is associated with an increase in 0.027 connections per one hundred households.

Study 6232 (SMS 3 – sub-national) evaluates the impact of provision on household broadband adoption in the United States. The Community Connect programme provided municipalities with funds to extend broadband infrastructure, either through municipally-owned telecoms companies, or through public-private partnerships. The study examines three communities that received grants using county-level before-and-after survey data. In one of the three communities the grants were combined with public education and digital literacy programmes. The study finds that in community that received grants and education programmes, the grants lead to the largest increase in broadband adoption (21 percentage points) relative to a control community that received no support. In one of the grants-only communities, grants led to a more moderate increase (13 percentage points) and the in other the other they had no effect relative to the control community.

Study 1150 (SMS 2 – sub-national) evaluates the impact of direct provision on broadband subscriptions per capita in the United States. The study considers the impact of laws that limit direct broadband provision by municipalities. The study finds that limiting municipality powers to provide broadband has no impact on the number of broadband subscribers. Although this finding may imply that direct provision policies do not have an impact on broadband penetration, it can also be explained if municipalities would not have undertaken direct provision policies in the absence of the policy.

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**The cross-country evidence is more mixed. Of the three cross-country studies, one finds a positive effect, one finds no effect and one finds a negative effect. The more mixed results compared to sub-national studies might be explained by the fact that direct provision tends to be based on municipal level projects, the effects of which may be difficult to measure using adoption at the national level. Evidence from one study suggests that PPPs are more effective at increasing household adoption when the government retains ownership of the infrastructure and when countries initially have low levels of broadband penetration. Another study finds greater effects on household adoption when public provision is combined with public education and digital literacy programmes.**

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Study 217 (SMS 3 – cross-country) evaluates the effect of provision on number of broadband subscriptions per one hundred inhabitants. Here, provision involves all policies in which the government supports broadband infrastructure either by investing itself (direct or PPP) or through policies to encouragement private provision. The encouragement policies include supply subsidies, administrative simplification, and territorial mapping. Accordingly, it is not possible to isolate the impact of government provision programmes. Using a dataset for OECD countries across time, the study finds that provision does not have a significant impact on broadband penetration. The study speculates that this lack of effect may be due to the fact that broadband markets in the OECD are already saturated.

Study 143 (SMS 3 – cross-country) evaluates the impact of the direct provision and PPPs on the share of optical fibre subscribers per overall broadband users. Fibre optic broadband provides faster internet through the use of fibre optic cables, while Digital Subscriber Line (DSL) makes use of slower copper wires. The study exploits a dataset of 33 OECD countries over time, finding that government engagement in direct provision and/or PPPs decreases the share of fibre optic users by 6.5 percentage points. This result implies that fibre optic penetration is lower in countries where the government engages in provision, than in in countries

where it is provided solely by the private sector. This negative impact might be explained by an extreme form of crowding-out where private firms completely drop-out from providing fibre-optic in countries where the government is involved. State provided fibre optic might be less effective at penetrating the market if it is more expensive, less reliable, or more poorly marketed than in countries where it is provided solely by the market. The study concedes, however, that it is possible that government investment in optical fibre networks may only yield positive impacts a few years after the investment is made and so effects would not be detected by the evaluation.

Study 108 (SMS 2 – cross-country) evaluates the impact of PPPs on the number of broadband subscribers per one hundred inhabitants. The study uses country-level data for 30 OECD countries and finds that PPPs are associated with a significant increase in broadband subscriptions. PPPs where the government owns the infrastructure are found to be more effective than PPPs where private companies retain ownership. While the former is associated with an increase of 0.646 subscriptions per one hundred inhabitants, the latter is associated with gains of 0.519 subscriptions per one hundred inhabitants. The study performs a separate analysis to find that public provision is most effective in countries with low levels of existing broadband penetration.

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**The evidence is inconclusive on the effect of public provision (PPPs or direct provision) on internet speed or price. One study finds a negative effect of public provision on speed (fibre optic share) and no effect on price.**

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Study 143 (SMS 2 – cross-country) evaluates the impact of government provision of fibre-optic on the market share of fibre optic. This study is discussed in more detail above in the context of broadband penetration. However, since fibre optic is a faster form of internet than broadband, it is also relevant for understanding effects on internet speed. The study finds a negative relationship between public provision and the share of fibre-optic, suggesting lower overall speeds. It also finds that provision has no impact on broadband price. As discussed above, these findings may reflect that government provision of fibre optic networks only yields impacts a few years after the investment is made.

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**Evidence from one study of firms in rural Italy suggests that public provision (a PPP) may have a positive effect on firm sales and value added but has no effect on employment.**

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Study 210 (SMS 4 – sub-national) evaluates the impact of a PPP on firm outcomes in rural Italy. The Italian government outsourced the expansion of broadband infrastructure to Telecom Italia, a private company. Using a dataset comprised of municipal-level data on exposure to the policy and firm-level data, the study finds that the PPP had a positive and significant impact on firm sales and value added. The partnership increased firm sales turnover by 40 per cent and value-added by 20 per cent over two years. However, the policy did not have any impact on firm employment. The sales effects remain positive for all industries when broken down into 9 different sectors. The value-added effects remain positive in most industries (they become insignificant for Transport/Communication and Real Estate).

Our [Broadband Evidence Review](#) includes study 210 as well as three further studies of the effects of private provision of broadband on firm productivity. Two of the three studies examining private provision examine the effects on productivity for manufacturing firms, with one finding no effect and the other finding a positive effect only if complementary policies are in place (i.e. changes in supply management). The third study looks at a sample of overall firms (services and manufacturing): it also finds no impact on

productivity. Given the low number of studies overall, it is not possible to make a meaningful comparison between private and public provision.

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**Evidence from one Norwegian study suggests that public provision increases wages and employment of skilled workers, but decreases wages and has no effect on employment for unskilled workers.**

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Study 620 (SMS 4 – sub-national), evaluates the impact of direct provision in Norway. It finds that a 10 percentage point increase in broadband availability increases the wages of skilled workers by 0.2 per cent, and increases employment of skilled workers by 0.2 per cent. In contrast, a ten percentage point increase in firm broadband access decreases the wages of unskilled workers by 0.1 per cent, and has no impact on employment levels.

The [Broadband Evidence Review](#), draws on three studies to conclude that market provision of broadband has mixed effects on similar outcomes. In terms of employment (at the area or firm level) three studies find positive effects and two find no effect. In terms of income, two studies find positive effects and one finds a negative effect. Given the low number of studies overall, it is not possible to make a meaningful comparison between private and public provision.

## Cost effectiveness

For two of the studies (420 and 6232), we were able to use the reported programme costs and estimated benefits, combined with additional information to compute cost effectiveness of the programmes in terms of pound spent per additional household broadband connection. We were not able to compute cost effectiveness for any other outcomes.

Study 420 examines the BTOP programme (which includes direct provision policies as well as others), which disbursed £3.6 billion to 289 projects, at an average disbursement of around £12.2 million per project.<sup>4</sup> Back-of-the-envelope calculations suggest that the BTOP programme involved a cost of £404 per additional household subscription.<sup>5</sup>

Study 6232 evaluates the Community Connect programme run by the US Department for Agriculture deployed in three rural communities. The programme made use of both direct provision and PPPs. In each community the programme cost around £200,000. In one community the programme had no effect, so the programme was not cost-effective. In the remaining two communities the cost per additional broadband subscription was £791 and £5,091.<sup>6</sup> The far larger cost for the second community is a result of a smaller effect size for a smaller population of households combined with similar programme cost.

Overall, these two studies suggest that the cost effectiveness of public provision may vary quite substantially depending on both the impact and scale of programme. Overall there is too little evidence to make a direct comparison of cost effectiveness with other broadband policy tools.

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4 USD to GBP conversion rate (1 to 1.23) provided by Financial Times currency rates for 19/10/2016.

5 The study notes that a one per cent increase in spending leads to an increase in 0.027 subscriptions per 100 inhabitants. The total cost of the programme was £3.6 billion, which means that £36 million increases subscriptions by 0.027 per hundred inhabitants. The US population for 2013 is 316.5 million, which means that the policy would lead to 85,455 subscriptions at the national level. Each subscription therefore costs £36,000,000/85,455 or £404.

6 USD to GBP conversion rate (1 to 1.23) provided by Financial Times currency rates for 19/10/2016.

The studies do not help to determine the relative cost effectiveness of direct provision or PPPs. However, it is important to note that PPPs are not necessarily a cheap options. In many cases they require considerable public investment plus additional private investment, meaning that the social costs may be just as high as with direct provision.

## Evidence Reviewed

Ref No	Reference
108	Belloc, F., Nicita, A., & Rossi, M. A. (2011). The Nature, Timing and Impact of Broadband Policies: A Panel Analysis of 30 OECD Countries (No. 615). Department of Economics, University of Siena.
143	Sudtasan, T. (2015). Economic determinants of optical fiber share in total broadband connections in OECD countries. In 26th European Regional ITS Conference, Madrid 2015 (No. 127179). International Telecommunications Society (ITS).
210	Canzian, G., Poy, S., & Schüller, S. (2015). Broadband Diffusion and Firm Performance in Rural Areas: Quasi-Experimental Evidence.
217	Mayer, W. J., Madden, G., Jin, Z., & Tran, T. (2015). Modelling OECD broadband subscriptions in disequilibrium. <i>Technological Forecasting and Social Change</i> , 90, 476-486.
420	Hauge, J. A., & Prieger, J. E. (2015). Evaluating the impact of the American Recovery and Reinvestment Act's BTOP on broadband adoption. <i>Applied Economics</i> , 47(60), 6553-6579.
620	Akerman, A., Gaarder, I., & Mogstad, M. (2015). The Skill Complementarity of Broadband Internet. <i>The Quarterly Journal of Economics</i> , 130(4), 1781-1824.
1150	Wallsten, S. J. (2005). Broadband penetration: an empirical analysis of state and federal policies.
6232	LaRose, R., Strover, S., Gregg, J. L., & Straubhaar, J. (2011). The impact of rural broadband development: Lessons from a natural field experiment. <i>Government Information Quarterly</i> , 28(1), 91-100.

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