TELECOM ADVISORY SERVICES

ASSESSMENT OF THE ECONOMIC IMPACT OF TAXATION ON COMMUNICATIONS INVESTMENT IN THE UNITED STATES

A report to the Broadband Tax Institute

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Telecom Advisory Services LLC (TAS) is an international consulting firm specialized in the development of business strategies and public policies for digital and telecommunications companies, governments, and international organizations. Its clients include leading companies in the digital and telecommunications sectors, as well as international organizations such as the International Telecommunications Union, the World Bank, the Inter-American Development Bank, the World Economic Forum, the UN Economic Commission for Latin America and the Caribbean, the GSMA Association, the CTIA, the NCTA, Cable Europe, and the FTTH Council (Europe).

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EXECUTIVE SUMMARY

In this study we assess the impact of taxation on the level of telecommunications and cable industry investment in communications networks in a model that includes data on all states, and in a number of specific state case studies (Florida, Georgia, Illinois, Kentucky, Oklahoma, Tennessee, and Texas). In 2012, when we did the first iteration of this study, thirty states and local authorities imposed a sales tax on wireless and wireline network equipment purchases, and thirty-one states (plus the District of Columbia) did so on cable network equipment. Since then, the number of states collecting a sales tax on communications equipment purchase has increased to thirty-three in telecommunications and thirty-four for the cable industry. Furthermore, while in 2010 the average sales tax rate of the states that collected levies was 4.22%, in 2018 the average rate reached 4.40%[1]. If the rates are prorated by the size of investment by state and sector, the average rate for 2018 would be 4.58%.

The research literature to date provides evidence that taxes tend to raise the required pre-tax rate of return of capital invested and to affect negatively the incentives of a company to make investments. In industries such as telecommunications and cable that provide broadband services, a critical platform to deliver information, public services, and ensure economic growth, taxation tends to reduce the level of capital investment. According to the econometric models we developed with panel data between 2006 and 2018, a decrease of 1 percentage point in the average weighted state and local sales tax rate affecting initial equipment purchases (from 4.58% to 3.58%) would increase investment by 1.97 % over the current level of $42.93 billion. This would represent an additional investment of $847 million.

We also consider a scenario under which the states with sales tax on communications equipment were to join those states that have eliminated these taxes to promote network deployment. Under this scenario, we estimate an additional investment of $3.88 billion (an increase of 9.04% over the current level), reaching $9.92 billion on a cumulative basis over two years due to the inertia in capital planning[2]. Alternatively, under a scenario where the average rate were to be reduced by 34.50% (from 4.58% to 3.00%), the increase in investment would be $1.34 billion in the first year (an increase of 3.12% over the 2018 level) and $ 3.42 billion cumulative over two years.

Research indicates that the economic benefits associated with investment in communications networks are broadly distributed. By relying on input-output analysis, we estimate that an increase in investment of $3.881 billion over one year and $9.920 billion cumulative over two years (sales tax elimination scenario) will translate into the following economic contribution:

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[1] See calculation in Appendix B for a simple arithmetic average. The impact analysis contained in this report relies on weighted average tax rates by state and sector.

[2] As estimated in the econometric models, capital expenditures in the communications sector in a given year are strongly conditioned by spending in the prior year.

- $6.52 billion in additional annual GDP in the first year after the increase in investment and $16.65 billions of cumulative output over two years driven by broadband construction[3].
- 27,500 jobs in the first year after the increase in investment and 70,300 cumulative job/years over two years resulting from the same effect (although given the full employment context, these could originate in other sectors or through new entrants to the job market)

The sum total of the economic effects is presented in table A.

Table A. Economic effects of eliminating the Sales Tax on Network Equipment

Horizon	Incremental Investment ($ Billions)	Direct Effects		Indirect and induced Effects		Total Effects	
		Incremental Output ($ billions)	Jobs (*)	Incremental Output ($ billions)	Jobs (*)	Incremental Output ($ billions)	Jobs (*)
Short-Term (1 year)	$3.88	$3.88	15,933	$2.64	11,582	$ 6.52	27,515
Long-Term (2 years) (**)	$9.92	$9.92	40,724	$6.73	29,606	$ 16.65	70,330

(*) Measured in job years
(**) Cumulative but assuming an inertia effect of investment in year 2
Source: Telecom Advisory services analysis

Furthermore, the new economic activity will generate substantial offsetting revenues for state and local governments as new economic activity generates income, sales, property, and other tax revenue for governments. Finally, the additional investment will trigger additional deployment and consequently adoption of broadband. It is estimated that the long-term effect on incremental investment resulting from the elimination of the sales tax on communications equipment in those states that currently have such a levy would yield additional broadband penetration of 0.26% (178,700 additional new broadband connections), over and above the natural growth in broadband lines.

In the following table we present the economic contribution in seven states from the elimination of the sales tax on communications equipment purchase.

Table B. Economic effects of eliminating the sales tax on network equipment in specific States

Economic Indicators	Florida			Georgia		
	Current	Short-run	Long-run	Current	Short-run	Long-run
GDP per capita	$ 48,655	$ 48,677	$ 48,711	$ 55,913	$ 55,949	$ 56,004
Incremental GDP ($M)	$ 0	$ 464	$ 1,186	$ 0	$ 378	$ 966
Incremental Jobs	0	1,958	5,005	0	1,595	4,076
Broadband Penetration	85.25%	85.30%	85.38%	83.75%	83.88%	84.08%

[3] Given broadband's high penetration level, current spillover effects are driven primarily by an increase in service quality rather than growth in penetration, although new broadband lines represent a contribution to reducing the digital divide.

Economic Indicators	Illinois			Kentucky		
	Current	Short-run	Long-run	Current	Short-run	Long-run
GDP per capita	$ 67,858	$ 67,884	$ 67,925	$ 46,625	$ 46,640	$ 46,663
Incremental GDP ($M)	$ 0	$ 333	$ 851	$ 0	$ 65	$ 167
Incremental Jobs	0	1,406	3,594	0	276	705
Broadband Penetration	85.10%	85.17%	85.27%	81.67%	81.77%	81.94%

Economic Indicators	Oklahoma			Tennessee		
	Current	Short-run	Long-run	Current	Short-run	Long-run
GDP per capita	$ 50,716	$ 50,729	$ 50,751	$ 54,003	$ 54,029	$ 54,070
Incremental GDP ($M)	$ 0	$ 55	$ 139	$ 0	$ 176	$ 449
Incremental Jobs	0	230	588	0	742	1,896
Broadband Penetration	81.95%	82.04%	82.19%	82.07%	82.24%	82.50%

Economic Indicators	Texas		
	Current	Short-run	Long-run
GDP per capita	$ 61,870	$ 61,895	$ 61,932
Incremental GDP ($M)	$ 0	$ 692	$ 1,768
Incremental Jobs	0	2,920	7,463
Broadband Penetration	84.51%	84.63%	84.80%

Source: Telecom Advisory services analysis

I. INTRODUCTION

In 2012, we published research that assessed the impact of taxation on the level of investment in communications networks and its economic consequences in the United States[4]. In that study we provided evidence that a decrease of 1 percentage point in the average weighted states and local sales tax rate affecting initial equipment purchasing (from 4.45% to 3.45% for cable operators and from 4.02% to 3.02% for telecommunications providers) would increase total annual investment in communications networks by $ 428 million (1.03% over the 2012 level of $ 41.489 billion). We also estimated at the time the economic spillovers if these levies were eliminated in order to promote broadband network deployment. This scenario resulted in a baseline estimate of an increase in investment of $1.78 billion, $ 8.69 billion in additional annual Gross Domestic Product (GDP) in the first year after the elimination of the sales tax and $48.26 billion over three years, 64,000 new jobs in the first year and 354,000 over three years, and an increase in broadband deployment of 712,000 new connections.

Since the publication of our 2012 study, several changes have taken place both in the communications industry and, to some degree, in the network equipment sales taxation landscape. Wireless, wireline and cable service providers are under considerable pressure to invest in their networks. Broadband Internet traffic has been growing at 28% per year, driven in part by the increase in the number of devices that rely on the internet (PCs, smartphones, tablets, smart TVs). For example, in 2018 smartphone penetration reached 86.43%, increasing from 52.61% in 2012[5], while personal computer adoption per household reached 94.48% from 78.90% in the same year[6]. In parallel, the usage per device has increased dramatically. In 2017, each smartphone in the United States generated 4.2 GB per month (up from 3.5 GB in 2016). Of this traffic, video represented 64%[7].

The impact of applications penetration on broadband network speed requirements is clear. For instance, a family of five streaming two video channels in high definition (requiring approximately 51 Mbps in total), while simultaneously playing high-definition online games (using up to 14 Mbps) and taking part in multiple-user online conversations (which demand 8 Mbps), through smartphones and/or laptops would need approximately 150 Mbps in total[8]. A comparable household would in 2012 require, at most, 72 Mbps. As expected, the growth in Internet traffic has been paralleled by an increase in fixed broadband speed. In fact, we estimate that the average broadband download speed has been growing by 26.81% annually[9]. In light of these demand trends, operators in the broadband communications industry are increasingly under pressure to accelerate their investment in infrastructure in order to accommodate the growth in traffic and continue delivering quality service.

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[4] Katz, R., Flores-Roux, E., Callorda, F. (2012). *Assessment of the economic impact of taxation of communication investment in the United States: a report to the Broadband Tax Institute*. October

[5] Source: GSMA Intelligence

[6] Source: International Telecommunications Union.

[7] Source: CISCO Visual Networking Index

[8] Source: Broadband speed calculator

[9] Source: Ookla/Speedtest.

In addition to continuing the investment in broadband networks to support the ever-growing needs of American broadband users, operators are pushing to address the digital divide by deploying new networks or expanding capacity in rural and isolated areas. According to the FCC, by the end of 2017 21 million people resided in areas unserved broadband services[10]. These two imperatives – continue investing to accommodate traffic growth and deploy networks in unserved areas – put pressure on operators' network spending. Between 2014 and 2018 wireless, wireline and cable operators invested $ 210.86 billion in communications networks, and $42.93 billion alone in 2018. This trend will not subside, considering the ever-increasing pressure to sustain the required maintenance and capacity upgrade investment, while modernizing networks (e.g. 5G, fiber optics, and DOCSIS 4.0). In this context, taxation on broadband equipment purchasing, by increasing capital costs, reduces the amount of capital available for broadband deployment.

As mentioned above, in 2012 thirty states had a sales tax on wireless and wireline equipment purchasing, and thirty-one states (plus the District of Columbia) had one on cable equipment. In 2018, the number of states has increased to thirty-three. In 2010, the average sales tax rate of the states that collected levies was 4.22%, while in 2018, the average rate reached 4.40%[11].

Our main hypothesis in this study is that sales taxes on the initial purchase of equipment increase the cost of deploying infrastructure and, consequently, have the potential to reduce the amount of capital geared for deploying communications networks, in particular broadband infrastructure. Since communications have been proven to contribute to economic growth and job creation, a lesser amount of investment caused by sales taxes, would reduce their social and economic impact. In this study we will provide quantitative evidence of the negative economic impact of taxation of communications equipment purchase. On this basis, we model what the expected impact would be if the existing levels of taxation were to be reduced or outright eliminated.

In Chapter II we review the research literature regarding the impact of taxation on corporate investment. While emphasizing that a rise in the tax rate in an open economy causes a net capital outflow and negative economic welfare, the research also tends to emphasize the complex mechanisms by which taxes tend to affect capital investment in the communications sector. Among the different variables highlighted, we review the varying impact of taxes on investment depending on the state of the economy, the importance of inertia of past capital planning decisions as a driver of future investment decisions, and the competitive impact that taxes might have in attracting future investment from one state to another.

In Chapter III we provide evidence of how taxation has been affecting communications network investment levels since 2014 in the United States. Focusing on sales taxes on initial equipment purchasing by the three industries mentioned above, we first review the current situation in terms of the weighted-average state and local sales. On this basis, we develop an econometric

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[10] While this number is significant, it should be mentioned that in 2013 the unserved population reached 51.6 million. This significant reduction in unserved population indicates the sizable investment effort conducted by broadband service providers. Source: FCC, *2019 Broadband Deployment Report*, Figure 1, p.16.
[11] If the rates are prorated by the size of investment, the average rate for 2018 would be 4.58%.

model to explain the negative relationship between sales taxes and investment. The third body of evidence we include in this chapter comprises selected case studies based on the analysis of longitudinal data of sales taxes and investment for those states that have increased them since 2014 (e.g. Louisiana, and South Dakota).

Having proven the negative relationship between sales taxes on equipment purchasing and investment, we then move to determine the social and economic impact of a reduction in taxation. In Chapter IV we review the research literature on the impact of communications networks on economic growth and job creation, underlining both the short-term effects of network deployment and the long-term impact through positive externalities and spill-over effects on the whole economy.

With the review of the literature on economic effects as a background, we present in chapter V the estimates of alternative scenarios regarding the reduction of sales taxes on network equipment purchasing of the telecommunications and cable industries. The simulations are based on impact models constructed for the national economy, calculating the impact coefficients for economic growth, job creation, and broadband penetration.

Finally, we utilize the econometric models presented in Chapters III and V to estimate what the economic impact would be if an exemption of state and local sales taxes for communications network equipment purchase were enacted in Florida (chapter VI), Georgia (chapter VII), Illinois (chapter VIII), Kentucky (chapter IX), Oklahoma (chapter X), Tennessee (chapter XI), and Texas (chapter XII).

II. EVIDENCE OF THE IMPACT OF TAXATION ON INVESTMENT: A REVIEW OF THE LITERATURE

The most important function of taxes is to raise revenue to finance various government activities, such as the delivery of public goods, like education, health, security, and public infrastructure. Taxes are typically collected on both net income and consumption of goods and services. The first type is collected over income generated in a fiscal or a calendar year, while the second one is linked to the acquisition of a good or service (for example, retail sales tax, value-added tax, and import duties)[12].

Decisions regarding taxation are driven by public policies guided by normative goals (how much revenue should the state collect to pay for what type of services to be provided to its citizens?) and the cost/ benefit equation incurred to meet those objectives. While the benefits of taxes relate to general policies (e.g. raising revenues to support the public administration) or specific objectives (e.g., support the development of broadband in schools), economic theory also shows that, in general terms, an increase in taxation affects market equilibrium by shifting the demand and supply curves as a result of raising prices with the consequent reduction in the quantity of goods. Therefore, the impact of taxation in the digital economy needs to be structured around not only the benefits it generates, but also the costs in lost surplus it may imply.

II.1. The impact of taxation on capital investment

The research literature tends to find that, since higher taxes tend to raise the required pre-tax rate of return of capital invested, the aggregate capital stock in a given economy depends on the effective tax rate (Slemrod, 1990; Devereux and Freeman, 1995; Jun, 1994; Billington, 1999). As Devereux (2006) states,

> "(If a) company should invest up to the point at which the marginal product of capital equals the cost of capital (…) the impact of taxation should be measured by the influence of (an effective marginal tax rate) on the cost of capital"

Accordingly, when a firm has to make an investment decision, taxation plays a significant role. As stated by Lintner (1954), taxes affect both the incentives of a company to make investments and reduce the supply of funds available to finance them. Thus, not surprisingly, many empirical studies indicate that higher marginal and average tax rates have a negative effect on investment decisions.

Since investment is one of the engines of long-term economic growth, taxation also plays a role in determining an economy's prospects. Talpos and Vancu (2009) showed that a reduction of corporate income taxation determines, over time, an increase in the level of gross fixed capital formation. The authors also found this effect to be more important in emerging economies, where investment is needed more.

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[12] See OECD. *Addressing the tax challenges of the Digital Economy.* Paris, 2014.

Taxes are just one of the many factors driving capital investment decisions. Beatty et al. (1997) show that high net equity financing activity (access to low cost funds) and high stock returns (market signaling) are also important in explaining high future net capital expenditures. Similarly, as expected, the authors found that high net income and low dividend payouts are important predictors. Nevertheless, when controlling for these factors, the authors also found that changes in the United States tax code in 1986 had a real effect on the investment behavior of US-based firms[13].

In general terms, Lintner (1954) also found that in periods of economic expansion, when taxes are fully borne by firms, the negative impact of taxation on investment affects primarily the supply of funds and not the incentives to invest. Investment may be undertaken to maintain or improve a company's competitive position or to increase market share. Conversely, in periods of economic downturn, the effects of taxes on investment incentives would be relatively more important, and the availability of funds becomes less important in influencing investment decisions.

The mechanisms by which taxes affect telecom investment are fairly complex. Devereux (2006) considers that taxation first affects two binary decisions: **which business** to invest (e.g. wireless, broadband, other) and **which geographic location** to invest (e.g. a specific state). While the first decision - which business – is not relevant to this study, the second one is critical. As McLure (1970) has explored, tax policy has a critical impact on industrial location, particularly under high capital mobility contexts. In addition, taxes also influence a continuous choice: once a business and locations are agreed upon based on taxation attractiveness, businesses see levies affecting their capital expenditure allocation process (in other words, taxes will influence **how much** will investment favor certain states to the detriment of others).

It should be noted that changes in tax regimes do not affect investment decisions instantaneously. Investment decisions are partially driven by variables that only change gradually (e.g. changes in the cost of capital). As a result, a modification of taxation regimes (e.g. a change in the sales tax rate affecting the initial purchasing of equipment) might affect the incentives to invest immediately but translate into investment decisions only gradually (Auerbach, 2005).

II.2. Taxation and capital spending in communications industries

Typical capital planning processes in communications comprise decisions in three domains: maintenance of existing plant (e.g. replacement of depreciated equipment), network modernization (e.g. deployment of 5G networks, fiber in the access network, or DOCSIS 3.1), and capacity upgrades (e.g. investment to accommodate growth in demand). Each investment domain is driven by different time constraints. For example, maintenance capital investment is

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[13] In 1986, the U.S. Congress passed the Tax Reform Act (TRA) to simplify the income tax code, broaden the tax base and eliminate many tax shelters and other preferences. The act raised overall revenue by $54.9 billion in the first fiscal year after enactment. As of 2014, the Tax Reform Act of 1986 was the most recent major simplification of the tax code, drastically reducing the number of deductions and the number of tax brackets (for the individual income tax) to three.

typically multi-year and mostly non-discretionary; therefore, it is largely predictable and relatively less subject to taxation effects. Network modernization capital, while also being multi-year, could be affected by capital allocation decisions influenced by taxation (in other words, if taxation reduces the supply of funds, it could impact investment thereby affecting the rate of modernization). On the other hand, capacity upgrades have a long-term component driven by demand forecast, but also a very short-term component focused on surgical infrastructure upgrades (e.g. accommodate spikes in demand in certain portions of the network). This area of capital investment might be less affected by taxation regimes since it is directly linked to revenue generation opportunities.

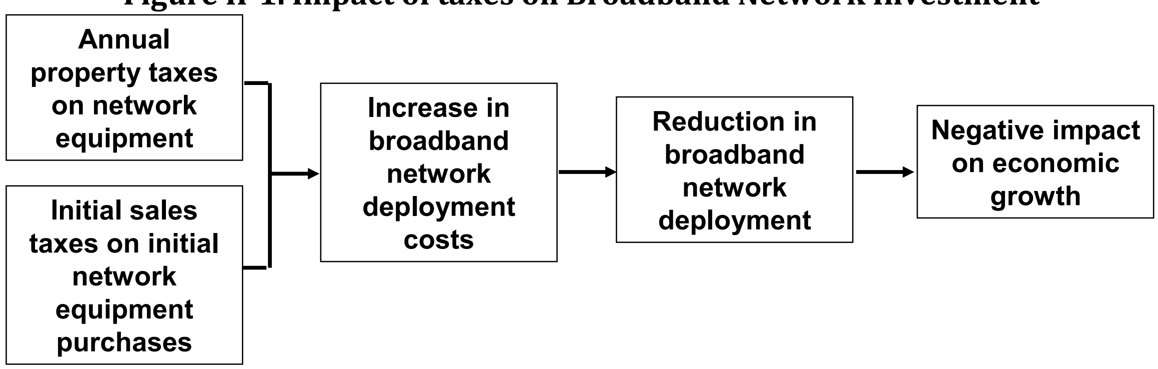
Based on these considerations, when we construct econometric models that explain the evolution of communications network investment, it is critical for us to incorporate control variables that go beyond the measurement of changes in taxation regimes. For example, since investment levels are affected by whether the economy is expanding or contracting, it is important that we include variables measuring the performance of the economy (or alternatively including time fixed effects) in the models. Likewise, given that investment is driven, to a large degree, by the imperative to capture market potential, it is critical for us to include variables and/or proxies for variables reflecting the intrinsic attractiveness of the business opportunity which could be captured by location fixed effects). Finally, while our models of communications investment rely on a single dependent variable (industry investment across the wireline, wireless, and cable sectors), this metric subsumes, as mentioned above, a number of management and capital planning allocation decisions, each one being influenced by specific conditions of taxation regimes. In that sense, it is critical that we develop methodologies that accommodate the inertia of allocation processes, whereby future capital investments can be, to some degree, determined by the level of investment in prior years.

Sales taxes are collected when a good or service is sold to its final consumer. The amount of the tax varies although it is usually based on a percentage of the sale amount. In the United States, sales taxes are collected at the state and local level. Since there can be several jurisdictions charging a sales tax, the retailer must add the amount of tax for each of them to calculate the Combined Sales Tax Rate. In the case of Internet sales, the rate used is that of the location where the consumer resides. Other taxes that are similar to the sales tax are the excise tax (charged on goods or sales produced within the country), and the gross receipt tax (charged on the gross revenues of a business or company). Sales tax on initial equipment purchase is a conventional way by which broadband service providers contribute to the treasury. Rates for this equipment can reach up to 10%, to which customs duties on network equipment may be added. The fundamental difference in sales taxes or import duties on purchased equipment in these cases is that both are charged to the firm producing the good (such as a telecommunications operator) rather than the consumer, although the operators may transfer some of these taxes to consumers. However, under conditions of competitive pressure and/or regulation, transferring the full amount of the tax to the consumer might be impossible, and the service provider might be put in a situation where investment is reduced. Even if all the taxes are passed on to the consumers could have a negative impact on investment since the consequent increased prices decrease output, thereby reducing the demand for investment.

While not being analyzed in this study, property taxes are another type of taxation imposed on broadband service providers. For example, in the United States these operators pay property taxes for the physical assets they own in each state. Payment of property taxes in many states is based on the notion that broadband providers are "utilities", and as such, they need to pay taxes originally established for railroads and electric companies. The amount may be calculated by valuing the entire business enterprise, rather than summing up the fair market value of specific fixed assets owned by the business[14]. The key ratio in determining the tax to be paid is the so-called "assessment ratio", which is the proportion of the property value that the tax rate is applied in establishing the amount to be paid in property taxes. In an example of sector discrimination, a number of states define higher assessment ratios to the property of telecommunications companies than the ratio applied to property of general businesses.

Direct taxes such as sales taxes collected on initial network equipment purchases that are imposed on broadband service providers have a negative economic impact. The underlying causality of this effect is depicted in figure II-1.

Figure II-1. Impact of taxes on Broadband Network Investment



Source: Telecom Advisory Services

According to the logic presented in figure II-1, taxes on network equipment in the two dimensions mentioned above – property taxes and sales tax on equipment - may affect the deployment of broadband infrastructure by telecommunications carriers and cable operators. Suppliers of broadband services have their capital investments pre-determined by financial benchmarks (e.g. carriers typically tend to spend 15-20% of their sales in capital expenditures). Within this envelope, taxes could frame the allocation of capital across locations, thereby potentially negatively impacting deployment in certain geographies.

Reflecting the growing shift to digital platforms in commerce, advertising, and content distribution, taxation is becoming an increasingly important topic. Two opposing trends can be detected in terms of fiscal policy in the digital economy: one is to maximize collections based on growing digital flows; the second one is to recognize that lowering taxation benefits consumers and businesses.

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[14] See Bierbaum, D., Fenwick, J. and Mackey, S. (2011). *Property Tax Discrimination: Barrier to broadband*. Presentation at the ALEC Spring Conference. Cincinnati, OH, April 29, 2011.

According to the first trend, some policy makers are recognizing growing digital flows as critical in their generation of revenues and are putting in place more mechanisms to maximize collection in these domains of economic activity. For example, in the United States wireless tax burdens have increased since 2006. The combined federal, state, and local burden on wireless consumers increased from 15.19 % to 19.10 %, or nearly 4 percentage points. Underlying the discriminatory trend, overall tax burdens on wireless consumers grew about three times faster than general sales taxes on other taxable goods and services[15]. According to the second trend, some policy makers consider that lowering taxes on the digital sector of the economy triggers spillovers that are larger than the foregone taxes. As a consequence, digital goods and their supporting equipment might be exempted from certain taxes.

II.3. Conclusion

To sum up, taxes can create distortions if they affect the choices made by market agents, which in the digital space could be as follows:

- Consumers, particularly those that are price sensitive, limit their adoption of technology;
- Telecommunications operators reduce their rate of investment in infrastructure;
- Global digital technology providers adapt their deployment footprint according to a minimization of tax burden; and
- Different tax regimes within the digital ecosystem create asymmetries.

In consequence, the design of an efficient tax structure in the digital space needs to consider several somewhat contradicting requirements:

- Ensure proper collection of taxes for income generated at source;
- Avoid over taxation of digital activities when compared to other industries;
- And, very relevant to this study, provide exemptions to facilitate investment in infrastructure and promote adoption by end-users.

[15] Mackey, S. and Henchman, J. (2018). *Wireless Taxes and Fees Climb Again in 2018*. Tax Foundation Fiscal, December, No. 626.

III. THE IMPACT OF TAXATION ON CAPITAL INVESTMENT IN COMMUNICATIONS NETWORK DEPLOYMENT IN THE UNITED STATES

III.1. Current level of investment and sales tax rate on initial communications network equipment purchasing

Telecommunications and cable service provider investment in 2018 in the United States reached $ 42.927 billion, averaging $ 131.21 per capita. This figure represents the sum of investment of the four major wireline telecommunications carriers (ATT, Verizon, Sprint, and CenturyLink), the five major wireless carriers (ATT, Sprint, T-Mobile, US Cellular, and Verizon), as well as almost all cable operators[16]. It includes only network investments, excluding other capital expenditures such as consumer premise equipment, vehicles, administrative offices, expenditures related to retail stores and any other "soft" costs typically not subject to sales/use tax.

When looking at the communications network investment per capita over time between 2006 and 2018, in addition to a gradual increase, we see a growing dispersion across states over time (see table III-1).

Table III-1. Evolution of Communications Network Investment per Capita in the United States (2006-18)

YEAR	Total (2006-10)	2014	2015	2016	2017	2018	Total (2014-18)
Mean	$ 129.68	$ 130.57	$ 136.08	$ 128.38	$ 126.67	$ 131.21	$ 130.57
States std. dev.	$ 69.69	$ 91.79	$ 71.18	$ 79.25	$ 61.74	$ 78.33	$ 76.51

Sources: Broadband Tax Institute; Telecom Advisory Services analysis

In the period between 2006 and 2010, corresponding to our prior study, the average investment across states was $ 129.68, increasing only to an average of $ 130.57 per capita during the 2014-2018 time period. However, between 2006 and 2010 the standard deviation, defined as the amount of dispersion across investment per capita by each state was $ 69.69. The standard deviation between 2014 and 2018 is $ 76.51 (an increase of close to 10%). The tendency is clear: while the average investment has remained constant, a polarization trend is emerging. Some states are increasingly receiving more per capita network investment than others. While it is obvious that, as stated in the research literature reviewed above, conventional variables such as market potential and competitive imperative drive investment intensity, it is pertinent to raise the question as to what the role of taxation is in driving capital investment levels and the growing polarization across geographies.

In 2010, the simple five-year average sales tax rate on initial equipment purchase for the cable industry was 4.45%, while the five-year average rate for wireless and wireline providers was

[16] It is estimated that this figure represents in excess of 80% of the investment of telecommunications carriers and nearly all the cable TV industry (source: Broadband Tax Institute).

4.02%. In 2018, the average tax rate was 4.40%[17]. The five-year average sales tax on communications equipment purchase between 2014 and 2018 has been relatively stable (around 4.35%), although it depicted a growing standard deviation across states over time (see table III-2).

Table III-2. Evolution of US Sales Tax on Communications investment (2006-2018)

Year	2006	2007	2008	2009	2010	2014	2015	2016	2017	2018
Mean	4.01%	4.08%	4.10%	4.27%	4.22%	4.28%	4.30%	4.34%	4.37%	4.40%
Standard deviation	3.50%	3.55%	3.58%	3.60%	3.67%	3.24%	3.24%	3.25%	3.27%	3.31%
States without sales taxes on telecom and cable network equipment	13	13	13	12	13	13	13	13	13	13
States with sales taxes exemption in at least one technology	26	26	26	25	26	22	22	22	22	22

Sources: Broadband Tax Institute; Telecom Advisory Services analysis

It is important to note the change in the average tax rate since the last study we conducted. In 2010, the average sales tax rate was 4.22%, but increased since then reaching 4.40% in 2018. Furthermore, taxation on initial communications equipment purchase does not represent a homogeneous fiscal policy across the nation. In 2018, seventeen states (plus the District of Columbia) do not tax telecommunications provider network equipment, while seventeen do not do so in the cable provider case. The number of states with sales tax exemption for all communications network equipment has remained stable at 13, although the number of states with at least one type of exemption has diminished from 26 to 22. More importantly, nineteen states have increased their state and local sales tax rate for all communications equipment between 2014 and 2018, while five states have done so for at least one or two technologies (see table III-3).

Table III-3. State and Local Sales tax rate on communications equipment purchasing (2010-2018)

State	2010			2014			2018		
	Wireless	Wireline	Cable	Wireless	Wireline	Cable	Wireless	Wireline	Cable
Alaska	- - -	- - -	- - -	1.69%	1.69%	1.69%	1.76%	1.76%	1.76%
Alabama	1.50%	1.50%	0.00%	6.38%	4.26%	6.38%	6.83%	4.55%	6.83%
Arkansas	8.38%	8.38%	8.38%	9.19%	9.19%	9.19%	9.41%	9.41%	9.41%
Arizona	0.00%	0.00%	8.20%	0.00%	0.00%	8.17%	0.00%	0.00%	8.33%
California	9.25%	9.25%	9.25%	8.41%	8.41%	8.41%	8.54%	8.54%	8.54%
Colorado	7.56%	7.56%	7.56%	7.39%	7.39%	7.39%	7.52%	7.52%	7.52%
Connecticut	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
DC	0.00%	0.00%	5.75%	0.00%	0.00%	5.75%	0.00%	0.00%	5.75%
Delaware	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Florida	7.25%	7.25%	7.25%	6.62%	6.62%	6.62%	6.80%	6.80%	6.80%
Georgia	7.50%	7.50%	7.50%	6.97%	6.97%	6.97%	7.15%	7.15%	7.15%
Hawaii	- - -	- - -	- - -	4.35%	4.35%	4.35%	4.35%	4.35%	4.35%
Iowa	1.86%	1.86%	6.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Idaho	6.00%	6.00%	6.00%	6.03%	6.03%	6.03%	6.03%	6.03%	6.03%
Illinois	8.75%	8.75%	8.75%	8.16%	8.16%	8.16%	8.70%	8.70%	8.70%

[17] If the rates are prorated by the size of investment, the average rate for 2018 would be 4.58%.

State	2010			2014			2018		
	Wireless	Wireline	Cable	Wireless	Wireline	Cable	Wireless	Wireline	Cable
Indiana	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Kansas	8.13%	8.13%	8.13%	8.15%	8.15%	8.15%	8.68%	8.68%	8.68%
Kentucky	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
Louisiana	9.00%	9.00%	9.00%	8.89%	8.89%	8.89%	10.02%	10.02%	10.02%
Massachusetts	6.25%	6.25%	0.00%	6.25%	6.25%	0.00%	6.25%	6.25%	0.00%
Maryland	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
Maine	5.00%	5.00%	5.00%	5.50%	5.50%	5.50%	5.50%	5.50%	5.50%
Michigan	0.00%	0.00%	6.00%	0.60%	0.60%	6.00%	0.60%	0.60%	6.00%
Minnesota	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Missouri	0.00%	0.00%	7.23%	0.00%	0.00%	7.58%	0.00%	0.00%	8.03%
Mississippi	0.00%	0.00%	7.00%	1.75%	1.75%	7.00%	1.77%	1.77%	7.07%
Montana	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
North Carolina	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
North Dakota	0.00%	0.00%	6.00%	6.55%	6.55%	6.55%	6.80%	6.80%	6.80%
Nebraska	7.00%	7.00%	7.00%	6.79%	6.79%	6.79%	6.89%	6.89%	6.89%
New Hampshire	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
New Jersey	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
New Mexico	7.60%	7.60%	0.00%	7.26%	7.26%	7.26%	7.66%	7.66%	7.66%
Nevada	7.91%	7.91%	7.91%	7.93%	7.93%	7.93%	8.14%	8.14%	8.14%
New York	0.00%	0.00%	8.25%	0.00%	0.00%	8.47%	0.00%	0.00%	8.49%
Ohio	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Oklahoma	8.45%	8.45%	0.00%	8.72%	8.72%	0.00%	8.91%	8.91%	0.00%
Oregon	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Pennsylvania	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Rhode Island	7.00%	7.00%	7.00%	7.00%	7.00%	7.00%	7.00%	7.00%	7.00%
South Carolina	7.25%	7.25%	0.00%	7.19%	7.19%	0.00%	7.37%	7.37%	0.00%
South Dakota	5.96%	5.96%	5.96%	5.83%	5.83%	5.83%	6.40%	6.40%	6.40%
Tennessee	9.25%	9.25%	9.25%	9.45%	9.45%	9.45%	9.46%	9.46%	9.46%
Texas	8.25%	8.25%	8.25%	6.06%	6.06%	6.06%	6.06%	6.06%	6.06%
Utah	0.00%	0.00%	6.80%	0.00%	0.00%	6.68%	0.00%	0.00%	6.77%
Virginia	5.00%	5.00%	0.00%	5.63%	5.63%	0.00%	5.63%	5.63%	0.00%
Vermont	6.50%	6.50%	6.50%	6.14%	6.14%	6.14%	6.18%	6.18%	6.18%
Washington	9.00%	9.00%	9.00%	8.88%	8.88%	8.88%	9.18%	9.18%	9.18%
Wisconsin	5.55%	5.55%	5.55%	5.43%	5.43%	5.43%	5.42%	5.42%	5.42%
West Virginia	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Wyoming	5.50%	5.50%	5.50%	5.49%	5.49%	5.49%	5.46%	5.46%	5.46%

Exemption Increase rate Decrease rate Stable rate

Source: Tax Foundation

III.2. Model explaining the impact of sales tax rate on investment by cable and telecommunications companies

Following the general methodology implemented in our 2012 study, we build an econometric model to test the impact of sales taxes on telecommunications and cable network investment. In order to benefit from additional observations to build higher statistical significance, the data collected in the 2012 study (corresponding to the period 2006-2010) was included in a panel of time series between 2014 and 2018[18]. Our model estimates the impact of different tax rates among states and years, controlling for state and year fixed effects. In addition, we include in our

[18] The data between 2011 and 2013 was interpolated to generate a continuous panel between 2006 and 2018.

model a lagged investment variable to control for the inertia in capital spending from year to year[19]. Beyond this, the investment per capita variables were converted to natural logarithms in order to estimate the impact of a percentage change in indicators. The advantage of this conversion is that the model estimates the change in investment for every increase or decrease in percentage points of the sales tax rate. The model for assessing the impact of sales taxes on investment is structured as follows:

$$\text{Ln Taxable Investment PC}_{it} = \alpha_1 (\text{Equipment State Sales Tax Rate}_{it}) + \alpha_2 (\text{Ln Taxable investment}_{it-1}) + f.e._{i} + f.e._{t} + e_{it}$$

Beyond the two terms used for fixed effects by state and year (indicated by f.e. in the equation), the variables considered are the following (see table III-3):

Table III-3. Variables of Sales Taxes Effect on Investment

Variable	Explanation	Rationale	Source
State communications investment per capita	Sum of state investment by operators per capita (in current dollars) 2006-2010 2014-2018 2011-2013 interpolated	Total state communications investment normalized by population size	Broadband Tax Institute
State sales tax rate on initial equipment purchase	Effective sales tax rate on cable, wireline or wireless equipment 2006-2010 2014-2018 2011-2013 interpolated	Independent variable	Tax Foundation
State communications investment per capita lagged	Sum of state investment by operators per capita one year before (in current dollars)	Control for investment inertia	Broadband Tax Institute

Source: Telecom Advisory Services analysis

Model results are presented in the following table.

[19] In other words, it accounts for the importance of investment in the prior year in predicting investment in the current year, an effect we found in the review of the research literature on capital planning.

Table III-4. Model of Impact of Sales Tax Rate on Investment

Impact on Ln Investment per capita	Coefficients
Ln Investment per capita$_{t-1}$	0.5560 *** (0.0325)
Tax Rate$_{t}$	-0.0197 * (0.0110)
Constant	2.1255 *** (0.1614)
State Fixed Effect	Yes
Time Fixed Effect	Yes
Number of States	49
Years	2007-2018
Observations	588
R-Square	0.3625

***, **, * significant at 1%, 5% and 10% critical value respectively.
Source: Telecom Advisory Services analysis

As can be seen in Table III-4, we find that investment in communications equipment by telecommunications and cable service providers is negatively affected by sales taxes. The coefficient for the sales tax rate variable indicates that a decrease of 1 percentage point in this rate (for example, from 4.58% to 3.58%) would increase telecom and cable investment by 1.97% across all states. These results are statistically significant at the 10% level. This coefficient allows for the calculation of the impact on investment per capita of alternative tax rate scenarios. For example, a decrease in the sales tax rate affecting initial equipment purchase from an average 4.58% to 3.00% (a rate reduction of 34.50%) would yield an increase in investment per capita of $ 4.09 (3.12% over the current level).

Similarly, a total elimination of the sales tax affecting the purchase of equipment would generate an increase in investment of $11.86 per capita. This would result in a total increase of $3.88 billion from a base of $42.93 billion. Under the assumption of a total exemption across states, the total investment would reach $ 46.81 billion, which means that for every dollar of taxes that is not collected, the investment would increase by $ 1.97.

III.3. Impact of sales tax rate on investment by cable and telecommunications service providers in specific states

We also assess the impact of a reduction or an increase of the sales tax rate on equipment purchasing by examining the actual investment behavior of telecommunications carriers and cable operators in states that enacted such policies. We start this assessment by calculating the average sales tax rate on network equipment paid by all broadband operators in each state. Once the average tax rate was calculated, the states that had reduced or most significantly increased (over 5%) their average sales tax rate on initial equipment purchase between 2014 and 2018 were identified. Table III-6 ranks these states by the range of variation between 2014 and 2018.

Table III-6. Variation on Sales Tax Rate on Telecommunications Investment (2014-2018)

State Name	Variation on Sales Tax Rate 2014-2018	2014 Sales Tax Rate	2018 Sales Tax Rate
Louisiana	12.71%	8.89%	10.02%
South Dakota	9.78%	5.83%	6.40%
Alabama	6.90%	5.68%	6.07%
Illinois	6.62%	8.16%	8.70%
Kansas	6.50%	8.15%	8.68%
Missouri	5.94%	2.53%	2.68%
New Mexico	5.51%	7.26%	7.66%
Wisconsin	-0.18%	5.43%	5.42%
Wyoming	-0.55%	5.49%	5.46%

Source: Telecom Advisory Services analysis of Tax Foundation data

As indicated in table III-6, nine states either significantly increased (over 5%) or decreased by some amount the communications equipment average sales tax rate. We will now measure any changes that occurred in investment levels following the change in the effective tax rate for two states: Louisiana and South Dakota.

On a comparative basis, Louisiana has a high sales tax rate on communications equipment which has been increasing continually since 2014. In 2014 the rate was 8.89%, significantly higher than the national average. In 2017, due to budget pressure, the state increased the rate by 1 percentage point and by 2018 the average rate was increased again to 10.02 %, the highest in the United States. The 2018 sales tax rate on network equipment is the same for all three industry segments (wireless, wireline and cable). Over the long run, the variance in sales tax rate appears to have influenced network investment. Communications network per capita investment jumped from $57 in 2014 to $ 79 in 2015, but then dropped to $66 in 2016. The lagged effect between increasing tax rate in 2015 and investment decline in 2916 is a typical move in yearly capital planning processes. Even three years later, the investment levels had not recovered to the 2015 levels, although at $69 per capita they were somewhat higher than in 2014.

South Dakota is a state with a fairly high variation in communications equipment sales tax rate: in 2014 the rate was 5.83%, but increased in 2017, reaching 6.40% in 2018. Of note, the 2018 rate is the same for all three industry segments. A constant tax rate of 5.83% between 2014 and 2018 might have acted as an incentive for communications service providers to increase their network investment from $75 per capita to $93. In 2017, the average sales tax rate jumped first to 6.39% and then 6.40% in 2018. Investment reacted accordingly: a marginal increase in 2017 to $95 per capita and a decline to $87 per capita in 2018. This lagged effect is again consistent with capital planning processes which tend to react to changes in taxation policy only after two or more quarters after their enactment.

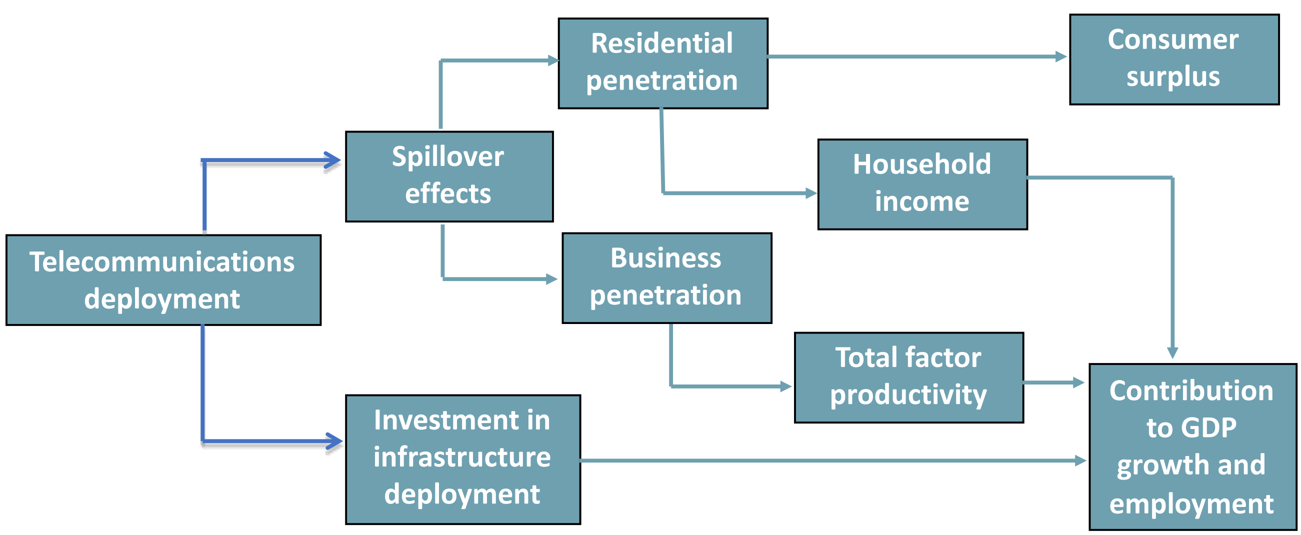
Both case studies could be understood with the help of the framework developed by Devereux (2006) and discussed in chapter II. When a state legislature votes to increase sales taxes on equipment purchase, it sends a signal to operators regarding the relative attractiveness of conducting business in that state. In the decision of how much capital investment will favor certain states to the detriment of others, the operators subsume two different reactions. The first one refers to the supply of funds decision, which means that “dollar for dollar”, the money saved in taxes flows to investment. The second one is what Lintner (1992) calls the incentive reaction, whereby funds that could have been invested in other states, now tend to flow away from the state that has increased its sales tax rate.

IV. RESEARCH EVIDENCE OF THE ECONOMIC IMPACT OF BROADBAND

If sales taxes reduce communications investment (as we have shown above), and communications, especially broadband, have a positive contribution to economic growth and job creation, it stands to reason that a reduction of investment resulting from increasing sales taxes should have a negative economic impact. In this chapter we review the evidence generated so far regarding the positive socio-economic impact of broadband services.

Broadband has been found to have multiple economic impacts, ranging from the growth of output, to job creation and increasing consumer surplus (see figure IV-1).

Figure IV-1. Broadband Economic Impact



Source: Katz (2012)

The first effect results from the construction of broadband networks. As with any infrastructure project, the deployment of broadband networks directly creates jobs and then has effects throughout the economy by means of multipliers. The second effect results from the "spill-over" externalities, which impact both enterprises and consumers. The adoption of broadband communications within firms leads to a multifactor productivity gain, which in turn contributes to the growth of GDP and employment. In addition, residential adoption drives an increase in household real income as a result of enhanced access to the job market and improved skills, among other factors. Residential users also receive a benefit in terms of consumer surplus, defined as the difference between what they would be willing to pay for broadband services and their actual price. This last measure, while not being captured in the GDP statistics, can be significant, insofar that it represents benefits in terms of enhanced access to information, entertainment and public services. Each effect will be reviewed in turn.

IV.1. The broadband deployment effect

Broadband deployment entails capital spending which, in turn, will translate into GDP growth and jobs. Broadband construction affects the economy and employment in three ways. In the first place, the capital investment to deploy infrastructure translates into additional GDP and direct jobs (such as telecommunications technicians, construction workers, and manufacturers of the required telecommunications equipment). In addition, this spending creates indirect spending triggered by upstream buying and selling between communications service providers constructing their networks and their suppliers of inputs (electronic equipment, metal products, etc.). Finally, the household spending resulting from the income generated from the direct and indirect effects creates additional "induced" economic effects throughout the economy.

Six national studies have estimated the impact of broadband network construction on GDP and job creation: Crandall et al. (2003), Atkinson et al. (2009), Liebenau et al. (2009), and in prior research carried out by the author (Katz et al., 2008, Katz et al, 2009, Katz et al., 2010). All of these studies relied on input-output analysis and assumed a given amount of capital investment (see Table IV-1). [20]

Table IV-1: Economic impact of network deployment

Country	Authors – Institution (*)	Objective	Results
United States	Crandall et al. (2003) – Criterion Economics	Estimate the employment impact of US$ 63.6 billion in broadband deployment aimed at increasing household adoption from 60% to 95%, requiring an investment of US$ 63.6 billion	• Creation of 61,000 jobs per year over nineteen years • Total jobs: 1.159 million (including 546,000 for construction and 665,000 indirect)
	Atkinson *et al.* (2009) – ITIF	Estimate the impact of a US$ 10 billion investment in broadband deployment	• Total jobs: 498,000 jobs if investment achieved in one year (including 64,000 direct, 166,000 indirect and induced, and 268,000 in network effects)
Switzerland	Katz et al. (2008) – Telecom Advisory Services /Polynomics	Estimate the impact of deploying a national broadband network requiring an investment of CHF 13 billion	• Total jobs: 114,000 over four years (including 83,000 direct and 31,000 indirect)

[20] Input-output tables measure the interdependence of an economy's productive sectors by considering the product of each industry both as a commodity demanded for final consumption and as a factor in the production of itself and other goods. While input-output tables are a reliable tool for predicting investment impact, they are static models reflecting the interrelationship between economic sectors at a certain point in time and are only infrequently updated. Since those interactions may change, the matrices from one period may overestimate or underestimate the impact of broadband deployment in a different period. For example, if the electronic equipment industry is outsourcing jobs overseas at a fast pace, the employment impact of broadband deployment will diminish over time and part of the investment will "leak" overseas.

Country	Authors – Institution (*)	Objective	Results
United Kingdom	Liebenau et al. (2009) – London School of Economics	Estimate the impact of investing US$ 6.4 billion to achieve the target of the *"Digital Britain"* Plan	• Total jobs: 280,000 jobs if investment achieved in one year (including 76,500 direct, 134,500 indirect and induced, and 69,500 in network effects)
Germany	Katz et al. (2010)	Estimate the impact of investing EUR 20.243 billion for implementing the 2014 Broadband Strategy	• Total GDP: EUR 20.2 billion in investment and EUR 52.32 billion in additional output • Total jobs: 304,000 jobs (including 158,000 direct, 71,000 indirect and 75,000 induced
United States	Katz and Suter (2009)	Estimate the impact of investing US$ 6.39 billion for broadband deployment	• Total jobs: 127,800 direct and indirect

Source: Compiled by Telecom Advisory Services

All studies calculated multipliers, which measure the total output and employment change throughout the economy resulting from the deployment of a broadband network.[21]

IV.2. Broadband spillover effects

Studies on the spillover impact of telecommunications have been produced for the past two decades confirming, to a large extent, that wireline and wireless telephony, as well as fixed and mobile broadband have an impact on economic growth and, in some cases, on employment and productivity (Hardy, 1980; Karner and Onyeji, 2007; Jensen, 2007; Katz et al., 2010; Katz, 2011; Katz et al., 2012a; Katz et al, 2012b, Arvin and Pradhan, 2014).

Studies in the U.S. have been primarily focused on estimating the contribution of broadband to GDP growth. Crandall et al. (2007) published one of the first studies that applied a cross-sectional dataset using broadband penetration data to determine the impact of the technology on output. This study provided some empirical support for the conclusion that expanded broadband capacity led to an increase in GDP, particularly in the service sector, namely finance, real estate, and educational services. However, the correlation between broadband penetration and GDP lacked statistical significance.

Gillett et al. (2006) conducted an econometric study measuring the impact of fixed broadband availability on local economic development using sub-state geographic data. The study classified each ZIP (postal) code area based on its broadband availability in 1999, and then followed the growth in economic indicators over time. The statistical methodology included matching ZIP

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[21] Multipliers are of two types. Type I multipliers measure the direct and indirect effects (direct plus indirect divided by the direct effect), while Type II multipliers measure Type I effects plus induced effects (direct plus indirect plus induced divided by the direct effect).

code areas with broadband to those without to create “treatment” and “control” groups, and then used regression analysis, and other econometric techniques to distinguish causality from mere correlation. The major findings of the study were that broadband added 1.0 to 1.4 per cent to the growth rate of local employment, and 0.5 to 1.2 per cent to the growth rate of the number of business establishments from 1998 to 2002.

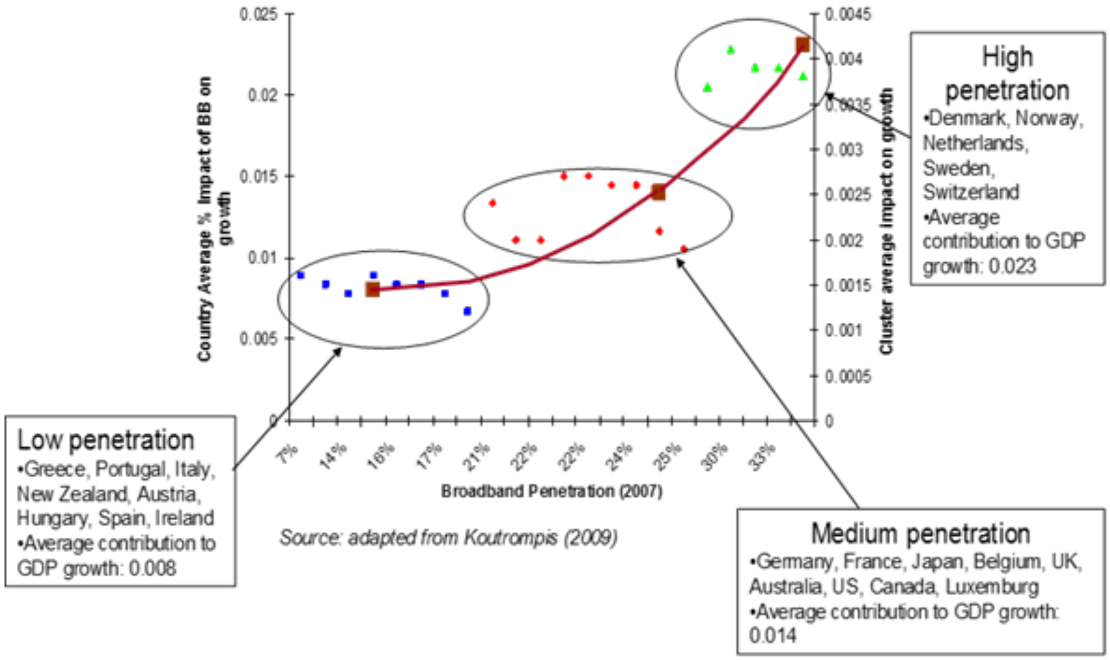
In another study, Kolko (2010) found that broadband expansion is correlated with economic growth over the period 1999-2006. This relationship was strongest in industries that relied heavily on ICT: information; professional, scientific, and technical services; management; and administrative services. The author estimated an instrumental variables regression that explicitly accounted for the potential simultaneity of broadband and employment growth.

A critical issue of the evolving research on telecommunications spillovers is the impact different telecommunications penetration levels may have on output and employment. More specifically, is there a linear relationship between broadband adoption and economic growth, whereby higher penetration yields larger impact? Or, alternatively, are we in the presence of more complex non-linear causal effects, such as “increasing returns to scale” and/or diminishing returns due to saturation?

According to the initial research on this topic, Roller and Waverman (2001) and implemented by Koutroumpis (2009), Katz and Koutroumpis (2012a; 2012b), and Katz and Callorda (2014; 2016; 2018), the impact of telecommunications infrastructure on economic output is maximized once the infrastructure reaches critical mass generally associated with higher levels of penetration. In the first study identifying this “return to scale” effect, Roeller and Waverman (2001) examined the impact of investment in telecommunications infrastructure on the GDP of 21 OECD countries and 14 developing or newly-industrialized non-OECD countries between 1970 and 1990 and found that the economic contribution of wireline telecommunications was not linear: it was greater in OECD countries than it was in non-OECD countries and in countries that had reached “critical mass”. The authors concluded that critical mass needed to influence economic growth is present when telephone penetration reaches 40 main telephone lines per 100 population.

The findings in wireline and wireless telephony were, subsequently, extended to fixed broadband. Koutroumpis (2009) found that for OECD countries the contribution of broadband to economic growth increased with penetration. According to Koutroumpis' research, in countries with low broadband penetration (under 20%), an increase of 1% in broadband adoption contributed to 0.008 % of GDP growth, while in countries with medium penetration (between 20% and 30%), the effect is of 0.014 % and in countries with penetration higher than 30%, the impact of 1% adoption reaches 0.023 (see Graph IV-1).

Graph IV-1. Impact of fixed broadband on GDP growth in OECD countries, 2009 (in percent)



Katz *et al.* (2010) confirmed this finding in their study of Germany's counties (Landkreisse). In this case, the authors split their dataset between counties with high fixed broadband penetration (average 31%) and low (average 24.8%) and found that the coefficient of economic impact was positive and higher in the counties with high penetration. Similarly, Katz and Callorda (2018) estimated through multiple structural models that fixed broadband penetration had a higher economic impact in high-income countries (0.14% increase in GDP growth with each 1% increase in broadband penetration) than middle income nations (0.05% in GDP growth with similar increase in penetration), while results for low income countries was not statistically significant.

The question remains whether there is a point after which additional penetration does not yield economic spillover growth. Research points to the existence of a saturation point of declining returns to broadband penetration. For example, Atkinson *at al.* (2009) point out that network externalities decline with the build out of networks and the maturation of technology over time. There is evidence that supports this argument. It has been demonstrated in diffusion theory that early technology adopters are generally those who can elicit the higher returns of a given innovation. Conversely, network externalities would tend to diminish over time because those effects would not be as strong for late adopters. Gillett *et al.* (2006) contend that the relation between penetration and economic impact should not be linear "because broadband will be adopted (...) first by those who get the greatest benefit (while) late adopters (...) will realize a lesser benefit" (pp. 10). In confirmation of diminishing returns to broadband penetration, in their study of the state of Kentucky, Shideler et al. (2007) estimated that employment growth is highest around the mean level of broadband saturation at the county level, driven by the decreasing returns to scale of the infrastructure. According to the research, a critical amount of broadband infrastructure may be needed to sizably increase employment, but once a community is completely built out, additional broadband infrastructure will not further affect employment growth.

That said, the spillover impact of broadband at higher penetration levels still remains, although it occurs through another variable: broadband speed. Two types of effects explain this causal relationship. First, faster broadband contributes to an improvement in productivity resulting from the adoption of more efficient business processes. For example, improved marketing of excess inventories and optimization of the supply chain are two of the effects that might be generated. Second, faster connectivity yields an acceleration of the rate of introduction of new products, services, and the launch of innovative business models. An early study that assessed the impact of broadband speed on GDP (Rohman and Bohlin, 2012) looked at 33 OECD countries and concluded that a 100% increase (or doubling) of speed yields a 0.3% increase in GDP. Following on this study, Kongaut and Bohlin (2014) use a similar approach but differentiate between high and low-income OECD countries and determined that an increase in broadband speed of 1% yields an increase in GDP per capita of 0.1% for low income countries and 0.06% for high income countries[22]. In another example, in their study of the United States Carew *et al.* (2018) concluded that a 1% increase in speed equates to a 0.0197% in real GDP.

*   *   *   *   *

To sum up, the literature of communications economic impact concludes that the impact of reduced taxation proceeds along two paths. On one hand, a reduction in taxation would result in an increase in communications investment, with the consequent effect in network construction employment and output. This effect comprises: a) additional direct jobs and output (defined as employment and economic production generated in the short term in the course of deployment of network facilities), b) indirect jobs and output (understood as employment and production generated by indirect spending in industrial sectors such as metal products, and electrical equipment), and c) induced jobs and output (which results from household spending based on the income earned from direct and indirect effects). In addition, once additional networks are being deployed, they yield enhanced positive externalities in terms of spillover effects on GDP and employment, although at high penetration levels, such as the one currently existing in the United States, spillovers due to additional penetration tend not to materialize.

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[22] Another area of broadband economic impact is the contribution to consumer surplus, defined as the amount that consumers benefit from purchasing a product for a price that is less than what they would be willing to pay. Most studies of consumer surplus derived from faster speed are based on surveys or focus groups where consumers stipulate the amount they would be willing to pay for a service such as broadband (Savage et al. (2004); Greenstein and McDewitt (2011); Liu et al. (2018)). Other studies that lack access to survey data tend to rely on pricing differences to estimate consumer surplus (Greenstein and McDewitt, 2011; Greenstein and McDewitt, 2012). Finally, other studies on consumer surplus focus on how consumers' data usage reacts to variations in price. For example, Nevo et al. (2015) studied hour-by-hour Internet usage for 55,000 US subscribers facing different price schedules. They concluded that consumers will pay between $0 to $5 per month for a 1 Mb/s increase in connection speed, with an average of $2[22]. However, with the availability of more content and applications, consumers will likely increase their usage, implying greater time savings and a greater willingness to pay for speed.

V. ECONOMIC IMPACT OF LOWERING TAXES ON COMMUNICATIONS NETWORK INVESTMENT

In order to estimate the economic impact of reduced taxation at the national level, we first calculate what the additional investment in communications would be as a result of alternative taxation scenarios. Once we define these scenarios and we calculate the additional investment based on the econometric models specified in chapter III, we estimate the impact of the increased investment on employment and output.

V.1. Defining alternative taxation scenarios

To estimate the impact of investment on employment and GDP, we based on the coefficient of impact of tax rate on investment level estimated in the econometric models specified in section III.2.3: a decrease of 1 percentage point in this rate (for example, from 4.58% to 3.58%) would increase telecommunications and cable investment by 1.97% across all states.

We calculated investment impact of four scenarios, in which the average taxes for both sectors would be reduced to 3.0%, 2.0%, 1.0%, and 0.0%. We first estimate the short-term impact (one year) and then calculate the longer term (two years) as a result of the inertia in capital planning discussed in chapter II. All the results are presented in tables V-1 and V-2.

Table V-1. Short-Term (one-year) Incremental Network Investment resulting from changes in Sales Tax Rate (in millions unless indicated)

Average sales tax rate	Total Investment Growth	Total Additional Investment
3.0%	3.12%	$ 1,339
2.0%	5.09%	$ 2,186
1.0%	7.07%	$ 3,034
0.0%	9.04%	$ 3,881

Source: Telecom Advisory Services analysis

According to the data in table V-1, we find that if sales taxes were to be reduced to an average of 3.0%, this would generate an additional investment of $1,339 million. Alternatively, if sales taxes were eliminated in all states, total communications network investment would increase by $3,881 million. This means that, propelled by the incentive effect identified in the research literature reviewed in chapter II, operators would invest beyond the supply of funds benefit of tax decrease (an effect of 197% of the reduction in taxes).

The results in table V-1 correspond to the initial impact of a tax reduction from changes in the sales tax rate. As shown in the econometric model of Table III-4, we find that the investment in year 2 depends not only on the tax rate but also on the investment of year 1 (the "inertia" effect). According to the model, the industry invests, *ceteris paribus*, an additional 55.60 % of the investment from the previous year. Consequently, the elimination or reduction of sales taxes produces not only a short-term effect (depicted in Table V-1) but also a long-term effect on investment. We estimate long-term effects on investment for year 2 after a change in the sales tax rate (see table V-2).

Table V-2. Incremental Network Investment resulting from changes in Sales Tax rate in the second year (in millions unless indicated)

Average sales tax rate	Total Investment Growth	Total Additional Investment
3.0%	4.85%	$ 2,083
2.0%	7.92%	$ 3,402
1.0%	11.00%	$ 4,720
0.0%	14.07%	$ 6,039

Source: Telecom Advisory Services analysis

The estimates for the second year after the change in sales tax rate allow us to project the total additional investment resulting from the sum of the two years (Additional Investment of Year 1+Additional Investment of Year 2) (see table V-3).

Table V-3. Incremental Long-Term Network Investment resulting from changes in Sales Tax Rate (Sum of Year 1 and 2) (in millions unless indicated)

Reduction in average sales tax rate	Total Investment Growth	Total Additional Investment
3.0%	7.97%	$ 3,422
2.0%	13.02%	$ 5,588
1.0%	18.06%	$ 7,754
0.0%	23.11%	$ 9,920

Source: Telecom Advisory Services analysis

While it is difficult to estimate what portion of this reinvested capital would be used in network modernization projects, it is reasonable to assume that, since the other two CAPEX categories (maintenance and capacity upgrades) are non-discretionary, any incremental available funds would be, in large part, invested in network modernization.

V.2. Economic impact of alternative taxation scenarios

Having calculated the impact on telecom investment of a reduction in sales taxes on initial equipment purchase, we estimate the economic effect on incremental GDP and job creation. According to the research literature reviewed above, those effects can be estimated both in terms of the direct and indirect impact resulting from network deployment (e.g. construction) and in terms of a contribution to the increase in broadband penetration.

V.2.1. Assessment of Construction Effects

We conducted the assessment of the direct, indirect and induced impact of additional investment on telecommunications and cable construction by relying on Input / Output analysis, which allows us to estimate, as a result of multipliers, the impact throughout the economy of additional investment in one sector [23]. According to this, an elimination of sales taxes that 38 states currently collect on initial equipment purchase by telecommunications and cable service providers would generate 27,500 jobs and $6.52 billion in GDP in the first year.

Effects would, obviously, vary according to the four cases of sales tax changes defined above (from lowering the average rate to 3% to completely eliminating it). Table V-4 presents the range of short-term estimates for network construction effects. Of note, considering that the economy is operating at full employment, the jobs triggered by network construction would be shifted from other sectors or benefitting new entrants to the labor force.

Table V-4. Direct, Indirect and Induced Short-Term Economic Effect of Changes in Sales Tax on Network Equipment Purchasing (all $ figures in billions)

Reduction in average sales tax rate	Investment	Jobs	Output
3.00%	$ 1.34	9,493	$ 2.25
2.00%	$ 2.19	15,501	$ 3.67
1.00%	$ 3.03	21,508	$ 5.09
0.00%	$ 3.88	27,515	$ 6.52

Source: Telecom Advisory Services analysis

By relying on the sum of the incremental investment in the two years following the tax reduction (presented in table V-4), we can project the long-term impact on employment and GDP (direct and indirect effects) (see table V-5).

Table V-5. Direct, Indirect and Induced Long-Term Economic Effect of Changes in Sales Tax on Network Equipment Purchasing (all $ figures in billions) (Total of 2 years)

Reduction in average sales tax rate	Investment	Jobs	Output
3.00%	$ 3.42	24,265	$ 5.75
2.00%	$ 5.59	39,620	$ 9.38
1.00%	$ 7.75	54,975	$ 13.02
0.00%	$ 9.92	70,330	$ 16.65

Note: The number of jobs is presented as job years
Source: Telecom Advisory Services analysis

V.2.2. Increase in broadband penetration

[23] See methodology in appendix A.

In addition to the construction impact, as indicated in section IV.2.1, network investment will yield a contribution to an increase in broadband lines penetration and a consequent reduction in the digital divide. The assumption, as reviewed in the literature in chapter IV, is that the additional investment triggered by a reduction in sales taxes will not have an additional spillover effect on GDP given that fixed broadband deployment in the United States has reached high penetration levels (87.5%). Furthermore, since the economy is already operating at full employment, the contribution to employment would be through absorption of jobs from other sectors or an opportunity for new entrants to the labor force.

To estimate the impact of additional investment in broadband penetration, we believe that additional deployment resulting from a reduction in sales tax on network equipment will materialize primarily in an increase in broadband lines in low penetration states, with a lower increment in high penetrated areas. In the 2012 study, we developed econometric models linking the growth in network investment to the increase in broadband penetration. A similar model was specified this time with time series data extending through 2018, differentiating between high and low penetration states (see table V-6).

Table V-6. Econometric Models linking network investment to incremental investment in broadband penetration

Model of Impact of Investment Growth on Broadband Penetration Growth
OLS model

Dependent Variable: Broadband Penetration Growth
Independent Variable: Investment Growth, Broadband Penetration 1 period lagged

Sample	Full Sample		Low Penetration		High Penetration	
Investment Growth	0.004543	*	0.011111	*	0.002231	
	(0.00313)		(0.00592)		(0.00218)	
Broadband Penetration lagged 1 period	-0.003137	***	-0.005129	***	-0.003247	***
	(0.00017)		(0.05852)		(0.00024)	
Constant	0.279788	***	0.431293	***	0.292275	
	(0.01503)		(0.04683)		(0.02060)	
R^2	0.8742		0.8817		0.8889	
Year Fixed Effect	Yes		Yes		Yes	
State Fixed Effect	Yes		Yes		Yes	
Number of Observations	588		196		392	

Note: ***, **, * significance at 1%, 5% & 10% level

Source: Telecom Advisory Services analysis

As indicated in the table V-6, the impact of network investment growth on broadband penetration growth in states with low penetration is 0.0111% for every increase in investment of 1%. When considering the full sample, the impact coefficient decreases to 0.004543. The underlying assumption is that additional investment increases broadband deployment and, in turn, adoption. Of note, the impact coefficient in low penetration states has declined from 0.1345 in the 2012 iteration of this study. We believe this is due to the fact that, with the increase in fixed broadband penetration from 76.88% of households (2012) to 87.85% (2018), the cost of deployment is increasing because late adopters live in low density areas requiring higher investment per line.

We relied on the low penetration coefficient to estimate the increase in broadband lines in low penetration states and the full sample coefficient to estimate the increase in high penetration states. Under these considerations, the elimination of the sales tax rate would yield an increase in penetration of 0.26% (or 178,700 lines) (see table V-8).

Table V-8. Increase in broadband adoption due to the elimination of network equipment sales tax rate (includes only states with equipment sales tax)

State Name	Adoption Rate increase	New adoptions
Mississippi	0.19%	1,638
New Mexico	0.43%	2,623
Arkansas	0.53%	4,693
Louisiana	0.56%	7,623
Alabama	0.36%	5,322
North Dakota	0.38%	978
South Carolina	0.21%	3,260
Kentucky	0.34%	4,761
Oklahoma	0.30%	3,651
Tennessee	0.53%	11,332
South Dakota	0.36%	1,018
Vermont	0.35%	747
Missouri	0.24%	4,915
Georgia	0.40%	12,769
Maine	0.31%	1,477
Michigan	0.15%	5,105
Kansas	0.49%	4,652
Wisconsin	0.30%	6,088
Texas	0.34%	28,075
Illinois	0.20%	8,257
Florida	0.16%	10,378
New York	0.05%	3,121
Rhode Island	0.16%	557
Virginia	0.10%	2,688
Wyoming	0.13%	247
Hawaii	0.10%	389
Nebraska	0.16%	1,037
Nevada	0.19%	1,810
D.C.	0.00%	11
Idaho	0.14%	763
Arizona	0.07%	1,654
Alaska	0.04%	90

State Name	Adoption Rate increase	New adoptions
Massachusetts	0.11%	2,463
Maryland	0.14%	2,687
California	0.20%	22,710
Colorado	0.17%	3,354
Washington	0.21%	5,482
Utah	0.03%	302
USA	0.26%	178,728

Source: Telecom Advisory Services analysis

This increase in broadband lines resulting from an outright elimination of the sales tax on network equipment should be considered over and above the natural growth in broadband lines (which at this point is growing between 1 and 2 percentage points per year).

V.3. Conclusion

We estimate models for four cases of average sales tax reduction: 3%, 2%, and 1% and total elimination. For example, if sales taxes were to be reduced to an average of 3.00%, it would generate an additional investment of $1,339 million in the first year. Alternatively, if sales taxes were completely eliminated in all states, total communications network investment would increase by $3,881million in the first year. This finding is particularly significant insofar that it demonstrates the importance of tax reduction as a stimulus of network investment. In Table V-9 we present the decomposition by state for the new investment.

Table V-9. Increase in investment by state due to the elimination of network equipment sales tax rate (includes only states with equipment sales tax)

State Name	Inv. p. c growth	New Investment
Alabama	12.73%	$ 71,932,662
Alaska	3.47%	$ 322,832
Arizona	6.32%	$ 52,038,606
Arkansas	18.57%	$ 44,456,799
California	16.86%	$ 621,424,727
Colorado	14.84%	$ 212,582,552
D.C.	0.37%	$ 639,315
Florida	13.42%	$ 276,349,168
Georgia	14.11%	$ 225,027,693
Hawaii	8.59%	$ 15,907,889
Idaho	11.90%	$ 14,538,672
Illinois	17.17%	$ 198,432,829
Kansas	17.13%	$ 55,439,821
Kentucky	11.84%	$ 38,922,008
Louisiana	19.78%	$ 63,738,876
Maine	10.86%	$ 20,079,026
Maryland	11.84%	$ 103,171,423
Massachusetts	9.19%	$ 93,444,912
Michigan	5.40%	$ 37,703,586
Mississippi	6.82%	$ 10,558,709

Missouri	8.57%	$ 112,865,281
Nebraska	13.60%	$ 27,421,990
Nevada	16.07%	$ 73,555,789
New Mexico	15.12%	$ 25,057,668
New York	4.28%	$ 148,700,521
North Dakota	13.42%	$ 9,545,464
Oklahoma	10.56%	$ 32,488,151
Rhode Island	13.82%	$ 24,869,497
South Carolina	7.30%	$ 35,094,800
South Dakota	12.63%	$ 9,720,573
Tennessee	18.67%	$ 104,699,387
Texas	11.96%	$ 412,079,752
Utah	2.90%	$ 10,860,120
Vermont	12.20%	$ 5,164,818
Virginia	8.52%	$ 108,942,287
Washington	18.12%	$ 515,011,916
Wisconsin	10.70%	$ 59,566,104
Wyoming	10.78%	$ 8,507,938
USA	9.04%	$ 3,880,864,163

Source: Telecom Advisory Services analysis

Beyond this effect in the first year, the elimination or reduction of sales taxes also produces a long-term effect on investment (this is labeled the "inertia" effect). According to the econometric model, in year 2 communications firms invest about 55% more than in the first year after the sales tax reduction is enacted. By combining short and long-term investment effect, a reduction of average sales tax to 3% on network equipment will result in $ 3. 42 billion increase in network investment. As expected, total elimination of sales taxes under the long-term scenario would yield additional investment of $9.92 billion.

This additional investment has two types of economic effects: the contribution to output and jobs resulting from network construction, and the increase in broadband lines. By relying on input/output analysis, we estimate the impact of network construction. For example, an annual increase of $3.88 billion in investment (resulting from an elimination of the sales tax) will yield an increase in GDP of $6.52 billion and 27,500 jobs in the first year, and $16.65 billion in output and 70,300 job/years within two years. In addition, a total elimination of the sales tax will increase broadband access lines by 178,700.

CASE STUDIES

- FLORIDA
- GEORGIA
- ILLINOIS
- KENTUCKY
- OKLAHOMA
- TENNESSEE
- TEXAS

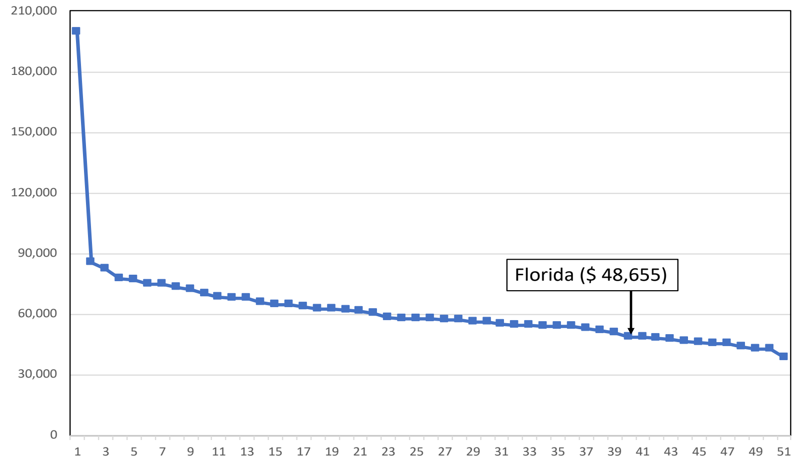
VI. THE ECONOMIC CONTRIBUTION OF COMMUNICATIONS NETWORK INVESTMENT IN FLORIDA

Having proven that a reduction of sales taxes on initial communications network equipment acquisition has a substantial economic impact on a national scale, we now address what that impact would be in the state of Florida.

VI.1. The economy of Florida:

Florida ranks 40th in the United States in terms of GDP per capita (see graphic VI-1).

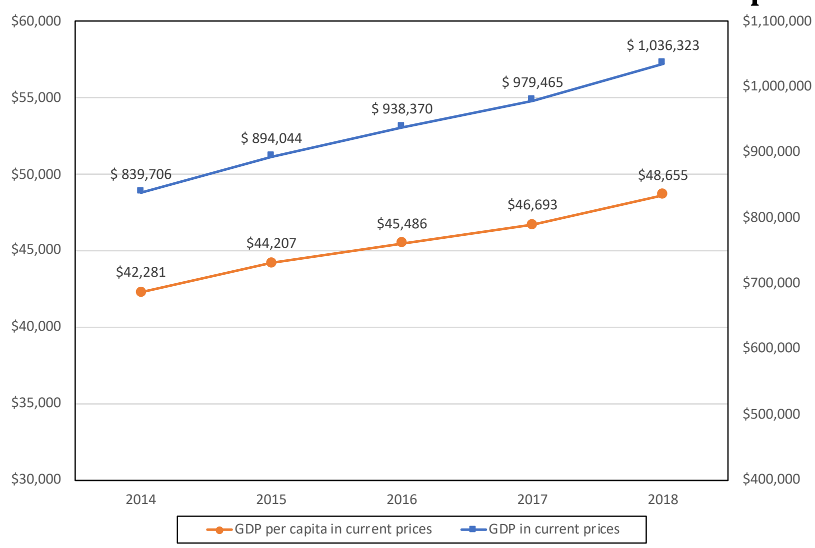
Graphic VI-1. United States: States Ranking by GDP per Capita (2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

Between 2014 and 2018 Florida's GDP per capita grew by 15.08%, in parallel with the overall state GDP.

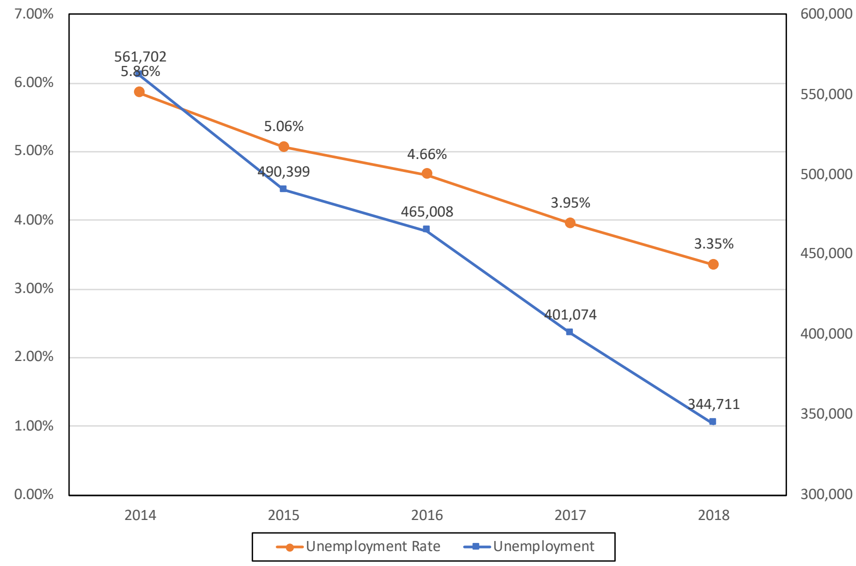
Graphic VI-2. Florida: Gross Domestic Product and GDP Per Capita (2014-2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

In January 2012, Florida's unemployment rate was 10.90%, implying that 2,019,516 individuals of a total labor force of 18,462,256 were unemployed. The unemployment rate has been declining ever since, reaching 3.35% in 2018 (with an unemployed labor force of 344,711) (see Graphic VI-3):

Graphic VI-3. Florida: Unemployment Rate and Number of Unemployed Workers (2014-2018)



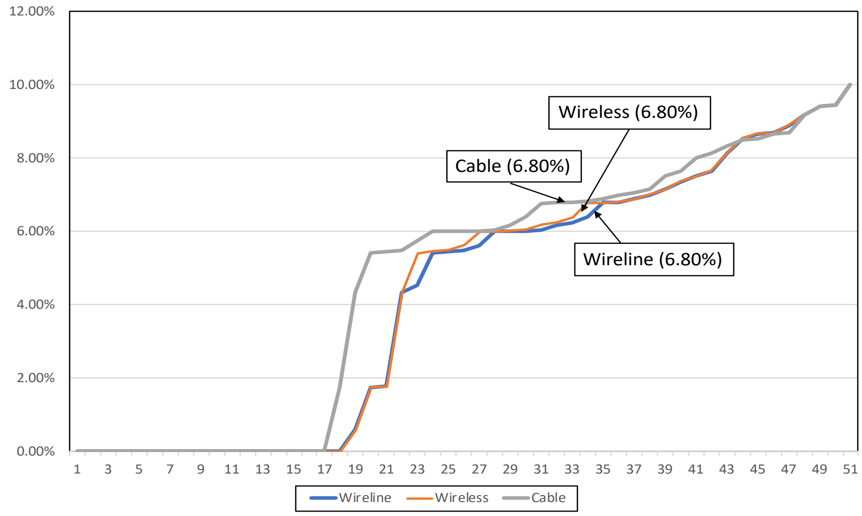
Sources: US Bureau of Labor Statistics; Telecom Advisory Services analysis

In this context, it is relevant to consider communications equipment taxation policies that will further both economic growth and job creation.

VI.2. Current taxation regime on initial equipment purchasing by telecommunications and cable service providers in Florida

Florida is one of the 32 states that applies a sales tax to purchase/use of communications network equipment and one of 33 states that collects a tax on cable network equipment. Both cable operators and telecommunications service providers paid a sales tax rate of 6.80% (average combined state-local rate for the state) in 2018. This implies that Florida is in 16th position in terms of tax rate for network investment affecting telecommunications operators and in 19th position in terms of sales tax collected on cable network equipment among all states (see Graphic VI-4).

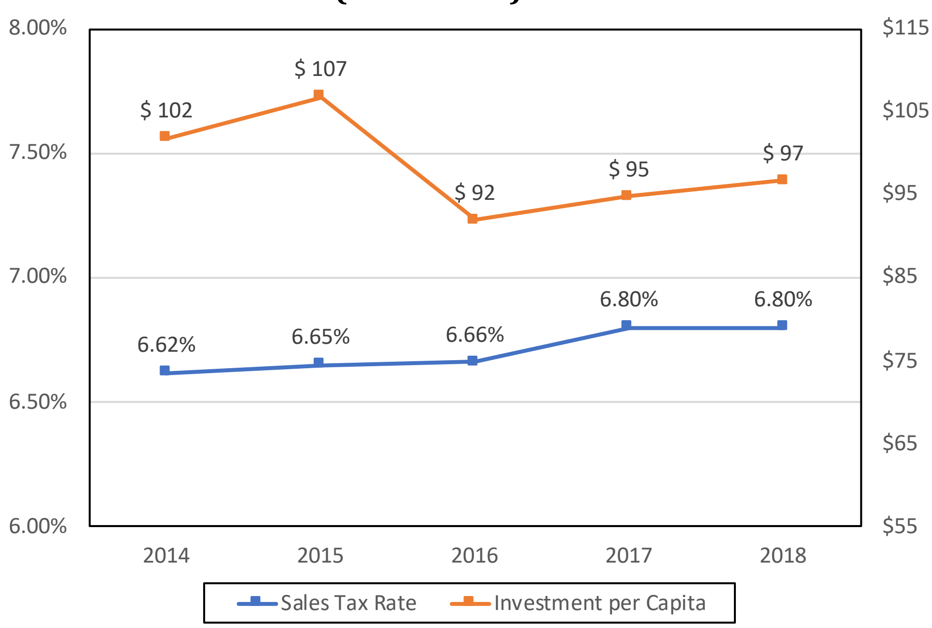
Graphic VI-4. Florida: Ranking in US Sales Tax Rate on Investment (2018)



Sources: Tax Foundation; Telecom Advisory Services analysis

The evolution of the sales tax rate on equipment investment compared to the telecommunications and cable network investment per capita in Florida indicates that both variables are inversely correlated[24] (see graphic VI-5).

Graphic VI-5. Florida: Sales Tax Rate and Communications Investment per Capita (2014-2018)



Sources: Tax Foundation; Broadband Tax Institute; Telecom Advisory Services analysis

From 2014 to 2018, Florida increased its weighted average state-local taxes from 6.62% to 6.80%. Simultaneously, the total telecommunications and cable network investment per capita

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[24] The correlation coefficient is -0.47

declined, from $101.83 in 2014 to $91.93 in 2016. Since 2017 the sales tax rate level stopped increasing, which, coupled with an improvement of the U.S. economy, resulted in an increase in the communications investment per capita from $91.93 in 2016 to $96.67 in 2018 (growth of 5.16%). In light of the inverse correlation between communications network equipment sales taxes and investment, we now consider what the impact would be if the sales tax on communications equipment were to be eliminated in the state.

VI.3. Economic impact of taxation of communications network equipment taxation in Florida

By relying on the coefficients of the econometric models linking tax rates to investment presented in section III.2, we estimated the short run and the long run impact of an elimination of the sales tax rate in Florida. Assuming that in year 1 the sales tax rate is eliminated, investment per capita would increase by $ 12.97[25] (equivalent to 13.42% over the current level of $96.67). In the case of a reduction of the sales tax rate to 50% of the actual rate, investment per capita would increase by $ 6.49 (equivalent to 6.71% over the current level of $96.67).

Furthermore, investment in year 2 after the elimination of the sales tax would be, to a large degree, dependent on the level in year 1. As a result, the elimination of sales taxes yields not only a short-term but also a long-term effect on investment levels (see table VI-1).

Table VI-1. Florida: Estimation of the Increase in Communications Investment Resulting from the Elimination of the Sales Tax on Network Equipment (in $ millions unless indicated)

	Year 1	Year 2	Total
Elimination of sales tax			
Investment Growth	$ 276.35	$ 430.00	$ 706.35
Savings from Sales Tax Elimination	$ 140.01	$ 140.01	$ 280.02
Share of Savings Reinvested	197.38%	307.13%	252.25%
50% reduction of sales tax			
Investment Growth	$ 138.17	$ 215.00	$ 353.18
Savings from Sales Tax Elimination	$ 70.00	$ 70.00	$ 140.01
Share of Savings Reinvested	197.38%	307.13%	252.25%

Source: Telecom Advisory Services analysis

The estimates presented in table VI-1 indicate that, as a result of a potential elimination of the sales tax on initially purchased equipment, in year 1 the cable, wireless and wireline operators reinvest 197.38% of what they would have paid as sales tax, and over the long run they would

[25] This estimate is based on a model that takes into consideration fixed effects.

continue to invest more than what they would have saved. In two years, the investment levels would represent 252.25% of saved taxes[26].

In turn, this additional investment would generate an impact on the economy of the state. By relying on the coefficients of the input/output matrix for United States and the econometric models of section V, we calculated the following estimates of statewide socio-economic impact (see table VI-2).

Table VI-2. Florida: Estimation of Direct and Indirect Socio-Economic Impact of Eliminating Sales Tax on Communications Equipment Purchases

Economic Indicators	Current Level	Short Run	Long Run
GDP Per Capita	$ 48,655	$ 48,677	$ 48,711
GDP Per Capita Growth	0.00%	0.04%	0.11%
Incremental GDP ($ million)	$ 0	$ 464	$ 1,186
Unemployment Rate	3.35%	3.35%	3.35%
Jobs created	0	1,958	5,005
Broadband Connections	6,657,251	6,661,311	6,667,629
Broadband Penetration	85.25%	85.30%	85.38%

Source: Telecom Advisory Services analysis

The economic analysis based on the coefficients of the models specified in chapters III and V indicate that eliminating the sales and use tax on communications infrastructure would, over two years:

- Generate over $1,186 million in new economic activity;
- Create 5,000 job/years;
- Create 10,300 new broadband connections

The studies reviewed in chapter IV have shown that the productivity benefits associated with the investment in communications networks are broadly distributed across the many businesses, governments, and non-profits that use information technology and communication services. Therefore, capital investments made by communications companies improve infrastructure that benefits the entire state of Florida, not just the companies making the investments. The $1,186 million in new economic activity that we estimate would result from the elimination of sales taxes on communications network investments would benefit sectors as diverse as wholesale trade, professional services, finance, and health care.

An exemption in sales taxes for communications equipment in Florida would also create 5,000 direct, indirect and induced jobs. While not being significant overall, job creation would be widespread as new employment is created not only in the installation of new equipment but also in the many business sectors that rely on communications networks to develop new, more efficient and profitable ways to do business. The new economic activity will generate substantial

[26] While it is difficult to estimate what portion of this reinvested capital would be used in network modernization projects, it is reasonable to assume that, since the other two CAPEX categories (maintenance and capacity upgrades) are non-discretionary, any incremental available funds would be, in large part, invested in network modernization.

offsetting revenues for state and local governments as new employment and economic activity generates income, sales, property, and other tax revenue for governments.

More rapid investment in communications networks will have immediate and direct benefits for consumers as well. New investment will benefit consumers by providing better and faster communications networks and will also accelerate competition between wireless, wireline, and cable providers of high-speed communications services. This competition directly benefits consumers through better services and lower prices.

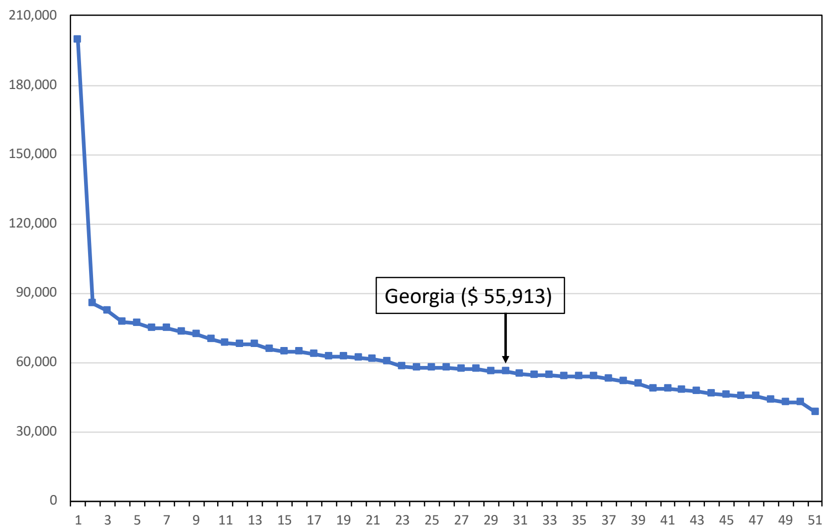
VII. THE ECONOMIC CONTRIBUTION OF COMMUNICATIONS NETWORK INVESTMENT IN GEORGIA

The economic gains of reducing the sales tax on initial communications equipment purchase are not only realized in Florida. The state of Georgia would also be able to improve its current economic situation if it were to reduce, or outright exempt communications equipment from the 7.15% tax.

VII.1. The situation of the Georgia economy

The state of Georgia ranks 30th in the United States in terms of GDP per capita (see graphic VII-1).

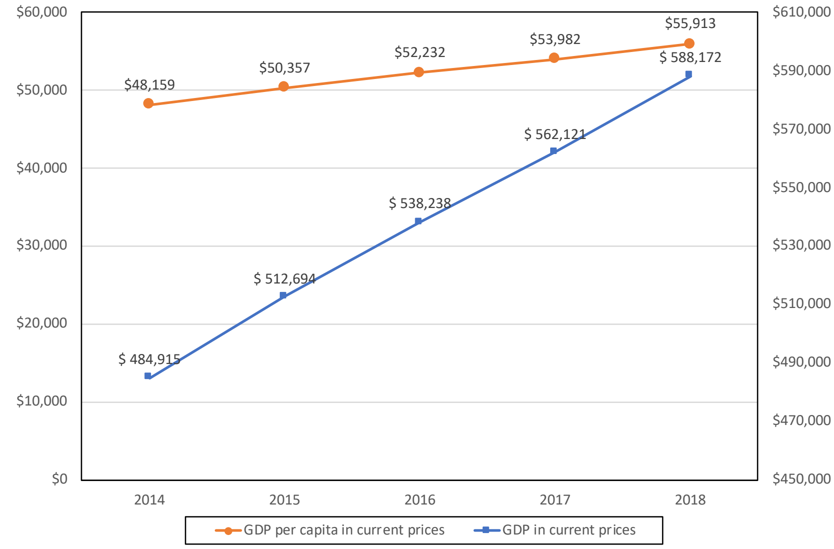
Graphic VII-1. United States: States Ranking by GDP per Capita (2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

Between 2014 and 2018 Georgia GDP per capita grew by 16%, while total GDP grew by 21% (the difference is explained by an increase in total population).

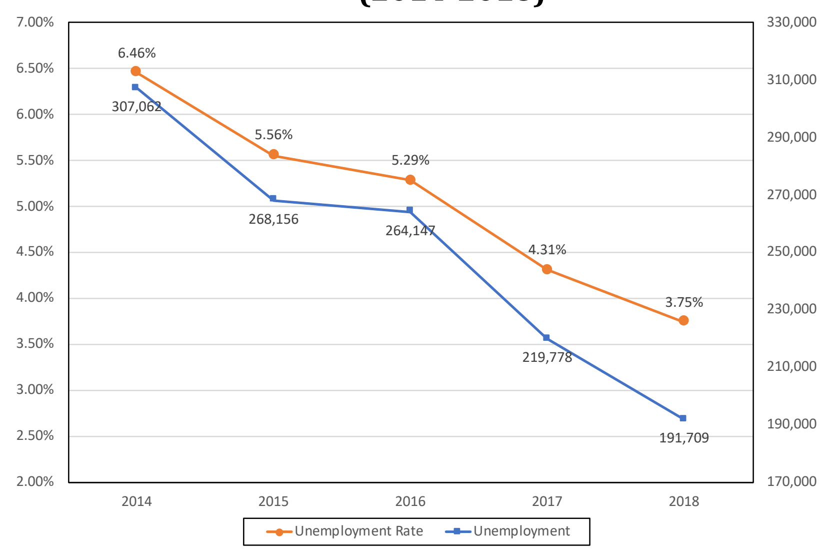
Graphic VII-2. Georgia: Gross Domestic Product and GDP Per Capita (2014-2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

In 2011, Georgia's unemployment rate was 9.80%, which implies that approximately 457,000 individuals of a total labor force of 4,663,000 were unemployed. The unemployment rate has consistently declined since then, reaching 3.75% (or 191,709 unemployed workers) in 2018 (Graphic VII-3):

Graphic VII-3. Georgia: Unemployment Rate and Number of Unemployed Workers (2014-2018)



Sources: US Bureau of Labor Statistics; Telecom Advisory Services analysis

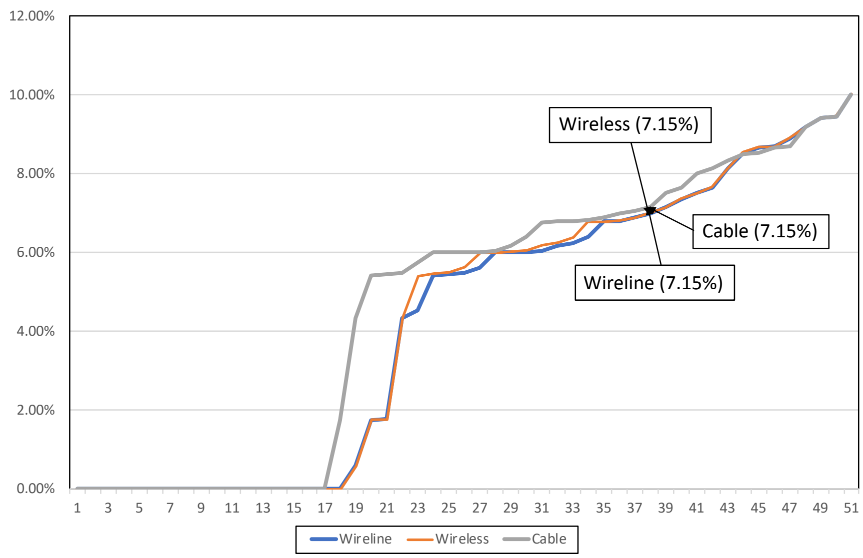
In this context, we should consider broadband equipment taxation policies that will further both economic growth and job creation.

VII.2. Current taxation regime on initial equipment purchasing by telecommunications and cable TV operators in Georgia

Georgia is one of 32 states that applies a sales tax to purchase/use of communications network equipment and 33 states that collects a tax on cable network equipment. The state and local authorities impose a weighted-average sales and use tax of 7.15%. The state alone imposes a sales and use tax of 4%, with additional rates between 1% and 4% imposed locally. The overwhelming majority of counties impose a rate of 3%, while a handful of counties impose local option rates of either 1% or 2%. The rate in the city of Atlanta is 8%, which includes the 4% state tax, the 1% city tax, and the 3% county tax.

This implies that Georgia has the 13th highest sales tax rate on wireless and wireline telecommunications as well as cable equipment in the country (see graphic VII-4).

Graphic VII-4. Georgia: Ranking in US Sales Tax Rate on Investment 2018



Sources: Tax Foundation; Telecom Advisory Services analysis

The sales tax on purchase and use network equipment in Georgia has been consistently increasing since 2014, albeit at a fairly slow rate, moving from 6.97% to 7.15% (see table VII-1).

Table VII-1. Georgia: Communications Equipment State-Local weighted average Tax rate (2014-2018)

	2014	2018
Wireless	6.97 %	7.15 %
Wireline	6.97 %	7.15 %
Cable	6.97 %	7.15 %
Average	6.97 %	7.15 %

Source: Tax Foundation

VII.3. Economic impact of communications network equipment taxation in Georgia

By relying on the coefficients of the econometric models presented in section III.2, we have estimated the short run and the long run impact of an elimination of the sales tax rate in Georgia. Assuming that in year 1 the sales tax rate is eliminated, investment per capita would increase by $ 21.39 (equivalent to 14.11% over the current level of $151.58). In the case of a reduction of the sales tax rate to 50% of the actual rate, investment per capita would increase by $ 10.70 (equivalent to 7.06% over the current level of $151.58).

Furthermore, according to the model in section III.2, investment in year 2 after the elimination of the sales tax is, to a large degree, dependent on the level in year 1. As a result, the effect of an elimination of sales taxes yields not only a short-term but also a long-term effect on investment levels (see table VII-2).

Table VII-2. Georgia: Estimation of the Increase in Communications Investment Resulting from the Elimination of the Sales Tax on Network Equipment (in $ millions unless indicated)

	Year 1	Year 2	Total
Elimination of sales tax			
Investment Growth	$ 225.03	$ 350.15	$ 575.17
Savings from Sales Tax Elimination	$ 114.01	$ 114.01	$ 228.01
Share of Savings Reinvested	197.38%	307.13%	252.25%
50% reduction of sales tax			
Investment Growth	$ 112.51	$ 175.07	$ 287.59
Savings from Sales Tax Elimination	$ 57.00	$ 57.00	$ 114.01
Share of Savings Reinvested	197.38%	307.13%	252.25%

Source: Telecom Advisory Services analysis

Our estimates in table VII-2 indicate that, as a result of a potential elimination of the sales tax on initially purchased equipment, in year 1 the cable, wireless and wireline operators reinvest 197.38% of what they would have paid as sales tax, and over the long run they would continue to have the incentive to invest more than what they would have saved. In two years, the investment levels would represent 252.25% of saved taxes[27].

In turn, this additional investment would generate an impact on the economy of the state. By relying on the coefficients of the input/output matrix for United States and the econometric models of section V, we calculated the socio-economic impact benefits derived from eliminating the sales tax on communications network equipment (see table VII-3).

[27] While it is difficult to estimate what portion of this reinvested capital would be used in network modernization projects, it is reasonable to assume that, since the other two CAPEX categories (maintenance and capacity upgrades) are non-discretionary, any incremental available funds would be, in large part, invested in network modernization.

Table VII-3. Georgia: Estimation of Direct and Indirect Socio-Economic Impact of Eliminating Sales Tax on Communications Equipment Purchases

Economic Indicators	Current Level	Short Run	Long Run
GDP Per Capita	$ 55,913	$ 55,949	$ 56,004
GDP Per Capita Growth	0.00%	0.06%	0.16%
Incremental GDP ($ million)	$ 0	$ 378	$ 966
Unemployment Rate	3.75%	3.75%	3.75%
Jobs created	0	1,595	4,076
Broadband Connections	3,184,947	3,189,943	3,197,716
Broadband Penetration	83.75%	83.88%	84.08%

Source: Telecom Advisory Services analysis

The economic analysis based on the coefficients of the models specified in chapter III and V indicates that eliminating the sales and use tax on communications infrastructure would, over two years:

- Generate over $966 million in new economic activity;
- Create 4,075 job/years;
- Create 12,750 new broadband connections

The studies reviewed in chapter IV have shown that the productivity benefits associated with the investment in communications networks are broadly distributed across the many businesses, governments, and non-profits that use information technology and communication services. Therefore, capital investments made by communications companies improve infrastructure that benefits the entire state of Georgia, not just the companies making the investments. The $966 million in new economic activity that we estimate would result from the elimination of sales taxes on communications network investments would benefit sectors as diverse as wholesale trade, professional services, finance, and health care.

An exemption in sales taxes for communications equipment in Georgia would also create 4,075 direct, indirect and induced jobs. While not being significant overall, job creation would be widespread as new employment is created not only in the installation of new equipment but also in the many business sectors that rely on communications networks to develop new, more efficient and profitable ways to do business. The new economic activity will generate substantial offsetting revenues for state and local governments as new employment and economic activity generates income, sales, property, and other tax revenue for governments.

More rapid investment in communications networks will have immediate and direct benefits for consumers as well. New investment will benefit consumers by providing better and faster communications networks and will also accelerate competition between wireless, wireline, and cable providers of high-speed communications services. This competition directly benefits consumers through better services and lower prices.

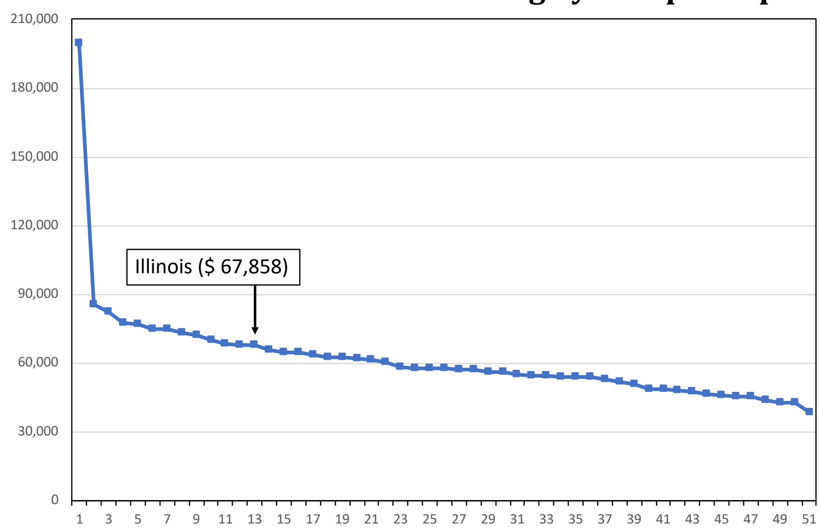
VIII. THE ECONOMIC CONTRIBUTION OF COMMUNICATIONS NETWORK INVESTMENT IN ILLINOIS

After explaining the economic benefits that Florida and Georgia would achieve by eliminating or reducing the sales tax rate on communications equipment, we calculate the impact of a similar scenario for Illinois. Illinois has enacted an 8.70% sales tax rate for both telecommunications and cable companies. As the fifth highest rate in the Nation, we estimate that this constrains equipment investment significantly.

VIII.1. The situation of the Illinois economy:

The state of Illinois ranks 12th in the United States in terms of GDP per capita (see graphic VIII-1).

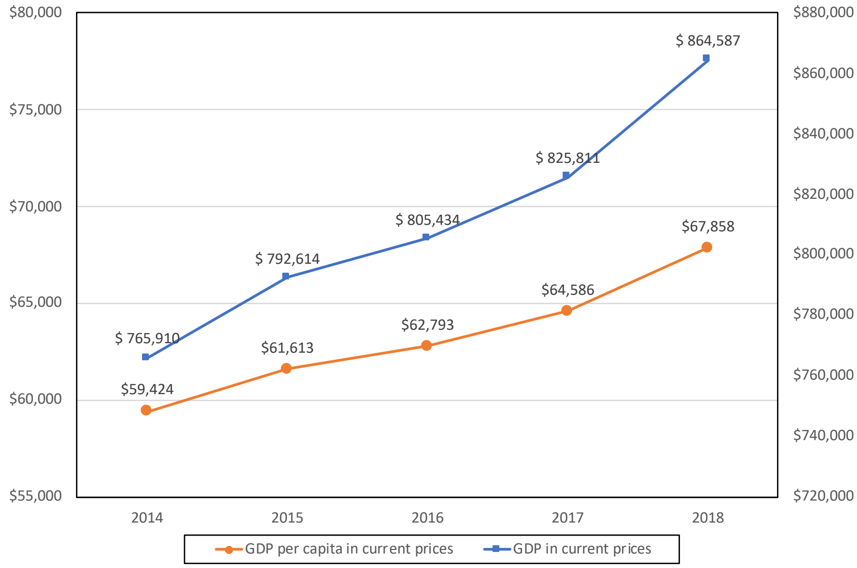
Graphic VIII-1. United States: States Ranking by GDP per Capita (2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

Between 2014 and 2018 the Illinois GDP per capita grew 14.19%, while the total GDP also increased, albeit at 12.88% (the difference is explained by a decrease in total population).

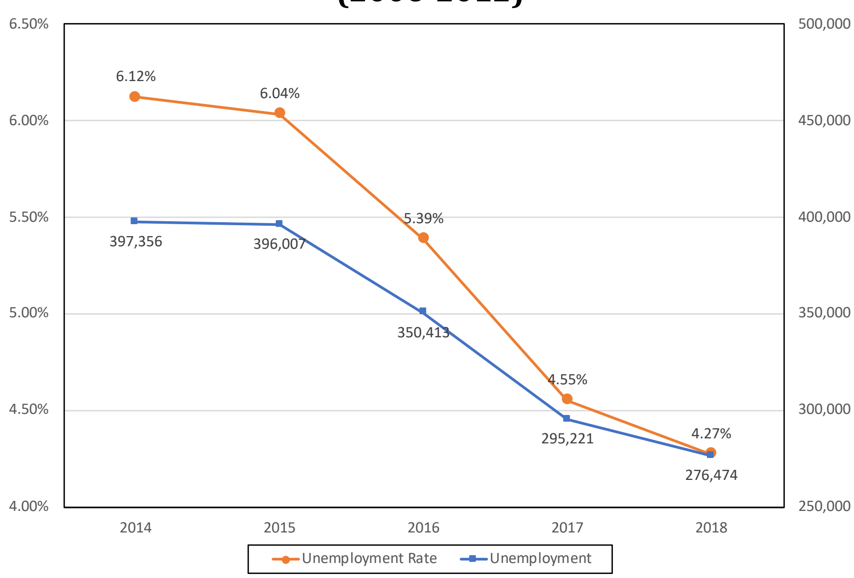
Graphic VIII-2. Illinois: Gross Domestic Product and GDP Per Capita (2014-2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

In 2014, unemployment rate in Illinois was 6.12%, which implied that 397,356 individuals of a total labor force of over 6,500,000 were unemployed[28]. The unemployment rate has declined, particularly between 2015 and 2017. In 2018, 276,474 workers were still unemployed (Graphic VIII-3):

Graphic VIII-3. Illinois: Unemployment Rate and Number of Unemployed Workers (2006-2012)



Sources: US Bureau of Labor Statistics; Telecom Advisory Services analysis

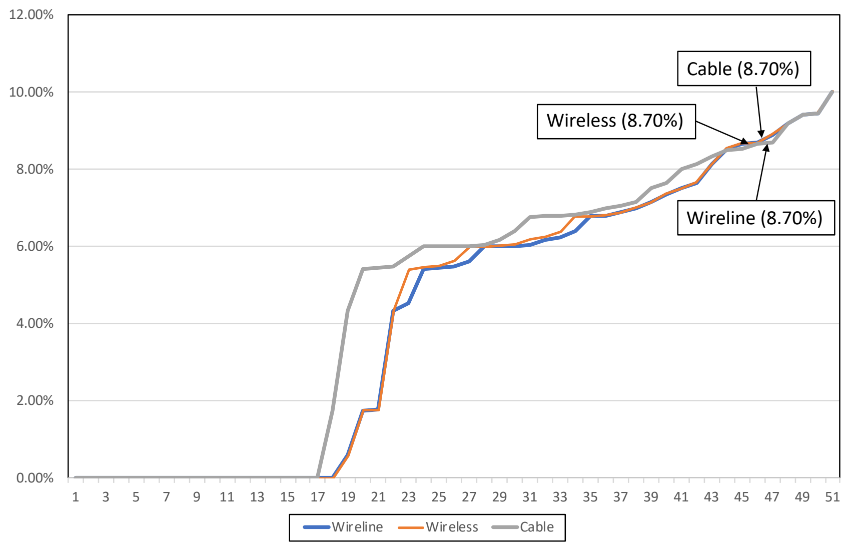
In this context, we consider need to consider network equipment taxation policies that might stimulate economic growth, while creating new jobs.

[28] State of Illinois. *Women and minorities in the Illinois Labor Force Annual Report 2015.*

VIII.2. Current taxation regime on initial equipment purchasing by telecommunications and cable TV operators in Illinois:

Illinois is one of the 32 states that applies a sales tax to purchase/use of communications network equipment and 33 states that collects a tax on cable network equipment. The state and local authorities impose a weighted average sales and use tax of 8.70% over communications equipment. This implies that Illinois has the sixth highest sales tax rate in the country on wireless and wireline telecommunications equipment and fifth highest in cable (see graphic VIII-4).

Graphic VIII-4. Illinois: Ranking in US Sales Tax Rate on Investment 2018



Sources: Tax Foundation; Telecom Advisory Services analysis

The sales tax on purchase and use network equipment in Illinois has been consistently increasing since 2014, albeit at a fairly slow rate, moving from 8.16% to 8.70% (see table VIII-1).

Table VIII-1. Illinois: Communications Equipment State-Local weighted average Tax rate (2014-2018)

	2014	2018
Wireless	8.16 %	8.70 %
Wireline	8.16 %	8.70 %
Cable	8.16 %	8.70 %
Average	8.16 %	8.70 %

Source: Tax Foundation

VIII.3. Economic impact of communications network equipment taxation in Illinois

By relying on the coefficients of the econometric models presented in section III.2, we estimated the short run and the long run impact of an elimination of the sales tax rate in Illinois. Assuming that in year 1 the sales tax rate is eliminated, investment per capita would increase by $ 15.57

(equivalent to 17.17% over the current level of $90.70). In the case of a reduction of the sales tax rate by 50% of the actual rate, investment per capita would increase by $ 7.79 (equivalent to 8.59% over the current level of $90.70).

Furthermore, investment in year 2 after the elimination of the sales tax would be, to a large degree, dependent on the level in year 1. As a result, the effect of an elimination of sales taxes yields not only a short-term but also a long-term effect on investment levels (see table VIII-2).

Table VIII-2. Illinois: Estimation of the Increase in Communications Investment Resulting from the Elimination of the Sales Tax on Network Equipment

	Year 1	Year 2	Total
Elimination of sales tax			
Investment Growth ($ million)	$ 198.43	$ 308.76	$ 507.20
Savings from Sales Tax Elimination ($ million)	$ 100.53	$ 100.53	$ 201.07
Share of Savings Reinvested	197.38%	307.13%	252.25%
50% reduction of sales tax			
Investment Growth ($ million)	$ 99.22	$ 154.38	$ 253.60
Savings from Sales Tax Elimination ($ million)	$ 50.27	$ 50.27	$ 100.53
Share of Savings Reinvested	197.38%	307.13%	252.25%

Source: Telecom Advisory Services analysis

Our estimates in table VIII-2 indicate that, as a result of a potential elimination of the sales tax on initially purchased equipment, in year 1 the cable, wireless and wireline operators reinvest 197.38% of what they would have paid as sales tax, and over two years, the investment levels would represent 252.25% of saved taxes[29].

In turn, this additional investment would generate an impact on the economy of the state. By relying on the coefficients of the input/output matrix for United States and the econometric models of section V, we estimate the socio-economic impact of the change in sales taxes (see table VIII-3).

Table VIII-3. Illinois: Estimation of Direct and Indirect Socio-Economic Impact of Eliminating Sales Tax on Communications Equipment Purchases

Economic Indicators	Current Level	Short Run	Long Run
GDP Per Capita	$ 67,858	$ 67,884	$ 67,925
GDP Per Capita Growth	0.00%	0.04%	0.10%
Incremental GDP ($ million)	$ 0	$ 333	$ 851
Unemployment Rate	4.27%	4.27%	4.27%
Jobs created	0	1,406	3,594
Broadband Connections	4,140,239	4,143,470	4,148,496
Broadband Penetration	85.10%	85.17%	85.27%

Source: Telecom Advisory Services analysis

[29] While it is difficult to estimate what portion of this reinvested capital would be used in network modernization projects, it is reasonable to assume that, since the other two CAPEX categories (maintenance and capacity upgrades) are non-discretionary, any incremental available funds would be, in large part, invested in network modernization.

The economic analysis based on the coefficient of the models specified in chapter III and IV indicates that eliminating the sales and use tax on communications infrastructure would, over two years:

- Generate over $851 million in new economic activity;
- Create 3,600 job/years;
- Create 8,250 new broadband connections

The studies we review in chapter IV have shown that the productivity benefits associated with the investment in communications networks are broadly distributed across the many businesses, governments, and non-profits that use information technology and communication services. Therefore, capital investments made by communications companies improve infrastructure that benefits the entire state of Illinois, not just the companies making the investments. The $851 million in new economic activity that would result from the elimination of sales taxes on communications network investments would benefit sectors as diverse as wholesale trade, professional services, finance, and health care.

An exemption in sales taxes for communications equipment in Illinois would also create 3,600 direct, indirect and induced jobs. While not being significant overall, job creation would be widespread as new employment is created not only in the installation of new equipment but also in the many business sectors that rely on communications networks to develop new, more efficient and profitable ways to do business. The new economic activity will generate substantial offsetting revenues for state and local governments as new employment and economic activity generates income, sales, property, and other tax revenue for governments.

More rapid investment in communications networks will have immediate and direct benefits for consumers as well. New investment will benefit consumers by providing better and faster communications networks. New investments will also accelerate competition between wireless, wireline, and cable providers of high-speed communications services. This competition directly benefits consumers through better services and lower prices.

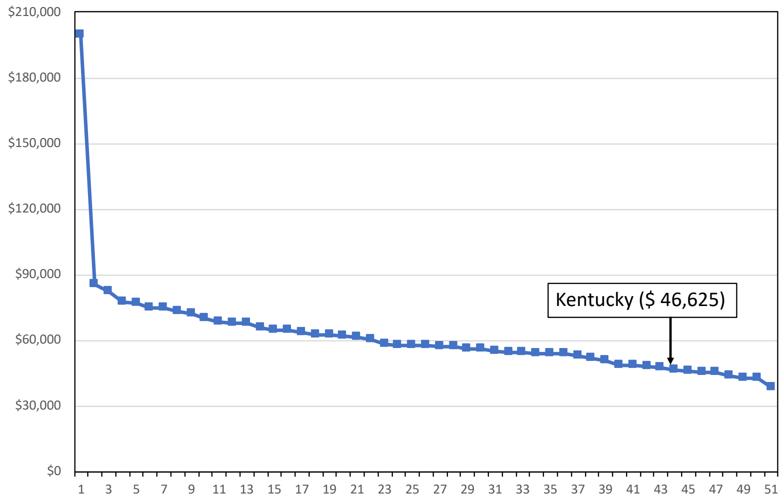
IX. THE ECONOMIC CONTRIBUTION OF COMMUNICATIONS NETWORK INVESTMENT IN KENTUCKY

The state of Kentucky has a 6.00% sales tax rate on network equipment sales and use for both telecommunications and cable service providers. As the twenty-fourth highest rate in the nation, we estimate that this rate constrains equipment investment.

IX.1. The situation of the economy in Kentucky:

The state of Kentucky has the 8th lowest GDP per capita in the United States (see graphic IX-1).

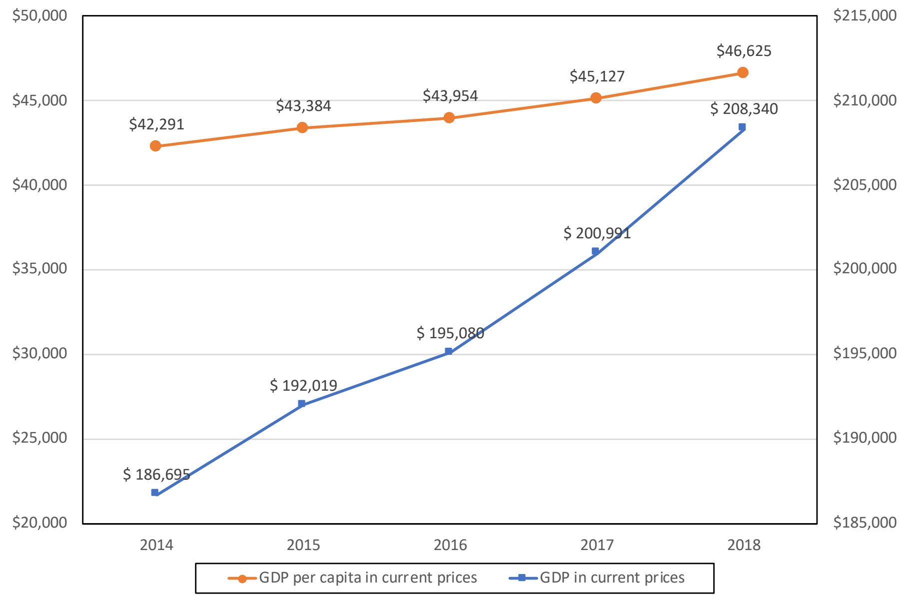
Graphic IX-1. United States: States Ranking by GDP per Capita (2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

Between 2014 and 2018 the Kentucky GDP per capita increased by 10.25%, while the total GDP increased by 11.59% (the difference is explained by an increase in total population).

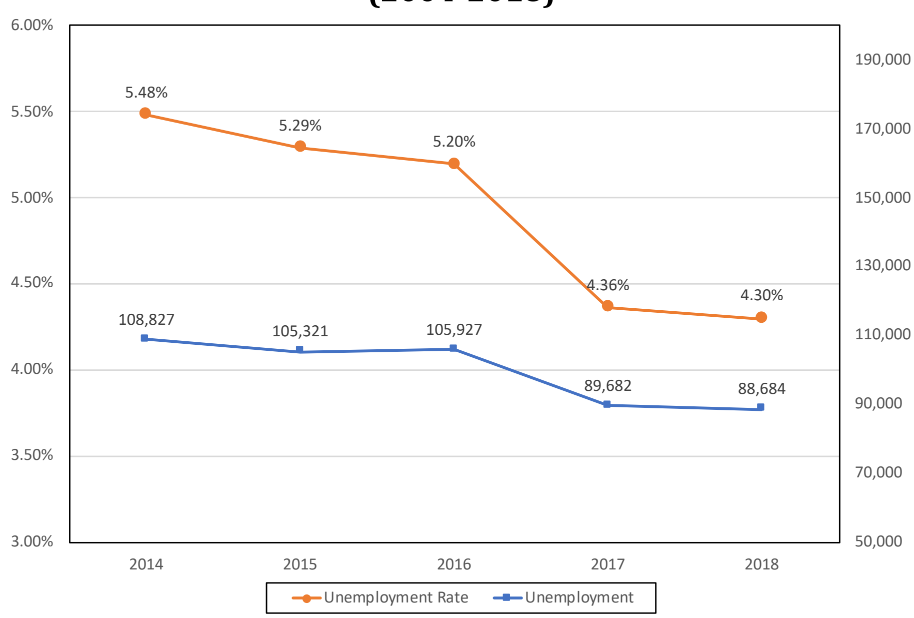
Graphic IX-2. Kentucky: Gross Domestic Product and GDP Per Capita (2014-2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

In March 2012, the Kentucky unemployment rate was 8.80%, implying that 581,116 individuals of a total labor force of 6,588,762 were unemployed. Unemployment rate has decreased substantially since then, reaching 4.30% (or 88,684 of the workforce) in 2018 (graphic IX-3):

Graphic IX-3. Kentucky: Unemployment Rate and Number of Unemployed Workers (2004-2018)



Sources: US Bureau of Labor Statistics; Telecom Advisory Services analysis

However, low unemployment is focused primarily in the "urban triangle" counties (Lexington, Louisville and Cincinnati), while low workforce participation is still concentrated in Martin, Lee, Elliott, Clay, Leslie, Morgan, and Wolfe counties. Creating abundant high-paying jobs in

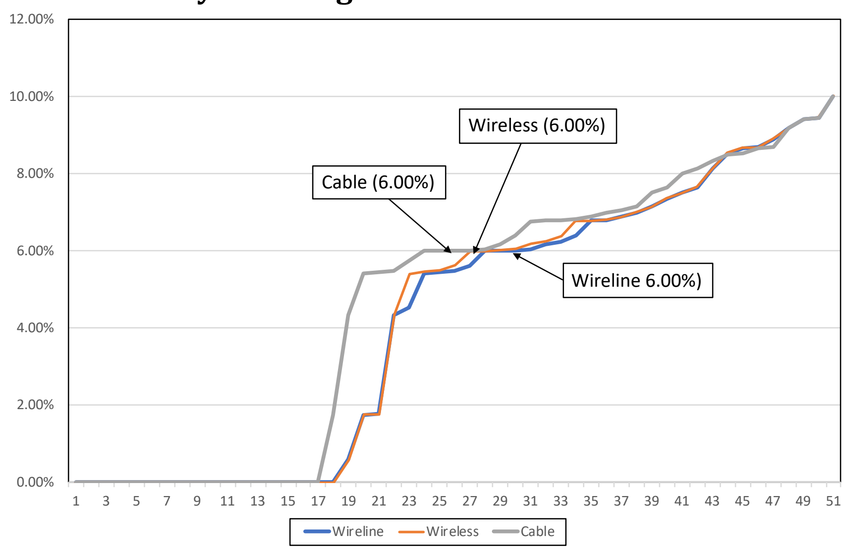
Kentucky's rural areas has been and continues to be a challenge for policymakers, economic development professionals, and civic leaders[30].

In this context, we consider critically important broadband network equipment taxation policies that could continue fostering both economic growth and job creation, while addressing disparities between urban and rural areas.

IX.2. Current taxation regime on initial equipment purchasing by telecommunications and cable TV operators in Kentucky:

As mentioned above, cable TV operators and telecommunications companies had to pay a sales tax rate of 6.00 % (weighted average combined state-local rate for the state) on network equipment purchase in 2018. This implies that Kentucky has the 23th highest tax rate for wireless and wireline telecommunications of the country and also the 26th highest for cable investment (see graphic IX-4).

Graphic IX-4. Kentucky: Ranking in US Sales Tax Rate on Investment (2018)



Sources: Tax Foundation; Telecom Advisory Services analysis

This sales tax rate has not changed since at least 2006.

IX.3. Economic impact of communications network equipment taxation in the state of Kentucky

By relying on the coefficients of the econometric models presented in section III.2, we estimate the short run and the long run impact of an elimination of the sales tax rate in Kentucky. Assuming that in year 1 the sales tax rate is eliminated, investment per capita would increase by $ 8.71 (equivalent to 11.84% over the current level of $73.55). In the case of a reduction of the

[30] University of Kentucky. Center for Business and Economic Research (2018). *Kentucky Annual Economic Report 2018.*

sales tax rate to 50% of the actual rate, investment per capita would increase by $ 4.36 (equivalent to 5.92% over the current level of $73.55)[31].

Furthermore, as indicated in section V.2.1, investment in year 2 after the elimination of the sales tax would be, to a large degree, dependent on the level in year 1. As a result, the effect of an elimination of sales taxes yields not only a short-term but also a long-term effect on investment levels (see table IX-2).

Table IX-2. Kentucky: Estimation of the Increase in Communications Investment Resulting from the Elimination of the Sales Tax on Network Equipment

	Year 1	Year 2	Total
Elimination of sales tax			
Investment Growth ($ millions)	$ 38.92	$ 60.56	$ 99.49
Savings from Sales Tax Elimination ($ millions)	$ 19.72	$ 19.72	$ 39.44
Share of Savings Reinvested	197.38%	307.13%	252.25%
50% reduction of sales tax			
Investment Growth ($ millions)	$ 19.46	$ 30.28	$ 49.74
Savings from Sales Tax Elimination ($ millions)	$ 9.86	$ 9.86	$ 19.72
Share of Savings Reinvested	197.38%	307.13%	252.25%

Source: Telecom Advisory Services analysis

Our estimates in table IX-2 indicate that, as a result of a potential elimination of the sales tax on initially purchased equipment, in year 1 the cable, wireless and wireline operators reinvest 197.38% of what they would have paid as sales tax, and over two years, the investment levels would represent 252.25% of saved taxes.

In turn, this additional investment would generate an impact on the economy of the state. By relying on the coefficients of the input/output matrix for United States and the econometric models of section V, we calculate the following estimates of socio-economic impact (see table IX-3).

Table IX-3. Kentucky: Estimation of Direct and Indirect Socio-Economic impact of eliminating sales tax on communications equipment purchases

Economic Indicators	Current Level	Short Run	Long Run
GDP Per Capita	$ 46,625	$ 46,640	$ 46,663
GDP Per Capita Growth	0.00%	0.03%	0.08%
Incremental GDP ($ million)	$ 0	$ 65	$ 167
Unemployment Rate	4.30%	4.30%	4.30%
Jobs created	0	276	705
Broadband Connections	1,415,036	1,416,899	1,419,797
Broadband Penetration	81.67%	81.77%	81.94%

Source: Telecom Advisory Services analysis

[31] While it is difficult to estimate what portion of this reinvested capital would be used in network modernization projects, it is reasonable to assume that, since the other two CAPEX categories (maintenance and capacity upgrades) are non-discretionary, any incremental available funds would be, in large part, invested in network modernization.

The economic analysis based on the coefficient of the models specified in chapter III and IV indicates that eliminating the sales and use tax on communications infrastructure would, over two years:

- Generate over $167 million in new economic activity;
- Create 700 job/years;
- Create 4,750 additional broadband connections

The studies we reviewed in chapter IV show that the productivity benefits associated with the investment in communications networks are broadly distributed across the many businesses, governments, and non-profits that use information technology and communication services. Therefore, capital investments made by communications companies improve infrastructure that benefits the entire state of Kentucky, not just the companies making the investments. The $167 million in new economic activity that would result from the elimination of sales taxes on communications network investments would benefit sectors as diverse as wholesale trade, professional services, finance, and health care.

An exemption in sales taxes for communications equipment in Kentucky would also create 700 direct, indirect and induced jobs. While not being significant overall, job creation would be widespread as new employment is created not only in the installation of new equipment but also in the many business sectors that rely on communications networks to develop new, more efficient and profitable ways to do business. The new economic activity will generate substantial offsetting revenues for state and local governments as new employment and economic activity generates income, sales, property, and other tax revenue for governments.

More rapid investment in communications networks will have immediate and direct benefits for consumers as well. New investment will benefit consumers by providing better and faster communications networks. New investments will also accelerate competition between wireless, wireline, and cable providers of high-speed communications services. This competition directly benefits consumers through better services and lower prices.

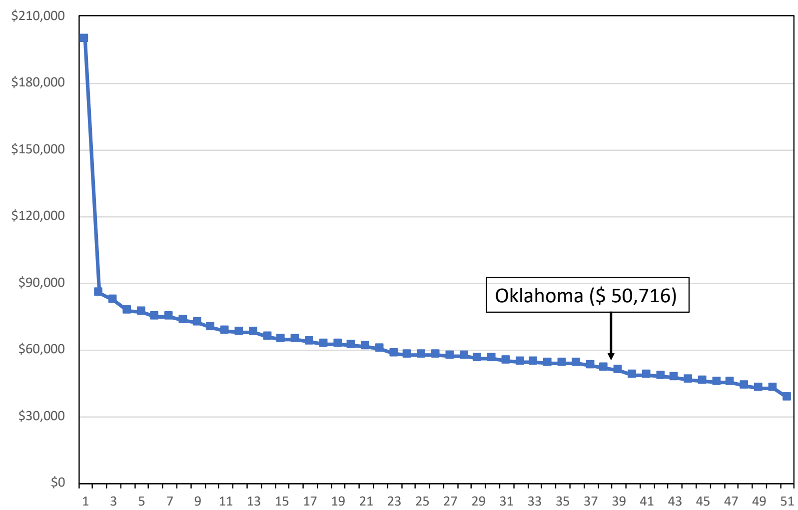
X. THE ECONOMIC CONTRIBUTION OF COMMUNICATIONS NETWORK INVESTMENT IN OKLAHOMA

In Oklahoma, telecommunications carriers pay sales taxes on network equipment purchase, but while cable operators are exempted. Wireless and wireline companies have to pay a sales tax of 8.91% of the capital invested in purchasing network equipment.

X.1. The situation of the economy in Oklahoma:

The state of Oklahoma ranks 39th position in the United States in terms of GDP per capita (see graphic X-1).

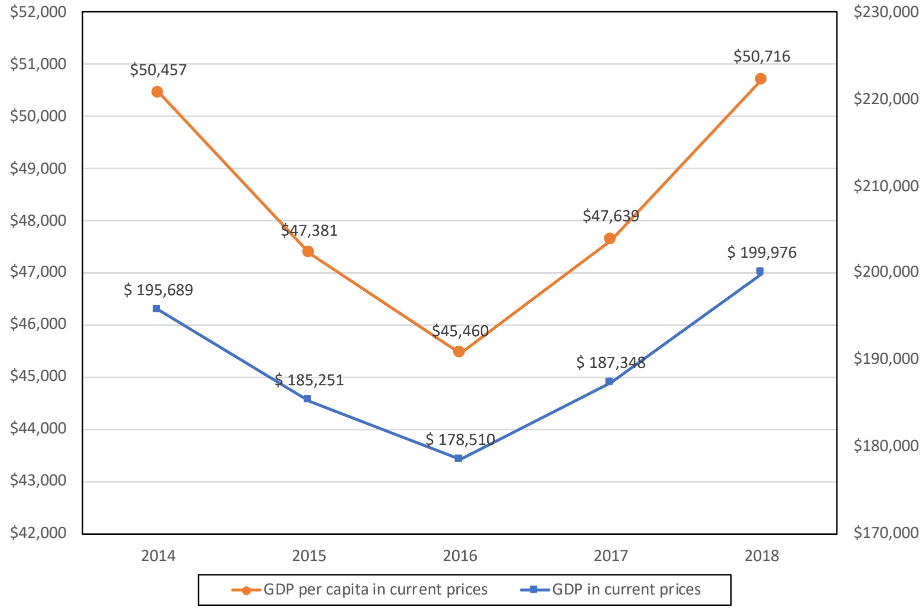
Graphic X-1. United States: States Ranking by GDP per Capita (2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

Between 2014 and 2016 the Oklahoma GDP per capita declined by 9.90%, reaching a low point in 2016 ($45,460 in per capita GDP). After that year, the GDP grew 11.56%, reaching $50,716 per capita.

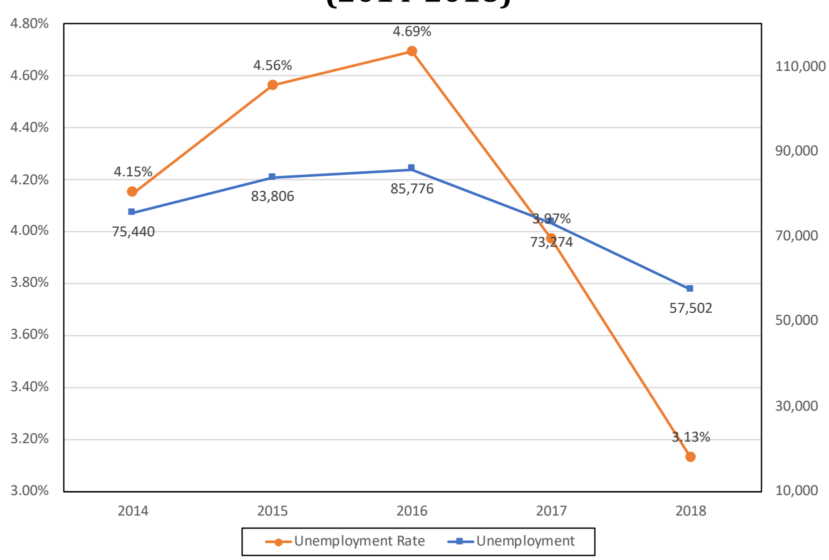
Graphic X-2. Oklahoma: Gross Domestic Product and GDP Per Capita (2014-2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

In January 2012, Oklahoma´s unemployment rate was 6.10%, which implies that 109,064 individuals of a total labor force of 1,784,846 were unemployed. The unemployment rate declined, although between 2014 and 2016 it increased reaching 4.69%. Since then, triggered by the national expansionary cycle, the rate declined to 3.13% (half of the 2012 level) (see graphic X-3):

Graphic X-3. Oklahoma: Unemployment Rate and Number of Unemployed Workers (2014-2018)



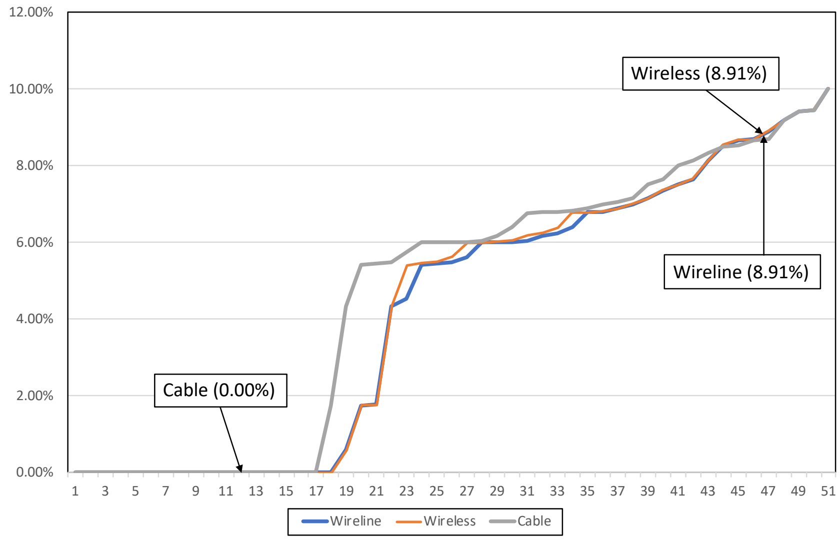
Sources US Bureau of Labor Statistics; Telecom Advisory Services analysis

In this context, we need to consider communications equipment taxation policies that might continue fostering both economic growth and job creation.

X.2. Current taxation regime on initial equipment purchasing by communications companies in Oklahoma:

Wireline and wireless companies pay a sales tax rate of 8.91% (weighted average combined state-local rate for the state), the fifth highest rate in the nation, while cable operators are exempted from sales taxes on network equipment (see graphic X-4).

Graphic X-4. Oklahoma: Ranking in US Sales Tax Rate on Investment (2018)



Sources: Tax Foundation; Telecom Advisory Services analysis

The evolution of sales tax rate on telecommunications equipment investment and communications investment per capita is presented in graphic X-5. The sales and use tax rate for telecom carriers network equipment has been consistently increasing between 2014 and 2018 (see table X-1).

Table X-1. Oklahoma: Communications Equipment State-Local weighted average Tax rate (2014-2018)

	2014	2018
Wireless	8.72 %	8.91 %
Wireline	8.72 %	8.91 %
Cable	0.00 %	0.00 %
Average	5.81 %	5.94 %

Sources: Tax Foundation

X.3. Economic impact of communications network equipment taxation in Oklahoma

By relying on the coefficients of the econometric models presented in section III.2, we estimate the short run and the long run impact of a potential elimination of the sales tax rate on telecommunications network equipment in Oklahoma. Assuming that in year 1 the sales tax rate on this capital good is eliminated, telecommunications investment per capita would increase by $ 8.24 (equivalent to 10.56% over the current level of $78.04). In the case of a reduction of the sales tax rate to 50% of the actual rate, investment per capita would increase by $ 4.12 (equivalent to 5.28% over the current level of $78.04)[32].

Furthermore, as indicated in section V.2.1, investment in year 2 after the elimination of the sales tax would be, to a large degree, dependent on the level in year 1. As a result, the elimination of sales taxes on telecommunications equipment purchase yields not only a short-term but also a long-term effect on investment levels (see table X-2).

Table X-2. Oklahoma: Estimation of the Increase in Communications Resulting from the Elimination of the Sales Tax on Network Equipment (in $ millions unless indicated)

	Year 1	Year 2	Total
Elimination of sales tax			
Investment Growth	$ 32.49	$ 50.55	$ 83.04
Savings from Sales Tax Elimination	$ 16.46	$ 16.46	$ 32.92
Share of Savings Reinvested	197.38%	307.13%	252.25%
50% reduction of sales tax			
Investment Growth	$ 16.24	$ 25.28	$ 41.52
Savings from Sales Tax Elimination	$ 8.23	$ 8.23	$ 16.46
Share of Savings Reinvested	197.38%	307.13%	252.25%

Source: Telecom Advisory Services analysis

Our estimates in table X-2 indicate that, as a result of a potential elimination of the sales tax on initially purchased equipment, in year 1 the cable, wireless and wireline operators reinvest 197.38% of what they would have paid as sales tax, and over the long run they continue to have the incentive to invest more than what they would have saved. In two years, the investment levels would represent 252.25% of saved taxes.

In turn, this additional investment would generate an impact on the economy of the state. By relying on the coefficients of the input/output matrix for United States and the econometric models of section V, we calculate the following estimates of socio-economic impact (see table X-3).

Table X-3. Oklahoma: Estimation of Direct and Indirect Socio-Economic Impact of Eliminating Sales Tax on Communications Equipment Purchases

Economic Indicators	Current Level	Short Run	Long Run
GDP Per Capita	$ 50,716	$ 50,729	$ 50,751
GDP Per Capita Growth	0.00%	0.03%	0.07%
Incremental GDP ($ million)	$ 0	$ 55	$ 139
Unemployment Rate	3.13%	3.13%	3.13%
Jobs created	0	230	588
Broadband Connections	1,217,175	1,218,603	1,220,826
Broadband Penetration	81.95%	82.04%	82.19%

Source: Telecom Advisory Services analysis

[32] While it is difficult to estimate what portion of this reinvested capital would be used in network modernization projects, it is reasonable to assume that, since the other two CAPEX categories (maintenance and capacity upgrades) are non-discretionary, any incremental available funds would be, in large part, invested in network modernization.

Our economic analysis based on the coefficient of the models specified in chapter III and IV indicates that eliminating the sales and use tax on communications infrastructure would, over two years:

- Generate over $139 million in new economic activity;
- Create 588 job/years;
- Create 3,650 broadband connections

The studies we review in chapter IV show that the productivity benefits associated with the investment in communications networks are broadly distributed across the many businesses, governments, and non-profits that use information technology and communication services. Therefore, capital investments made by communications companies improve infrastructure that benefits the entire state of Oklahoma, not just the companies making the investments. The $139 million in new economic activity that would result from the elimination of sales taxes on communications network investments would benefit sectors as diverse as wholesale trade, professional services, finance, and health care.

An exemption in sales taxes for communications equipment in Oklahoma would also create 588 direct, indirect and induced jobs. While not being significant overall, job creation would be widespread as new employment is created not only in the installation of new equipment but also in the many business sectors that rely on communications networks to develop new, more efficient and profitable ways to do business. The new economic activity will generate substantial offsetting revenues for state and local governments as new employment and economic activity generates income, sales, property, and other tax revenue for governments.

More rapid investment in communications networks will have immediate and direct benefits for consumers as well. New investment will benefit consumers by providing better and faster communications networks. New investments will also accelerate competition between wireless, wireline, and cable providers of high-speed communications services. This competition directly benefits consumers through better services and lower prices.

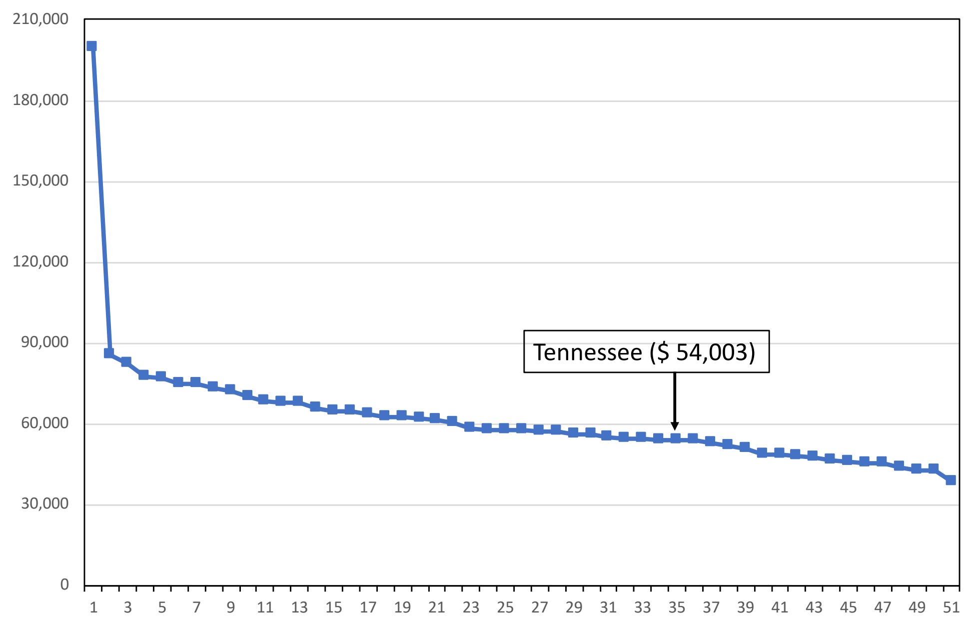
XI. THE ECONOMIC CONTRIBUTION OF COMMUNICATIONS NETWORK INVESTMENT IN TENNESSEE

Tennessee is another state that has one of the highest tax rates for sales and use of both telecommunication and cable investment in the nation.

XI.1. The situation of the economy in Tennessee:

The state of Tennessee ranks 35th in the United States in terms of GDP per capita (see graphic XI-1).

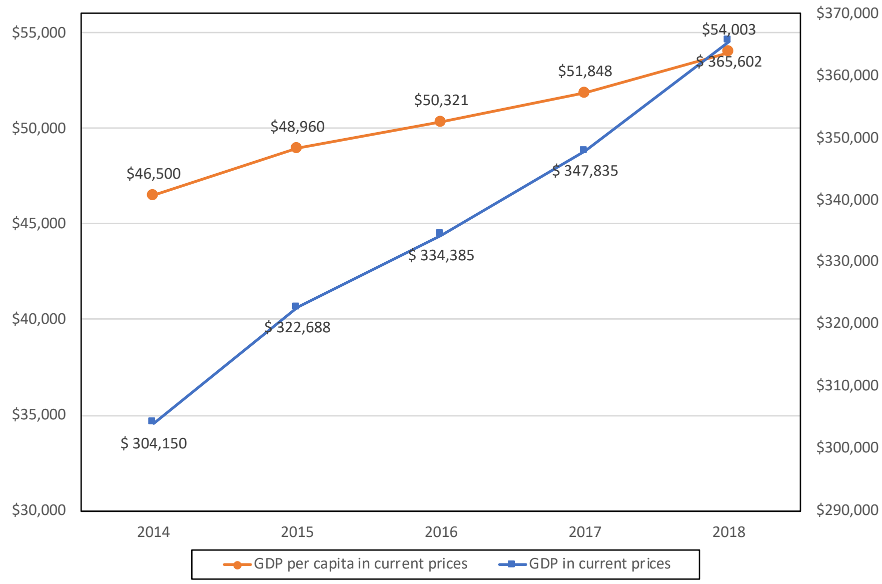
Graphic XI-1. United States: States Ranking by GDP per Capita (2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

Between 2014 and 2018 the Tennessee GDP per capita grew 16.14%, while the total GDP grew 20.20% (the difference is explained by an increase in total population).

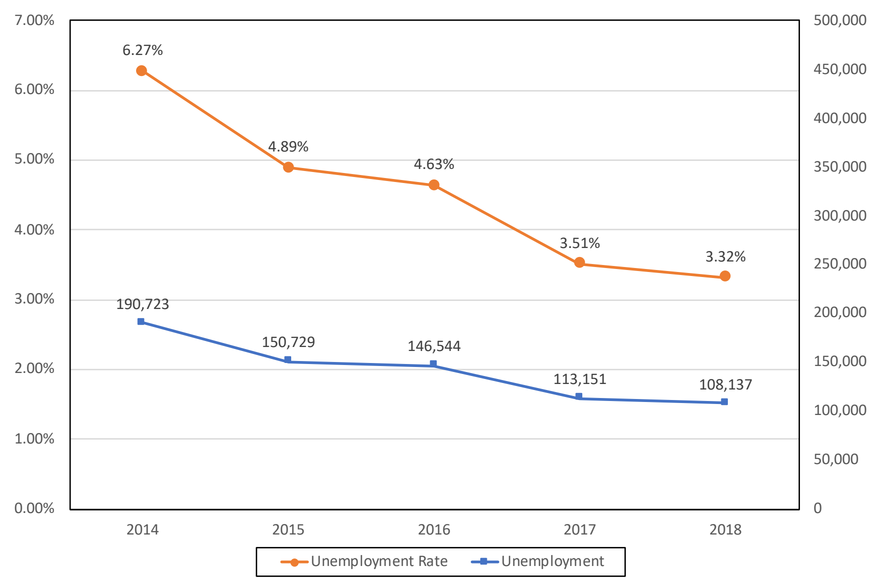
Graphic XI-2. Tennessee: Gross Domestic Product and GDP Per Capita (2014-2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

In January 2012, Tennessee´s unemployment rate was 7.10%, implying that 891,600 individuals of a total labor force of 12,518,200 were unemployed. Unemployment rate has decreased to 3.32% in 2018 (Graphic XI-3):

Graphic XI-3. Tennessee: Unemployment Rate and Number of Unemployed Workers (2014-2018)



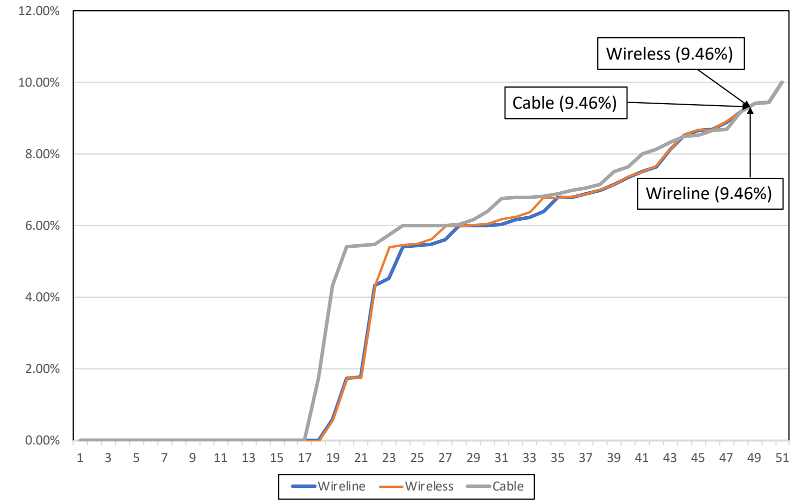
Sources: US Bureau of Labor Statistics; Telecom Advisory Services analysis

In this context, we should consider communications equipment taxation policies that might foster both economic growth and job creation.

XI.2. Current taxation regime on initial equipment purchasing by telecommunications and cable operators in Tennessee:

As mentioned above, in 2018 communications equipment investment was taxed at 9.46% (weighted average combined state-local rate for the state). This implies that Tennessee has the second highest tax rate for wireless and wireline telecommunications as well as cable investment (see Graphic XI-4).

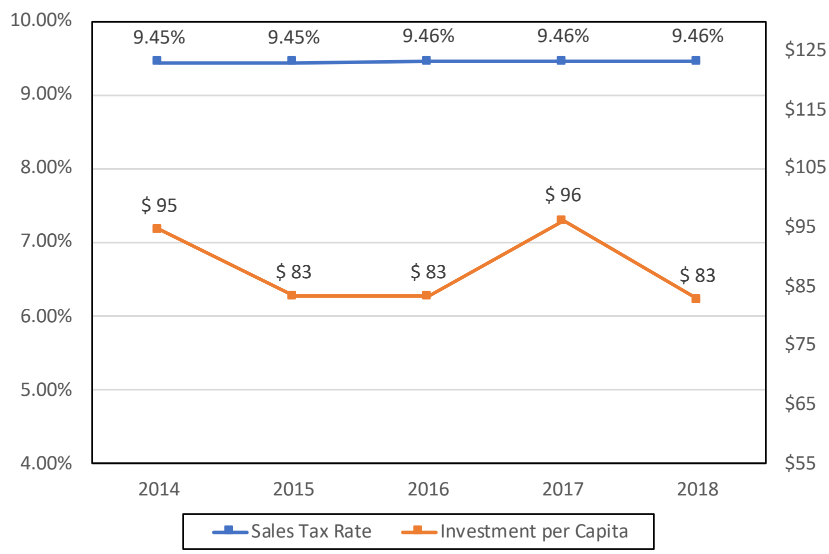
Graphic XI-4. Tennessee: Ranking in US Sales Tax Rate on Investment (2018)



Sources: Broadband Tax Institute; Telecom Advisory Services analysis

The evolution of sales tax rate on equipment investment and telecommunications and cable investment per capita is shown in graphic XI-5.

Graphic XI-5. Tennessee: Sales Tax Rate and Communications Investment per Capita (2014-2018)



Sources: Broadband Tax Institute Data; Telecom Advisory Services analysis

Tennessee exhibits in the period under analysis a fairly stable high sales tax rate of 9.46%. On the other hand, the investment per capita decreased significantly up to 2015, increasing temporarily in 2017, but resuming the decline in 2018. All in all, since 2010, the network investment per capita has dropped from $110 to $83.

XI.3. Economic impact of communications network equipment taxation in Tennessee

By relying on the coefficients of the econometric models presented in section III.2, we estimate the short run and the long run impact of an elimination of the sales tax rate in Tennessee. Assuming that in year 1 the sales tax rate is eliminated, investment per capita would increase by $ 15.47 (equivalent to 18.67% over the current level of $82.82). In the case of a reduction of the sales tax rate to 50% of the actual rate, investment per capita would increase by $ 7.73 (equivalent to 9.34% over the current level of $82.82)[33].

Furthermore, as we indicate in section V.2.1, investment in year 2 after the elimination of the sales tax would be, to a large degree, dependent on the level in year 1. As a result, the effect of an elimination of sales taxes yields not only a short-term but also a long-term effect on investment levels (see table XI-1).

Table XI-1. Tennessee: Estimation of the Increase in Communications Resulting from the Elimination of the Sales Tax on Network Equipment (in $ millions unless indicated)

	Year 1	Year 2	Total
Elimination of sales tax			
Investment Growth	$ 104.70	$ 162.91	$ 267.61
Savings from Sales Tax Elimination	$ 53.04	$ 53.04	$ 106.09
Share of Savings Reinvested	197.38%	307.13%	252.25%
50% reduction of sales tax			
Investment Growth	$ 52.35	$ 81.46	$ 133.81
Savings from Sales Tax Elimination	$ 26.52	$ 26.52	$ 53.04
Share of Savings Reinvested	197.38%	307.13%	252.25%

Source: Telecom Advisory Services analysis

Our estimates in table XI-1 indicate that, as a result of a potential elimination of the sales tax on initial purchases of equipment, in year 1 the cable, wireless and wireline operators reinvest 197.38% of what they would have paid as sales tax, and over the long run they would continue to have the incentive to invest more than what they would have saved. In two years, the investment levels would represent 252.25% of saved taxes.

In turn, this additional investment would generate an impact on the economy of the state. By relying on the coefficients of the input/output matrix for United States and the econometric models of section V, we calculate the following estimates of socio-economic impact (see table XI-2).

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[33] While it is difficult to estimate what portion of this reinvested capital would be used in network modernization projects, it is reasonable to assume that, since the other two CAPEX categories (maintenance and capacity upgrades) are non-discretionary, any incremental available funds would be, in large part, invested in network modernization.

Table XI-2. Tennessee: Estimation of Direct and Indirect Socio-Economic Impact of Eliminating Sales Tax on Communications Equipment Purchases

Economic Indicators	Current Level	Short Run	Long Run
GDP Per Capita	$ 54,003	$ 54,029	$ 54,070
GDP Per Capita Growth	0.00%	0.05%	0.12%
Incremental GDP ($ million)	$ 0	$ 176	$ 449
Unemployment Rate	3.32%	3.32%	3.32%
Jobs created	0	742	1,896
Broadband Connections	2,136,269	2,140,702	2,147,601
Broadband Penetration	82.07%	82.24%	82.50%

Source: Telecom Advisory Services analysis

Our economic analysis based on the coefficient of the models specified in chapter III and V indicates that eliminating the sales and use tax on communications infrastructure would, over two years:

- Generate over $449 million in new economic activity;
- Create 1,900 job/years;
- Create 11,300 broadband connections

The studies we review in chapter IV have shown that the productivity benefits associated with the investment in communications networks are broadly distributed across the many businesses, governments, and non-profits that use information technology and communication services. Therefore, capital investments made by communications companies improve infrastructure that benefits the entire state of Tennessee, not just the companies making the investments. The $449 million in new economic activity that would result from the elimination of sales taxes on communications network investments would benefit sectors as diverse as wholesale trade, professional services, finance, and health care.

An exemption in sales taxes for communications equipment in Tennessee would also create 1,900 direct, indirect and induced jobs. While not being significant overall, job creation would be widespread as new employment is created not only in the installation of new equipment but also in the many business sectors that rely on communications networks to develop new, more efficient and profitable ways to do business. The new economic activity will generate substantial offsetting revenues for state and local governments as new employment and economic activity generates income, sales, property, and other tax revenue for governments.

More rapid investment in communications networks will have immediate and direct benefits for consumers as well. New investment will benefit consumers by providing better and faster communications networks. New investments will also accelerate competition between wireless, wireline, and cable providers of high-speed communications services. This competition directly benefits consumers through better services and lower prices.

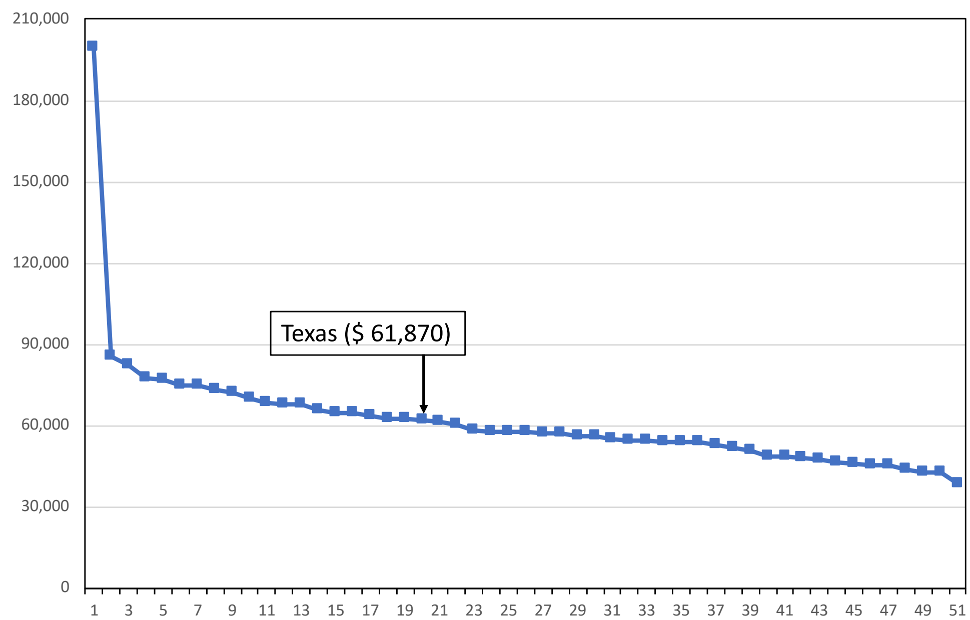
XII. THE ECONOMIC CONTRIBUTION OF COMMUNICATIONS NETWORK INVESTMENT IN TEXAS

Through 2013, the State of Texas had a sales and use tax rate for network equipment of 8.25% for both telecom carriers and cable service providers. In 2014, the legislature enacted a refund provision of sales taxes paid for communications equipment, which resulted in an effective rate of 6.06%.

XII.1. The situation of the economy in Texas

The state of Texas ranks 20th in the United States in terms of GDP per capita (see graphic XII-1).

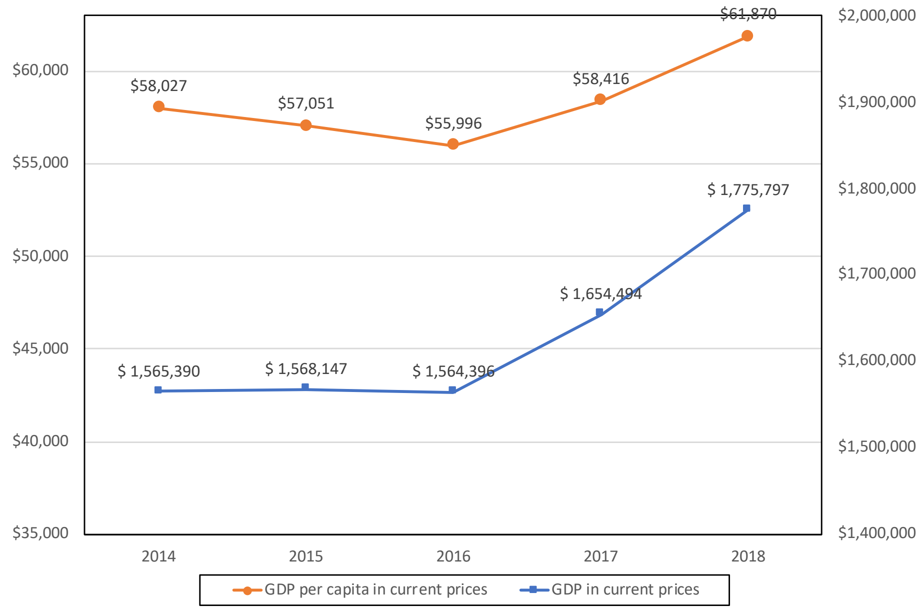
Graphic XII-1. United States: States Ranking by GDP per Capita (2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

Between 2014 and 2016 the Texas GDP per capita decreased by 3.50%, while the total GDP remained fairly constant (the difference is explained by an increase in total population). Since that year, both indicators grew at 10.49%.

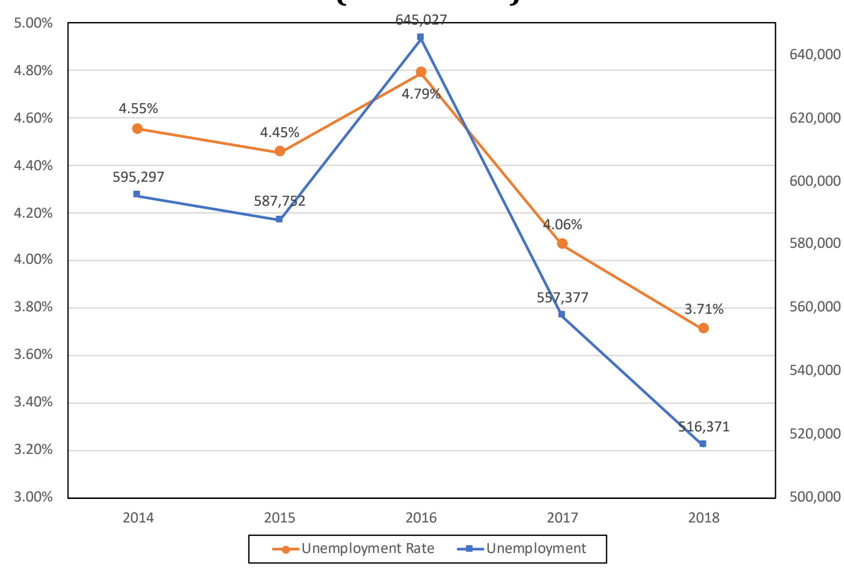
Graphic XII-2. Texas: Gross Domestic Product and GDP Per Capita (2014-2018)



Sources: US Bureau of Economic Analysis; Telecom Advisory Services analysis

In January 2012, Texas unemployment rate was 8.30%, implying that 291,443 individuals of a total labor force of 3,490,872 were unemployed. The unemployment rate has declined since (with an increase in 2016), driven by the national expansionary cycle reaching 3.71% in 2018 (see Graphic XII-3):

Graphic XII-3. Texas: Unemployment Rate and Number of Unemployed Workers (2014-2018)



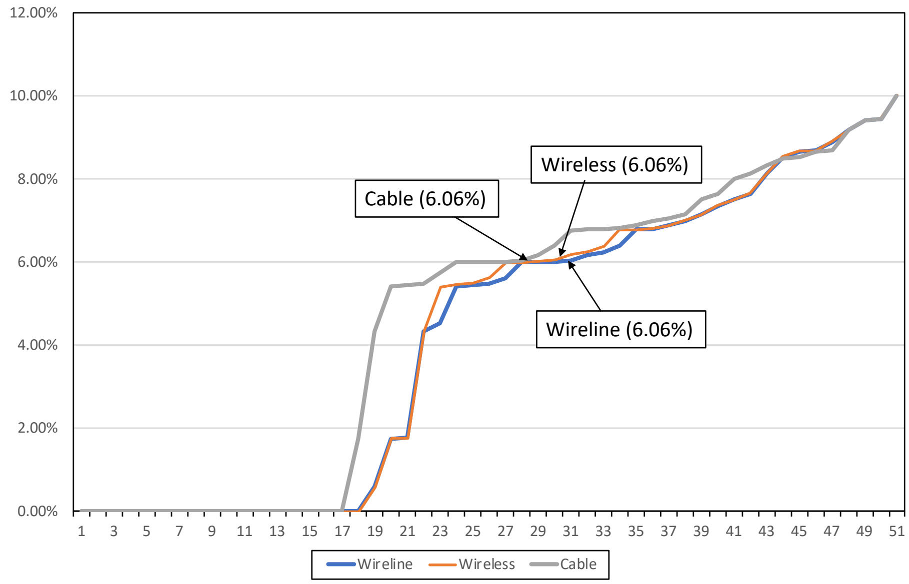
Sources: US Bureau of Labor Statistics; Telecom Advisory Services analysis

In this context, we consider communications network equipment public policies that might continue to stimulate both economic growth and job creation.

XII.2. Current taxation regime on initial equipment purchasing by telecommunications and cable TV operators in Texas:

As mentioned above, in 2018 communications equipment investment in Texas was taxed at 6.06% (weighted average combined state-local rate for the state). This implies that Texas has the 31st highest tax rate for wireless and wireline telecommunications of the country and also the 28th highest for cable investment (see Graphic XII-4).

Graphic XII-4. Texas: Ranking in US Sales Tax Rate on Investment (2018)



Sources: Broadband Tax Institute; Telecom Advisory Services analysis

As a result of this rate, telecommunications and cable companies paid approximately $209 million in sales taxes on their network investments in 2018 alone.

Until 2014, Texas imposed an average of 8.25% sales tax on purchase of communications equipment. As we mention above, based on the refund provision, Texas dropped its sales tax rate to an estimated 6.06%.

XII.3. Economic impact of communications network equipment taxation in Texas

By relying on the coefficients of the econometric models presented in section III.2, we estimate the short run and the long run impact of an elimination of the sales tax rate in Texas. Assuming that in year 1 the sales tax rate is eliminated, investment per capita would increase by $ 14.36 (equivalent to 11.96% over the current level of $120.03). In the case of a reduction of the sales tax rate to 50% of the actual rate, investment per capita would increase by $ 7.18 (equivalent to 5.98% over the current level of $120.03)[34].

Furthermore, as we indicate in section V.2.1, investment in year 2 after the elimination of the sales tax would be, to a large degree, dependent on the level in year 1. As a result, the effect of an elimination of sales taxes yields not only a short-term but also a long-term effect on investment levels (see table XII-1).

Table XII-1. Texas: Estimation of the Increase in Communications Resulting from the Elimination of the Sales Tax on Network Equipment (in $ millions unless indicated)

	Year 1	Year 2	Total
Elimination of sales tax			
Investment Growth	$ 412.08	$ 641.20	$ 1,053.28
Savings from Sales Tax Elimination	$ 208.77	$ 208.77	$ 417.55
Share of Savings Reinvested	197.38%	307.13%	252.25%
50% reduction of sales tax			
Investment Growth	$ 206.04	$ 320.60	$ 526.64
Savings from Sales Tax Elimination	$ 104.39	$ 104.39	$ 208.77
Share of Savings Reinvested	197.38%	307.13%	252.25%

Source: Telecom Advisory Services analysis

Our estimates in table XII-1 indicate that, as a result of a potential elimination of the sales tax on initially purchased equipment, in year 1 the cable, wireless and wireline operators reinvest 197.38% of what they would have paid as sales tax, and over the long run they would continue to have the incentive to invest more than what they would have saved. In two years, the investment levels would represent 252.25% of saved taxes.

In turn, this additional investment would generate an impact on the economy of the state. By relying on the coefficients of the input/output matrix for United States and the econometric models of section V, we calculate the following estimates of socio-economic impact (see table XII-2).

Table XII-2. Texas: Estimation of Direct and Indirect Socio-Economic Impact of Eliminating Sales Tax on Communications Equipment Purchases

Economic Indicators	Current Level	Short Run	Long Run
GDP Per Capita	$ 61,870	$ 61,895	$ 61,932
GDP Per Capita Growth	0.00%	0.04%	0.10%
Incremental GDP ($ million)	$ 0	$ 692	$ 1,768
Unemployment Rate	3.71%	3.71%	3.71%
Jobs created	0	2,920	7,463
Broadband Connections	8,262,153	8,273,137	8,290,228
Broadband Penetration	84.51%	84.63%	84.80%

Source: Telecom Advisory Services analysis

[34] While it is difficult to estimate what portion of this reinvested capital would be used in network modernization projects, it is reasonable to assume that, since the other two CAPEX categories (maintenance and capacity upgrades) are non-discretionary, any incremental available funds would be, in large part, invested in network modernization.

Our economic analysis based on the coefficient of the models specified in chapter III and V indicates that eliminating the sales and use tax on communications infrastructure would, over two years:

- Generate over $1,750 million in new economic activity;
- Create 7,450 job/years;
- Create 28,000 broadband connections

The studies we review in chapter IV have shown that the productivity benefits associated with the investment in communications networks are broadly distributed across the many businesses, governments, and non-profits that use information technology and communication services. Therefore, capital investments made by communications companies improve infrastructure that benefits the entire state of Texas, not just the companies making the investments. The $1,750 million in new economic activity that would result from the elimination of sales taxes on communications network investments would benefit sectors as diverse as wholesale trade, professional services, finance, and health care.

An exemption in sales taxes for communications equipment in Texas would also create 7,450 direct, indirect and induced jobs. While not being significant overall, job creation would be widespread as new employment is created not only in the installation of new equipment but also in the many business sectors that rely on communications networks to develop new, more efficient and profitable ways to do business. The new economic activity will generate substantial offsetting revenues for state and local governments as new employment and economic activity generates income, sales, property, and other tax revenue for governments.

More rapid investment in communications networks will have immediate and direct benefits for consumers as well. New investment will benefit consumers by providing better and faster communications networks. New investments will also accelerate competition between wireless, wireline, and cable providers of high-speed communications services. This competition directly benefits consumers through better services and lower prices.

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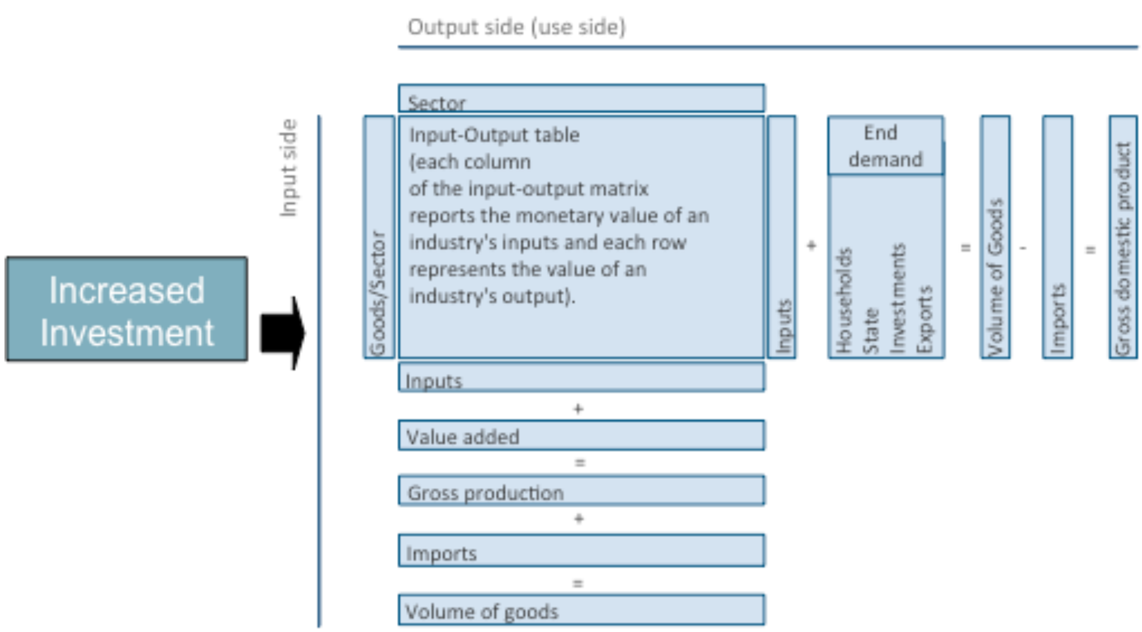
Appendix A. Input / Output Methodology

This methodology focuses on determining how much value added and employment is generated through the investment in communications networks. Input-output tables enable the calculation of the impact of additional inputs in specific sectors on the economy as a whole. The relationships between the sectors at the inputs stage trigger additional demand and thus increase production in other sectors. The sum of all these effects is the multiplier for the total volume of goods. Multipliers can be calculated in several ways and also for several economic dimensions. There are, for example, goods-related multipliers for the total volume of goods in an economy, for the value of total production or for the value added. There are also multipliers for labor market parameters such as the size of the workforce or the number of hours worked.

Once the investment input is calculated, the estimation of employment and output effects can be done. Input-output tables help calculating the direct, indirect, and induced effects of broadband network construction on employment and production. The interrelationship of these three effects can be measured through multipliers, which estimate how one unit change on the input side effects total employment change throughout the economy (see figure A.1).



To calculate employment effects resulting from communications investment, we relied on the input-output matrix published by Bureau of Economic Analysis. However, in order to be utilized in this analysis, the input-output matrices needed to be formatted to calculate the employment multipliers. Once the table is reformatted, one calculates the multipliers. From the I/O-table it is possible to obtain multipliers for total industry supply and additional variables as value added and employment. The calculation of the multipliers for the total industry supply uses the direct requirement table, which is also called Leontief-Inverse. The direct requirement table (DR) is calculated by the following formula:

DR = (I – A)^-1 with A = I/O-table / total industry supply (division of each cell of intermediate domestic supply by total industry supply) I = Identity matrix

The sum of the columns per industry reflects the increase of the total industry supply by one additional unit of demand in this specific sector. A correction for the share of imports on total industry supply results in the total domestic production of the industries. The multiplying of the share of value added of total domestic industry production results in the value-added multiplier. Using labor productivity, it is possible to calculate the job effects now. The I/O-table was built based on the Bureau of Economic Analysis (BEA) and GTAP make- and use-tables using a methodology from Chamberlain Economics LLC. To obtain an I/O-table that can be used to calculate multipliers that reflect domestic production it is necessary to exclude imports from the make- table.

Appendix B. State Sales Tax Rate (2014-2018)

State	Year	Wireless	Wireline	Cable	Average
Alaska	2014	1.69%	1.69%	1.69%	1.69%
Alabama	2014	6.38%	4.26%	6.38%	5.68%
Arkansas	2014	9.19%	9.19%	9.19%	9.19%
Arizona	2014	0.00%	0.00%	8.17%	2.72%
California	2014	8.41%	8.41%	8.41%	8.41%
Colorado	2014	7.39%	7.39%	7.39%	7.39%
Connecticut	2014	0.00%	0.00%	0.00%	0.00%
D.C.	2014	0.00%	0.00%	5.75%	1.92%
Delaware	2014	0.00%	0.00%	0.00%	0.00%
Florida	2014	6.62%	6.62%	6.62%	6.62%
Georgia	2014	6.97%	6.97%	6.97%	6.97%
Hawaii	2014	4.35%	4.35%	4.35%	4.35%
Iowa	2014	0.00%	0.00%	0.00%	0.00%
Idaho	2014	6.03%	6.03%	6.03%	6.03%
Illinois	2014	8.16%	8.16%	8.16%	8.16%
Indiana	2014	0.00%	0.00%	0.00%	0.00%
Kansas	2014	8.15%	8.15%	8.15%	8.15%
Kentucky	2014	6.00%	6.00%	6.00%	6.00%
Louisiana	2014	8.89%	8.89%	8.89%	8.89%
Massachusetts	2014	6.25%	6.25%	0.00%	4.17%
Maryland	2014	6.00%	6.00%	6.00%	6.00%
Maine	2014	5.50%	5.50%	5.50%	5.50%
Michigan	2014	0.60%	0.60%	6.00%	2.40%
Minnesota	2014	0.00%	0.00%	0.00%	0.00%
Missouri	2014	0.00%	0.00%	7.58%	2.53%
Mississippi	2014	1.75%	1.75%	7.00%	3.50%
Montana	2014	0.00%	0.00%	0.00%	0.00%
North Carolina	2014	0.00%	0.00%	0.00%	0.00%
North Dakota	2014	6.55%	6.55%	6.55%	6.55%
Nebraska	2014	6.79%	6.79%	6.79%	6.79%
New Hampshire	2014	0.00%	0.00%	0.00%	0.00%
New Jersey	2014	0.00%	0.00%	0.00%	0.00%
New Mexico	2014	7.26%	7.26%	7.26%	7.26%
Nevada	2014	7.93%	7.93%	7.93%	7.93%
New York	2014	0.00%	0.00%	8.47%	2.82%
Ohio	2014	0.00%	0.00%	0.00%	0.00%
Oklahoma	2014	8.72%	8.72%	0.00%	5.81%
Oregon	2014	0.00%	0.00%	0.00%	0.00%
Pennsylvania	2014	0.00%	0.00%	0.00%	0.00%
Rhode Island	2014	7.00%	7.00%	7.00%	7.00%
South Carolina	2014	7.19%	7.19%	0.00%	4.79%
South Dakota	2014	5.83%	5.83%	5.83%	5.83%
Tennessee	2014	9.45%	9.45%	9.45%	9.45%
Texas	2014	6.06%	6.06%	6.06%	6.06%
Utah	2014	0.00%	0.00%	6.68%	2.23%
Virginia	2014	5.63%	5.63%	0.00%	3.75%
Vermont	2014	6.14%	6.14%	6.14%	6.14%
Washington	2014	8.88%	8.88%	8.88%	8.88%
Wisconsin	2014	5.43%	5.43%	5.43%	5.43%

State	Year	Wireless	Wireline	Cable	Average
West Virginia	2014	0.00%	0.00%	0.00%	0.00%
Wyoming	2014	5.49%	5.49%	5.49%	5.49%
USA	2014	4.17%	4.13%	4.55%	4.28%
Alaska	2015	1.76%	1.76%	1.76%	1.76%
Alabama	2015	6.68%	4.46%	6.68%	5.94%
Arkansas	2015	9.26%	9.26%	9.26%	9.26%
Arizona	2015	0.00%	0.00%	8.17%	2.72%
California	2015	8.44%	8.44%	8.44%	8.44%
Colorado	2015	7.44%	7.44%	7.44%	7.44%
Connecticut	2015	0.00%	0.00%	0.00%	0.00%
D.C.	2015	0.00%	0.00%	5.75%	1.92%
Delaware	2015	0.00%	0.00%	0.00%	0.00%
Florida	2015	6.65%	6.65%	6.65%	6.65%
Georgia	2015	6.96%	6.96%	6.96%	6.96%
Hawaii	2015	4.35%	4.35%	4.35%	4.35%
Iowa	2015	0.00%	0.00%	0.00%	0.00%
Idaho	2015	6.01%	6.01%	6.01%	6.01%
Illinois	2015	8.19%	8.19%	8.19%	8.19%
Indiana	2015	0.00%	0.00%	0.00%	0.00%
Kansas	2015	8.20%	8.20%	8.20%	8.20%
Kentucky	2015	6.00%	6.00%	6.00%	6.00%
Louisiana	2015	8.91%	8.91%	8.91%	8.91%
Massachusetts	2015	6.25%	6.25%	0.00%	4.17%
Maryland	2015	6.00%	6.00%	6.00%	6.00%
Maine	2015	5.50%	5.50%	5.50%	5.50%
Michigan	2015	0.60%	0.60%	6.00%	2.40%
Minnesota	2015	0.00%	0.00%	0.00%	0.00%
Missouri	2015	0.00%	0.00%	7.81%	2.60%
Mississippi	2015	1.77%	1.77%	7.07%	3.54%
Montana	2015	0.00%	0.00%	0.00%	0.00%
North Carolina	2015	0.00%	0.00%	0.00%	0.00%
North Dakota	2015	6.56%	6.56%	6.56%	6.56%
Nebraska	2015	6.80%	6.80%	6.80%	6.80%
New Hampshire	2015	0.00%	0.00%	0.00%	0.00%
New Jersey	2015	0.00%	0.00%	0.00%	0.00%
New Mexico	2015	7.35%	7.35%	7.35%	7.35%
Nevada	2015	7.94%	7.94%	7.94%	7.94%
New York	2015	0.00%	0.00%	8.48%	2.83%
Ohio	2015	0.00%	0.00%	0.00%	0.00%
Oklahoma	2015	8.77%	8.77%	0.00%	5.85%
Oregon	2015	0.00%	0.00%	0.00%	0.00%
Pennsylvania	2015	0.00%	0.00%	0.00%	0.00%
Rhode Island	2015	7.00%	7.00%	7.00%	7.00%
South Carolina	2015	7.13%	7.13%	0.00%	4.75%
South Dakota	2015	5.83%	5.83%	5.83%	5.83%
Tennessee	2015	9.45%	9.45%	9.45%	9.45%
Texas	2015	6.06%	6.06%	6.06%	6.06%
Utah	2015	0.00%	0.00%	6.68%	2.23%
Virginia	2015	5.63%	5.63%	0.00%	3.75%
Vermont	2015	6.14%	6.14%	6.14%	6.14%
Washington	2015	8.89%	8.89%	8.89%	8.89%

State	Year	Wireless	Wireline	Cable	Average
Wisconsin	2015	5.43%	5.43%	5.43%	5.43%
West Virginia	2015	0.00%	0.00%	0.00%	0.00%
Wyoming	2015	5.47%	5.47%	5.47%	5.47%
USA	2015	4.18%	4.14%	4.57%	4.30%
Alaska	2016	1.78%	1.78%	1.78%	1.78%
Alabama	2016	6.73%	4.49%	6.73%	5.98%
Arkansas	2016	9.30%	9.30%	9.30%	9.30%
Arizona	2016	0.00%	0.00%	8.25%	2.75%
California	2016	8.48%	8.48%	8.48%	8.48%
Colorado	2016	7.52%	7.52%	7.52%	7.52%
Connecticut	2016	0.00%	0.00%	0.00%	0.00%
D.C.	2016	0.00%	0.00%	5.75%	1.92%
Delaware	2016	0.00%	0.00%	0.00%	0.00%
Florida	2016	6.66%	6.66%	6.66%	6.66%
Georgia	2016	7.01%	7.01%	7.01%	7.01%
Hawaii	2016	4.35%	4.35%	4.35%	4.35%
Iowa	2016	0.00%	0.00%	0.00%	0.00%
Idaho	2016	6.03%	6.03%	6.03%	6.03%
Illinois	2016	8.64%	8.64%	8.64%	8.64%
Indiana	2016	0.00%	0.00%	0.00%	0.00%
Kansas	2016	8.60%	8.60%	8.60%	8.60%
Kentucky	2016	6.00%	6.00%	6.00%	6.00%
Louisiana	2016	9.00%	9.00%	9.00%	9.00%
Massachusetts	2016	6.25%	6.25%	0.00%	4.17%
Maryland	2016	6.00%	6.00%	6.00%	6.00%
Maine	2016	5.50%	5.50%	5.50%	5.50%
Michigan	2016	0.60%	0.60%	6.00%	2.40%
Minnesota	2016	0.00%	0.00%	0.00%	0.00%
Missouri	2016	0.00%	0.00%	7.86%	2.62%
Mississippi	2016	1.77%	1.77%	7.07%	3.54%
Montana	2016	0.00%	0.00%	0.00%	0.00%
North Carolina	2016	0.00%	0.00%	0.00%	0.00%
North Dakota	2016	6.82%	6.82%	6.82%	6.82%
Nebraska	2016	6.87%	6.87%	6.87%	6.87%
New Hampshire	2016	0.00%	0.00%	0.00%	0.00%
New Jersey	2016	0.00%	0.00%	0.00%	0.00%
New Mexico	2016	7.51%	7.51%	7.51%	7.51%
Nevada	2016	7.98%	7.98%	7.98%	7.98%
New York	2016	0.00%	0.00%	8.49%	2.83%
Ohio	2016	0.00%	0.00%	0.00%	0.00%
Oklahoma	2016	8.82%	8.82%	0.00%	5.88%
Oregon	2016	0.00%	0.00%	0.00%	0.00%
Pennsylvania	2016	0.00%	0.00%	0.00%	0.00%
Rhode Island	2016	7.00%	7.00%	7.00%	7.00%
South Carolina	2016	7.22%	7.22%	0.00%	4.81%
South Dakota	2016	5.84%	5.84%	5.84%	5.84%
Tennessee	2016	9.46%	9.46%	9.46%	9.46%
Texas	2016	6.06%	6.06%	6.06%	6.06%
Utah	2016	0.00%	0.00%	6.69%	2.23%
Virginia	2016	5.63%	5.63%	0.00%	3.75%
Vermont	2016	6.17%	6.17%	6.17%	6.17%

State	Year	Wireless	Wireline	Cable	Average
Washington	2016	8.89%	8.89%	8.89%	8.89%
Wisconsin	2016	5.41%	5.41%	5.41%	5.41%
West Virginia	2016	0.00%	0.00%	0.00%	0.00%
Wyoming	2016	5.42%	5.42%	5.42%	5.42%
USA	2016	4.22%	4.18%	4.61%	4.34%
Alaska	2017	1.76%	1.76%	1.76%	1.76%
Alabama	2017	6.76%	4.51%	6.76%	6.01%
Arkansas	2017	9.30%	9.30%	9.30%	9.30%
Arizona	2017	0.00%	0.00%	8.25%	2.75%
California	2017	8.25%	8.25%	8.25%	8.25%
Colorado	2017	7.50%	7.50%	7.50%	7.50%
Connecticut	2017	0.00%	0.00%	0.00%	0.00%
D.C.	2017	0.00%	0.00%	5.75%	1.92%
Delaware	2017	0.00%	0.00%	0.00%	0.00%
Florida	2017	6.80%	6.80%	6.80%	6.80%
Georgia	2017	7.00%	7.00%	7.00%	7.00%
Hawaii	2017	4.35%	4.35%	4.35%	4.35%
Iowa	2017	0.00%	0.00%	0.00%	0.00%
Idaho	2017	6.03%	6.03%	6.03%	6.03%
Illinois	2017	8.64%	8.64%	8.64%	8.64%
Indiana	2017	0.00%	0.00%	0.00%	0.00%
Kansas	2017	8.62%	8.62%	8.62%	8.62%
Kentucky	2017	6.00%	6.00%	6.00%	6.00%
Louisiana	2017	9.98%	9.98%	9.98%	9.98%
Massachusetts	2017	6.25%	6.25%	0.00%	4.17%
Maryland	2017	6.00%	6.00%	6.00%	6.00%
Maine	2017	5.50%	5.50%	5.50%	5.50%
Michigan	2017	0.60%	0.60%	6.00%	2.40%
Minnesota	2017	0.00%	0.00%	0.00%	0.00%
Missouri	2017	0.00%	0.00%	7.89%	2.63%
Mississippi	2017	1.77%	1.77%	7.07%	3.54%
Montana	2017	0.00%	0.00%	0.00%	0.00%
North Carolina	2017	0.00%	0.00%	0.00%	0.00%
North Dakota	2017	6.78%	6.78%	6.78%	6.78%
Nebraska	2017	6.89%	6.89%	6.89%	6.89%
New Hampshire	2017	0.00%	0.00%	0.00%	0.00%
New Jersey	2017	0.00%	0.00%	0.00%	0.00%
New Mexico	2017	7.55%	7.55%	7.55%	7.55%
Nevada	2017	7.98%	7.98%	7.98%	7.98%
New York	2017	0.00%	0.00%	8.49%	2.83%
Ohio	2017	0.00%	0.00%	0.00%	0.00%
Oklahoma	2017	8.86%	8.86%	0.00%	5.91%
Oregon	2017	0.00%	0.00%	0.00%	0.00%
Pennsylvania	2017	0.00%	0.00%	0.00%	0.00%
Rhode Island	2017	7.00%	7.00%	7.00%	7.00%
South Carolina	2017	7.22%	7.22%	0.00%	4.81%
South Dakota	2017	6.39%	6.39%	6.39%	6.39%
Tennessee	2017	9.46%	9.46%	9.46%	9.46%
Texas	2017	6.06%	6.06%	6.06%	6.06%
Utah	2017	0.00%	0.00%	6.76%	2.25%
Virginia	2017	5.63%	5.63%	0.00%	3.75%

State	Year	Wireless	Wireline	Cable	Average
Vermont	2017	6.18%	6.18%	6.18%	6.18%
Washington	2017	8.92%	8.92%	8.92%	8.92%
Wisconsin	2017	5.42%	5.42%	5.42%	5.42%
West Virginia	2017	0.00%	0.00%	0.00%	0.00%
Wyoming	2017	5.40%	5.40%	5.40%	5.40%
USA	2017	4.25%	4.21%	4.64%	4.37%
Alaska	2018	1.76%	1.76%	1.76%	1.76%
Alabama	2018	6.83%	4.55%	6.83%	6.07%
Arkansas	2018	9.41%	9.41%	9.41%	9.41%
Arizona	2018	0.00%	0.00%	8.33%	2.78%
California	2018	8.54%	8.54%	8.54%	8.54%
Colorado	2018	7.52%	7.52%	7.52%	7.52%
Connecticut	2018	0.00%	0.00%	0.00%	0.00%
D.C.	2018	0.00%	0.00%	5.75%	1.92%
Delaware	2018	0.00%	0.00%	0.00%	0.00%
Florida	2018	6.80%	6.80%	6.80%	6.80%
Georgia	2018	7.15%	7.15%	7.15%	7.15%
Hawaii	2018	4.35%	4.35%	4.35%	4.35%
Iowa	2018	0.00%	0.00%	0.00%	0.00%
Idaho	2018	6.03%	6.03%	6.03%	6.03%
Illinois	2018	8.70%	8.70%	8.70%	8.70%
Indiana	2018	0.00%	0.00%	0.00%	0.00%
Kansas	2018	8.68%	8.68%	8.68%	8.68%
Kentucky	2018	6.00%	6.00%	6.00%	6.00%
Louisiana	2018	10.02%	10.02%	10.02%	10.02%
Massachusetts	2018	6.25%	6.25%	0.00%	4.17%
Maryland	2018	6.00%	6.00%	6.00%	6.00%
Maine	2018	5.50%	5.50%	5.50%	5.50%
Michigan	2018	0.60%	0.60%	6.00%	2.40%
Minnesota	2018	0.00%	0.00%	0.00%	0.00%
Missouri	2018	0.00%	0.00%	8.03%	2.68%
Mississippi	2018	1.77%	1.77%	7.07%	3.54%
Montana	2018	0.00%	0.00%	0.00%	0.00%
North Carolina	2018	0.00%	0.00%	0.00%	0.00%
North Dakota	2018	6.80%	6.80%	6.80%	6.80%
Nebraska	2018	6.89%	6.89%	6.89%	6.89%
New Hampshire	2018	0.00%	0.00%	0.00%	0.00%
New Jersey	2018	0.00%	0.00%	0.00%	0.00%
New Mexico	2018	7.66%	7.66%	7.66%	7.66%
Nevada	2018	8.14%	8.14%	8.14%	8.14%
New York	2018	0.00%	0.00%	8.49%	2.83%
Ohio	2018	0.00%	0.00%	0.00%	0.00%
Oklahoma	2018	8.91%	8.91%	0.00%	5.94%
Oregon	2018	0.00%	0.00%	0.00%	0.00%
Pennsylvania	2018	0.00%	0.00%	0.00%	0.00%
Rhode Island	2018	7.00%	7.00%	7.00%	7.00%
South Carolina	2018	7.37%	7.37%	0.00%	4.91%
South Dakota	2018	6.40%	6.40%	6.40%	6.40%
Tennessee	2018	9.46%	9.46%	9.46%	9.46%
Texas	2018	6.06%	6.06%	6.06%	6.06%
Utah	2018	0.00%	0.00%	6.77%	2.26%

State	Year	Wireless	Wireline	Cable	Average
Virginia	2018	5.63%	5.63%	0.00%	3.75%
Vermont	2018	6.18%	6.18%	6.18%	6.18%
Washington	2018	9.18%	9.18%	9.18%	9.18%
Wisconsin	2018	5.42%	5.42%	5.42%	5.42%
West Virginia	2018	0.00%	0.00%	0.00%	0.00%
Wyoming	2018	5.46%	5.46%	5.46%	5.46%
USA	2018	4.28%	4.24%	4.67%	4.40%

(*) Data for 2010 excludes Alaska and Hawaii