



what works centre for
local economic growth

Toolkit Broadband Local Loop Unbundling

What is it and what does it aim to do?

In many countries telecommunication networks were developed by a single provider (e.g. BT in the UK). To introduce competition into these markets, governments have regulated to allow for 'local loop unbundling' (LLU). The local loops are the copper wires that connect households to the local exchange to provide broadband and telephone services. Unbundling obliges incumbents to allow local loop access to market entrants and may also involve regulation of LLU pricing.

Unbundling may improve broadband provision if competition reduces prices, improves other aspects of the service (e.g. time to remedy faults), or allows for greater product differentiation (e.g. in terms of content). 'Bitstream access' – where the entrant buys services from the incumbent at wholesale prices and re-sells to customers – may generate these benefits. 'Line leasing' – where the entrant leases the line from the incumbent – may lead to additional effects if entrants augment the network by installing their own technology at local exchanges allowing for product differentiation in terms of speed, data limits, etc. This may also encourage the incumbent to upgrade its own network.

In the UK, only BT is currently required to unbundle its network. Further opportunities for unbundling are copper wires, cable and fibre optic built by other operators e.g. Virgin Media. There is also potential for extending regulation in the area of bitstream access (which has been recently deregulated). The telecoms regulator, Ofcom, could also set different LLU prices.

How effective is it?

Five out of six studies find a positive effect of line leasing on household broadband adoption. There is no evidence on the effect on firm adoption.

LLU regulation that lowers the one-off fee for accessing local exchanges or the (monthly) rental price for leasing lines leads to greater broadband adoption, according to four out of five studies.

One concern with LLU policies is that they may discourage investment if incumbents think that they will be unbundled in the future. However, only one of four studies that consider the impact on broadband investment or capital stock finds a negative impact and this latter is the least robust of the four. Of the remaining three, two find a positive effect and one finds no effect. One of the positive studies also shows that LLU regulation led to an upgrading of the network, in the form of a higher market share for fibre optic internet.

In terms of broadband speed and price, the impact of LLU regulation is unclear. One study finds no effect on speed, while another study (discussed above in the context of capital stock) finds that it increased the market share of fibre which may imply faster internet speeds. One study shows that bitstream access may make broadband more expensive for customers, but there is a lack of evidence on other forms of LLU.

How secure is the evidence?

This toolkit summarises the available ex-post (i.e. after introduction) evaluations of the effect of LLU policies for 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 twelve evaluations that meet our minimum evidence standards. Seven of these provide cross-country comparisons controlling for other factors that might affect adoption. Given that LLU regulation is generally implemented at a national level, this type of analysis is robust for our purposes.

All of the studies are based on data from OECD countries. Four studies consider several OECD countries, four consider several EU countries, and four focus on specific countries: one study each for the United States, Japan, Spain and the United Kingdom.

Is LLU cost effective?

From a public perspective, the only exchequer costs of LLU policies are bureaucratic. Unfortunately, none of the papers provide estimates of these costs, so it is not possible to infer the cost-effectiveness of such programmes. It is worth noting, however, that LLU also entails private costs, particularly for incumbent providers who lose market share with increased competition. Whether or not LLU is truly cost effective depends on whether the additional consumer benefits that result from increased competition outweigh the incumbent's loss of market share.

Things to consider

- **What are realistic aims for LLU policies?** Evidence strongly suggests that LLU policies can be expected to increase household adoption of broadband. This is the case for both line sharing and bitstream access variants of LLU.
- **Does LLU regulation discourage investment in new broadband infrastructure?** Only one study suggests that LLU has a negative impact on broadband infrastructure stock, whereas two find a positive effect and one finds no impact. This suggests that LLU policies may not discourage the building of new infrastructure, and could even encourage it.
- **What price should the government set for LLU leasing?** The evidence suggests that setting lower LLU prices leads to greater broadband adoption. But setting low prices might not be recommended if it discourages further investment. One study suggests this may be the case. Policymakers need to consider this tradeoff when designing reforms to current LLU policies.
- **Should LLU regulation be used as a substitute for other types of broadband policies?** Although LLU regulation is an effective way to increase broadband adoption, it does not guarantee, for instance, that broadband access is expanded to underserved areas. Accordingly, these policies should be seen as complementary to other provision or encouragement policies.
- **Can LLU reduce the price of broadband?** Greater competition should reduce prices, but there is a lack of evidence on the effect of LLU (in particular line leasing forms) on broadband price. Nevertheless, evidence from one study suggests that bitstream access actually increases the price of broadband.
- **Should one type of LLU be preferred over another?** Both line leasing and bitstream access appear to be effective at increasing household adoption. One study shows line leasing is more effective when bitstream access is also an option.

Annex: Evidence on local loop unbundling for broadband

In many countries telecommunication networks were developed by a single provider (e.g. BT in the UK). To introduce competition into these markets, governments have regulated to allow for 'local loop unbundling' (LLU). The local loop are the copper wires that connect households to the local exchange to provide broadband and telephone services. Unbundling obliges incumbents to allow local loop access to market entrants and may also involve regulation of LLU pricing.

Unbundling may improve broadband provision if competition reduces prices, improves other aspects of the service (e.g. time to remedy faults), or allows for greater product differentiation (e.g. in terms of content). 'Bitstream access' – where the entrant buys services from the incumbent at wholesale prices and re-sells to customers – may generate these benefits. 'Line leasing' – where the entrant leases the line from the incumbent – may lead to additional effects if entrants augment the network by installing their own technology at local exchanges, allowing for product differentiation in terms of speed, data

limits, etc. This may also encourage the incumbent to upgrade its own network.

Currently in the UK, only BT is required to unbundle its network. Further opportunities for unbundling are copper wires built by other operators e.g. Virgin Media, and other technologies such as cable or fibre-optic. There is also potential for extending regulation in the area of bitstream access (which has been recently deregulated). The telecoms regulator, Ofcom, could also set different LLU prices.

We looked for evidence on the effect of local loop unbundling either on household adoption of broadband and other broadband outcomes such as prices and infrastructure. 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. It has also been shown to be highly correlated with firm adoption.¹

We distinguished between studies looking at the effect of LLU regulation (e.g. obliging incumbent to share lines, or regulating price) and those looking at the effect of the LLU on market structure (e.g. the proportion of line at a local exchange that are being leased by an entrant).

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.

Using these criteria, we found twelve studies that looked at the effects of LLU. The next section examines the evidence on the effectiveness of such support.

The evidence

Five out of six studies find a positive effect of line leasing on household broadband adoption. Further, LLU regulation that lowers the one-off fee for accessing local exchanges or the (monthly) rental price for leasing lines leads to greater broadband adoption, according to four out of five studies. There is no evidence of the effect on firm adoption.

Study 217 (SMS 3 – cross-country) evaluates the impact of LLU regulation (line leasing) on the number of broadband subscribers per one hundred inhabitants in OECD countries. The study uses country-level data for OECD countries, from 2001 to 2009, which allows it to control for country-level fixed effects. The study finds that LLU regulation increases broadband subscriptions. Furthermore, by interacting the LLU variable with the market share of the DSL platform, the study finds that LLU is most effective in markets dominated by DSL (as opposed to cable or fibre optic).

Study 905 (SMS 3 – cross-country) evaluates the impact of LLU regulation (line leasing and price regulation) on the number of broadband subscribers per one hundred inhabitants in the OECD. The study uses country-level data from 2002 to 2008, which allows it to control for country-level fixed effects. The study finds that LLU regulation increases the number of broadband subscriptions by 61 per cent. The study finds that higher wholesale line rental prices lead to a decline in broadband penetration – a one per cent increase in the price of a leased line decreases broadband subscriptions by 0.56 per cent.

Study 917 (SMS 3 – cross-country) evaluates the impact of LLU regulation (line leasing and price regulation) on the number of broadband subscribers per one hundred inhabitants in the EU. The study uses country-level data for 17 EU countries, from 2000 to 2010, which allows it to control for country-level fixed effects. The study finds that LLU regulation increases broadband subscription rate by 15 percentage points. The study finds that the LLU one-off access fee has a negative impact on subscriptions – a standard deviation increase in fees decreases subscriptions by 1.2 percentage points.

Study 940 (SMS 2 – cross-country) evaluates the impact of the LLU regulatory environment (line leasing obligation, price regulation and bitstream access) on the number of broadband subscribers per one hundred inhabitants in the OECD. The study uses country-level data from 1996 to 2006, and considers three types of LLU policy, which they call LLU I, LLU II, and LLU III. In countries with LLU I, there is a line leasing obligation and bitstream access (but no line rental price regulation). In countries with LLU II, there is a line leasing obligation and line rental price regulation (but no bitstream access). Finally, in countries with LLU III, there is a line leasing obligation, line rental price regulation, and bitstream access. The study finds that LLU I is the most effective regulatory environment, increasing the broadband subscription rate by 23 percentage points. The second most effective policy is LLU II, which increases the broadband subscription rate by 21 percentage points. Finally, LLU III increases the broadband subscription rate by 16 percentage points. Whilst a comparison of LLU III and LLU I implies lower levels of adoption if government engages in price setting, this difference appears to be statistically insignificant. Further, it is worth noting that most countries that introduce a line leasing obligation also have line rental price regulation. The few countries without line rental price regulation may be subject to specific circumstances that may impact on leasing prices and/or adoption. Given the methods used, it is likely that these factors would bias the study estimates.

Study 906 (SMS 3 – sub-national) evaluates the impact of LLU (line leasing) on broadband subscriptions in the United Kingdom. The study uses a dataset of local exchanges from 2005 to 2009, which allows it to control for local exchange fixed effects. The study finds that having at least one competitor at the local exchange increases the broadband subscription share by 2.5 percentage points. Interacting the LLU variable with a time trend, the study also finds that the positive impacts of LLU decrease with time. The study authors suggest that this might be due to the fact that the broadband market reached saturation.

Study 1150 (SMS 2 – sub-national) evaluates the impact of LLU (line leasing and bitstream access) on broadband subscriptions per capita in the United States. The study uses a zip-code level cross-sectional dataset. The line leasing variable is the proportion of telephone lines that are leased by entrants. The study finds that leasing has no impact on household adoption of broadband. This is potentially due to the fact that the United States abolished significant elements of LLU regulation after 2003, so it is possible that the insignificant effects may be due to the fact that LLU policy was in place before broadband technology was widely available.

Study 903 (SMS 3 – sub-national) evaluates the effect of LLU price regulation on household broadband adoption in the European Union. The study uses a dataset of European regions from 2006 to 2010 (NUTS I), allowing it to control for regional fixed effects. The study finds that a one standard deviation increase in LLU price decreases broadband penetration share by 1.3 percentage points.

Study 901 (SMS 3 – cross-country) evaluates the impact of LLU price regulation on the number of broadband lines as a share of total number of telephone lines in Europe. The study uses country-level price and adoption data for 14 countries from 2000 to 2003, which allows it to control for country-level fixed effects. The study finds that a £100 increase in the price of the local loop decreases the share of broadband lines by 13.2 percentage points. Similarly, a £30 increase in the price of rental lines decreases the share of broadband lines by 0.04 percentage points.

Two studies considers Bitstream access, with one finding a positive impact on broadband adoption.

Study 1150 (SMS 2 – sub-national) analyses the impact of LLU (line sharing and bitstream access) on broadband subscriptions per capita in the United States. The study uses a zip-code level cross-sectional dataset. The study finds that an increase in the share of bitstream access lines from zero to one is associated with an increase of the broadband subscription rate of 34 percentage points.

Study 940 (SMS 2 – cross-country) discussed above evaluates the impact of the LLU regulatory environment (line leasing obligation, bitstream access, and price regulation) on the number of broadband subscribers per one hundred inhabitants in the OECD. Given that LLU III differs from LLU II only by the fact that incumbents are obliged to allow bitstream access, the difference in coefficients implies bitstream access is associated with a five percentage-point lower broadband penetration rate. However, it appears that this difference is statistically insignificant.

One concern with LLU policies is that they may discourage investment if incumbents think that they will be unbundled in the future. However, only one of four studies that consider the impact on broadband investment or capital stock (typically measured as value of infrastructure per capita), finds a negative impact (and this is the least robust of the four). Of the remaining three studies, two find a positive effect and one finds no effect. One of the positive studies also shows that LLU regulation leads to an upgrading of the network, in the form of a higher market share for fibre optic internet.

Study 143 (SMS 3 – cross-country) evaluates the impact of LLU regulation (line leasing) 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 DSL makes use of slower copper wires. Although this has implications for broadband speed, it also reflects infrastructure investment. In effect, the study considers whether LLU regulation fosters the construction of higher technology fibre optic infrastructure. The study exploits a dataset of 33 OECD countries from 2012 to 2014, which allows them to control for country-level fixed effects. The study finds that LLU regulation increases the share of fibre optic users by 9.4 percentage points.

Study 917 (SMS 3 – cross-country) evaluates the impact of LLU regulation (line leasing and price regulation) on investment in broadband infrastructure in the EU. The study uses country-level data for 17 EU countries, from 2000 to 2010, which allows it to control for country-level fixed effects. The study finds that LLU regulation increases infrastructure investment. It also finds that increases in the one-off fee lead to increases in infrastructure investment. This would imply that price regulation would reduce investment – however the study notes there are problems with the sample size.

Study 997 (SMS 3 – cross-country) evaluates the impact of LLU regulation (line leasing and bitstream access) on investment in broadband infrastructure in Europe. The study uses country-level data for 27 countries from 2002 to 2009, which allows it to control for country-level fixed effects. The study finds that LLU does not have any significant impact on investment in broadband infrastructure.

Study 931 (SMS 2 – sub-national) evaluates the impact of LLU (line leasing) on the investment in broadband infrastructure in Japan. The study uses municipal-level data from 2005 to 2009. The study finds that LLU has

a negative impact on broadband infrastructure stock – a 1 per cent increase in the number of competitors using LLU decreases the probability of investment in new infrastructure by 4.31 per cent.

In terms of broadband speed and price, the impact of LLU regulation is unclear. One study finds no effect on speed, while another study (discussed above in the context of capital stock) finds that it increased the market share of fibre, which may imply faster internet speeds.

Study 143 (SMS 3 – cross-country) evaluates the impact of LLU regulation (line leasing obligation) 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 DSL makes use of slower copper wires. While this has implications for household adoption, it also affects broadband speed. The study exploits a dataset of 33 OECD countries from 2012 to 2014, which allows them to control for country-level fixed effects. The study finds that LLU increases the share of fibre optic users by 9.4 percentage points.

Study 237 (SMS 2 – cross-country) evaluates the impact of LLU regulation (line leasing obligation) on broadband speed in OECD countries. The study uses a cross-sectional dataset. The LLU policy variable is the sum of three dummy variables, which take the value of “1” if the country obliges incumbents to lease their lines to competitors within the cable, DSL, or fibre-optic markets. The study finds that LLU has no impact on broadband speed.

One study shows that bitstream access may make broadband more expensive for customers, but there is a lack of evidence on other forms of LLU.

Study 904 (SMS 3 – sub-national) evaluates the impact of bitstream access on broadband price in Spain. The study uses a dataset of individual subscriptions (collected from the telecoms providers) from 2005 to 2011, which allows them to control for subscription-level fixed effects. The study finds that providing broadband via bitstream access increases average subscription prices by 21 per cent. The authors suggest that this might be due to the fact that with bitstream access, competitors do not build infrastructure at the local exchange, which may preclude them from offering differentiated (and more affordable) services.

Cost effectiveness

From a public perspective, the only exchequer costs of LLU policies are bureaucratic. Unfortunately, none of the papers provide estimates of these costs, so it is not possible to infer the cost-effectiveness of such programmes. However, LLU also entails private costs, particularly for incumbent providers who lose market share with competition. Whether or not these losses are offset by consumer surplus would be relevant for establishing the cost effectiveness of LLU policies, but unfortunately the relevant information is not available.

Evidence Reviewed

Ref No	Reference
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