



From the Selected Works of Reza Rajabiun, LLM, PhD

2016

Affordability of Communications Services

Reza Rajabiun

David Ellis

Catherine Middleton



Available at: https://works.bepress.com/reza_rajabiun/22/

Literature Review:
Affordability of Communications Services

March 2016

Prepared for the
Canadian Radio-television and Telecommunications Commission (CRTC)

by
Reza Rajabiun, David Ellis and Catherine Middleton

Literature Review: Affordability of Communications Services

Table of Contents

Executive Summary	1
1. Affordability: definitions, perceptions and scope.....	4
2. Public and private sector approaches to affordability	14
3. The digital divide and vulnerable populations	22
4. Findings and recommendations	30
Appendix	34
Bibliography	38

The report was commissioned by the Canadian Radio-television and Telecommunications Commission (CRTC) and prepared for the Commission by Dr. Reza Rajabiun (Ted Rogers School of Management, Ryerson University), Dr. David Ellis (York University) and Dr. Catherine Middleton (Ted Rogers School of Management, Ryerson University). The views expressed herein are the authors' alone and do not necessarily represent those of the CRTC, the Government of Canada, Ryerson University or York University.

Executive Summary

This report provides a review of research on affordability of access to communications services. The report documents several different approaches to defining affordability in the communications industries; identifies private sector strategies and public policy instruments available for enhancing affordability; and analyzes the trade-offs policymakers must consider in utilizing various policy instruments for achieving affordability objectives. The report highlights analytical approaches and practices best suited for use in the Canadian communications industries, including recommendations on how to define affordability and appropriate indicators for evaluating how it evolves.

For the purposes of this report, communications encompasses both telecommunications and broadcasting, and thus the various retail activities related to broadband Internet access, wireline telephony, mobile wireless services and subscription television, as well as the use of service bundling (e.g. the triple play). Broadband Internet access acts as a platform for a large number of other popular services such as VoIP (voice over Internet protocol telephony, a potential substitute for landline and/or mobile service); streaming video; multimedia; cloud computing; and similar advanced Internet applications and content services. In light of this role for broadband as an enabling technology, the report focuses primarily on the affordability of broadband access to the Internet, both internationally and in Canada.

The literature provides a variety of analytical frameworks for conceptualizing affordability, both as an economic constraint and as a policy objective. From the perspective of consumers, affordability is broadly viewed as a combination of pricing and income variables, as well as the subjective value individuals derive from spending scarce resources on particular goods and services. Traditional economic theory simplifies the concept of affordability in terms of the consumer's "willingness to pay" (i.e. demand), which tends to increase with incomes and decline with prices. In the longer term, technological and business process innovations that reduce costs and improve quality appear to be critical for enhancing affordability of access to products and services that are now considered necessities, but were once luxuries that only affluent early adopters could afford.

While the affordability of luxuries for high-income individuals may not justify public policy attention, the affordability of those goods and services considered essential by the majority of the population does represent a general policy problem. In some industries, market competition and innovation might be sufficient to improve affordability, particularly for consumers with relatively low incomes. However, in network industries, large fixed costs and scale economies often mean that competition is not necessarily feasible or desirable, a factor that has given rise to a long history of rate regulation in the delivery of utilities.

Beyond economic conceptualizations of affordability, lawmakers in various countries have tried to define affordability as a legal construct in terms of statutory policy objectives relating to the communications industries. In Canada, for example, affordability represents one of a number of potentially contradictory policy objectives that Parliament has mandated policymakers to pursue in the design and implementation of rules for the telecommunications and broadcasting industries. Understanding the extent to which affordability is achieved as a policy objective requires measuring how affordability evolves as an economic constraint.

Previous research shows that affordability of Internet access represents a leading indicator for predicting the growth of the broader digital economy. This is not surprising given that affordable access tends to

encourage both consumers and businesses to take advantage of the wide range of information and communications technology (ICT) services and applications that have emerged thanks to intense competition and innovation at the global level. As illustrated by the proliferation of mobile devices over the past decade, global competition and innovation have also played an important part in enhancing affordability of access to the equipment individuals and businesses require to deploy the ICT services and applications that meet their particular requirements. Unlike globally competitive markets for ICT applications and equipment, however, structural dominance is the norm in markets for the provision of the physical infrastructure that connects end-user equipment to Internet service and application providers, restricting the potential for competition to discipline prices and therefore improve affordability.

Broadband Internet access remains a luxury in many developing countries, accessible only to small groups of urban elites. By contrast, it has become an increasingly essential service for the vast majority of the population in advanced economies that have succeeded in building near-ubiquitous networks. In maturing markets where access and adoption are already widespread, the main concerns about affordability tend to be associated with either the high cost of provisioning networks in rural and remote communities or with the constraints imposed by limited disposable income among vulnerable populations.

Even in countries with high average incomes such as Canada, individuals with very low or no income must balance their spending on access to communications services against spending priorities for other essentials such as food and shelter. Although consumers with higher incomes can afford to pay higher prices for higher quality services, the extent to which low-income individuals can afford services of quality sufficient to meet their individual requirements depends on the level and range of the price/quality combinations on offer in the market. Understanding the multifaceted nature of affordability in a fine-grained manner requires detailed data on the price and quality of services, which can then be correlated with broader indicators of socioeconomic disparities, such as income, place of residence, health status, ethnic background, etc. Indicators of price levels, range of price/quality combinations, penetration rates of advanced technologies and other high-level market outcome measures can offer informative signals about affordability as an economic constraint on access, use, and the development of the broader ICT sector.

Over the past decade, various national and lower levels of government have responded to these issues by implementing a variety of initiatives supporting affordable access for: a) consumers in relatively high-cost and remote communities where the business case for private sector investments in network assets is limited or non-existent; and b) consumers with very low incomes and other vulnerable populations, such as persons with disabilities and marginalized communities. Improving affordability also serves as one justification for the adoption of policies aimed at promoting entry and competition in the provision of services. This general policy goal further acts as a rationale for crafting rules intended to protect consumers against abusive marketing practices, such as the utilization of hidden fees by sellers trying to make their offerings appear more affordable to low-income buyers. In order to provide the Commission with a balanced view of the issues, this report synthesizes the literature on both broad and targeted policy initiatives that can be employed to address the affordability of communications services, as well as on indicators for monitoring the affordability of access to the broadband networks that now serve as the main platform for the delivery of many other communications services.

This report concludes that attention to broadband affordability as a policy objective in advanced economies should not be confined to the particular challenges facing non-adopters. It is important to recognize that the increasing essentiality of fixed and mobile broadband services as an essential enabler of social and economic activities for the vast majority of the population makes affordability of these services a question of general policy interest. While availability and penetration rates of particular

services remain relevant as policy variables in developing countries where access to fixed and mobile connectivity remains a luxury, these indicators are far less relevant in maturing markets where the penetration rates of both fixed and mobile broadband have started to reach a maximum threshold. Affordability can pose a binding constraint on access and use for non-adopters and adopters with limited disposable incomes available to pay for increasingly essential communications services.

To the extent that access and use of broadband networks by low-income vulnerable groups and underserved communities can help them overcome social and economic disparities, reducing affordability constraints may counteract these inequalities. Based on affordability thresholds from the literature and recent data on the evolution of communications spending in Canada, we estimate that, for those with incomes below \$24,000 per year, paying for basic fixed and mobile access services can be considered unaffordable. While this high-level affordability threshold might be informative as a basis for future research and policymaking, such measures can conceal substantive inequalities, leading to underestimates of the magnitude of affordability gaps facing some of the most vulnerable groups, such as children from low-income households, persons with severe disabilities, low-income seniors and those facing structural unemployment.

1. Affordability: definitions, perceptions and scope

Context and scope

In popular parlance, the term “affordability” is usually associated with one’s capacity to pay for a product or service, or alternatively with the decision to refrain from paying for something. Sellers of luxuries and necessities alike tend to claim that the prices they charge are affordable given the value that the buyer will derive from the purchase. While improving the affordability of luxuries is not a concern of policymakers, the affordability of necessities such as food, shelter, water, basic education, healthcare, transportation and communications represents a basic economic policy problem in both advanced and developing countries.¹

This report provides an overview of the concept of affordability in communications services, focusing on the growing essentiality of broadband access to the Internet and thus to the vast array of services and applications made available over the Internet.² We look at affordability as an economic constraint on three partially overlapping groups of consumers: i) people who live in rural and remote communities typified by high costs in service provisioning, as well as by limited competition among service providers; ii) people who have not adopted certain communications services because they deem them to be too expensive; and iii) low-income consumers who pay for communications services, but restrict their usage because of variable costs, such as those generated by data caps.

Economic and legal conceptualizations of affordability

From an economic perspective, affordability can be viewed as a constraint on individual, household or business consumption of a particular good or service. Consumer demand is primarily shaped by a combination of pricing and income variables. In the case of necessities, the proportion of disposable income allocated to that particular good or service tends to decline as income increases,³ while the share of income allocated to luxuries tends to grow with increasing income.⁴

Although broadband access began as a luxury purchased by small groups of public sector employees, university communities and other early adopters in the 1990s, studies on demand for broadband in high-income OECD economies suggest that by the mid-2000s broadband had already transitioned from a luxury to a necessity.⁵ More recently, the proliferation of mobile devices has made mobile broadband

¹ See Kessides et al. (2009) and Milne (2009).

² We note that broadband networks allow access to the Internet and to other services (see Teksavvy Solutions Inc., 2015 on this point). In this report, the term broadband is used to describe an Internet access service made available over a high-speed network, i.e. at speeds greater than those offered on a dial-up connection. ‘Broadband’ describes the combination of access network and internet service sold to consumers as a broadband service.

³ More concretely, Engel’s Law predicts the proportion of income that is allocated to necessities such as food declines as income grows, even though total spending continues to grow (Houthakker, 1957).

⁴ Generally speaking, luxuries or superior goods are defined as those with an income elasticity of demand (i.e. measured as percentage change in quantity demanded divided by percentage change in income) larger than one. Those with income elasticities between 0 and 1 are defined as necessities, while those associated with inferior goods are negative/below 1 (i.e. increase in income reduces demand for inferior goods as there is a shift in consumption to more luxurious goods). See Varian (1992), Chapter 8.

⁵ See Cadman & Dineen (2008). They estimated income elasticity of demand for fixed access in OECD countries to be around 0.8. Their estimates documented that by the mid-2000s demand for broadband in advanced economies had already become relatively insensitive to price, with an estimated elasticity of -.43. While estimates vary across studies, later data confirms growing insensitivity of broadband demand to both income and price changes, as well as

networks an increasingly indispensable channel for Internet access . The extent to which the majority of the population relies on fixed and mobile broadband networks as essential helps explain why the affordability of broadband access is a policy problem of general relevance.⁶

Conceptualizations of affordability in the communications industries can be understood in the context of the transition away from the traditional regulated monopoly model. The monopoly model utilizes rate regulation to ensure affordability, an approach that remains popular in the delivery of other utilities. Under the regulated monopoly model governing the communications industry before the Internet age, both retail price regulations and regulatory barriers to entry were used to ensure universality and affordability of access to essential services, particularly plain old telephone service (POTS) on analogue copper networks.⁷ By limiting the scope for competition in low-cost urban areas and in the long-distance voice market, this framework provided the basis for explicit or implicit cross-subsidies enabling universal access.

These cross-subsidies promoted affordable access in higher cost rural areas and encouraged regulated entities to offer a relatively uniform level of service quality, with consistent prices across communities despite differences in cost structures. By the 1980s, however, it became increasingly apparent that barriers to entry and retail price regulation reduced the affordability and quality of access to local voice, long distance and emerging data services. Enhancing the affordability and quality of services by encouraging new providers to enter the market and compete represented a central justification for the wide-ranging deregulation and liberalization policies that emerged in the 1990s.⁸

The legal definitions of affordability currently in place in various advanced and developing countries have their origins in legislative frameworks adopted in the 1990s that hastened the erosion of the regulated monopoly model and prioritized the introduction of market competition.⁹ Although most countries have since adopted sector-specific statutes, some jurisdictions rely on general-purpose competition rules as the legal basis for telecommunications and media policy. General policy statements about the importance of affordability are common. On the other hand, binding legal obligations that ensure a certain quality of service at a reasonable price to users in high-cost areas or to low-income consumers tend to be restricted to legacy POTS or low-speed data services. Questions about the utility of defining broadband access as an essential service subject to universal access obligations remain prominent in telecommunications policy debates in many high-income countries.

Canadian policymaking exemplifies the priority placed on affordability as a communications policy objective. Section 7(b) of the 1993 *Telecommunications Act* provides that public policy should “render

that the fact that broadband remains a luxury in developing countries. See Galperin & Ruzzier (2013), Katz & Berry (2014), and World Bank (2014) for more information on this point.

⁶ Milne (2006).

⁷ For a discussion of trends and pressures that led to the erosion of the regulated monopoly model in Canada and its implications for consumers, as well as political commitments to affordable universal access to telephone services see Pike & Mosco (1986).

⁸ For an analysis of strategic and informational problems in the introduction of competition into the “natural monopoly” model see Laffont & Tirole (2001).

⁹ For a discussion of different approaches to defining affordability of access in the context of ongoing universal service policy debates in high income OECD countries see Calvo (2012). This report associates the concept of universal service in communications to the liberalization of the sector in 1990s and affordability with universal service. Notably, Calvo separates “universal service policies” (generally as all instruments that promote services beyond the point that can be reached by market dynamics alone) from “universal service obligations” that guarantee availability and affordability of service at some minimum standard.

reliable and affordable telecommunications services of high quality accessible to Canadians in both urban and rural areas in all regions of Canada” (emphasis added). Parliament further stipulated that policies implemented to achieve these and other objectives should be designed such that they “foster increased reliance on market forces” (s.7(f)), and “respond to the economic and social requirements of users of telecommunications services” (s.7(h)). These policies were therefore intended to complement market forces in order to achieve affordability, reliability and universality for both legacy and emerging communications services.

From a legal perspective, affordability is entrenched as one of a number of formal objectives intended to ensure that communications services of sufficient quality are made accessible in both rural and urban areas in all regions of Canada. In drafting the 1993 statutory framework, Parliament addressed the challenges posed by technological change and the new era of competition. Policymakers wished to preserve legacy obligations directed at universal access to telephony (despite not making explicit use of the phrase “universal access”), as well as to ensure that public policy would be responsive to the changing economic and social needs of users. After various modifications and additions over the past two decades, the basic service objectives under the *Telecommunications Act* currently apply to voice, low-speed data and some emergency services. Broadband access to the Internet remains outside the scope of the basic service objective and is thus not considered a basic service. In recent years, however, calls have been growing to reclassify broadband as a basic service, in recognition of the need for fast, affordable access in rural and remote communities, as well as to serve vulnerable groups such as Canadians with disabilities and those from low-income households. The question of what should constitute basic telecommunications service for Canadians is the subject of a CRTC consultation, underway at the time of writing this report.¹⁰

Policy choices influencing affordability

The legal construction of affordability as part of a universal service objective can obscure the influence exercised by a wide range of other public policies and private sector choices on the affordability of services in the marketplace. For example, formal and informal barriers to international investment and trade - such as influencing access to network equipment and services - tend to increase the price of inputs into network development and usually have an adverse effect on affordability and consumer welfare. In terms of domestic regulations, policymakers in most advanced economies have been reluctant to engage in rate regulation in retail markets for fixed and mobile Internet access. However, many

¹⁰ See Canadian Radio-Television and Telecommunications Commission (2015a). For discussions of affordability issues relating to low-income groups and vulnerable populations see Public Interest Advocacy Centre (2015) and Media Access Canada (MAC)/Access 2020 Coalition (2015a). For analysis of infrastructure development issues in remote communities and rural communities see submissions by The First Mile Connectivity Consortium (FMCC) and Eastern Ontario Warden’s Caucus(EOWC)/(EORN) to the CRTC 2015-134 consultations. On the other hand, submissions by incumbent network operators argue that market forces are sufficient to provide a range of price/quality combinations that meet the affordability needs of low-income consumers and deliver services of sufficient quality to all but a small number of remote communities. Under this interpretation of evidence, regulatory recognition of broadband as a basic service and adoption of industry funded mechanisms for addressing market failures are unnecessary. At the same time, operators subject to existing obligations on legacy voice services emphasize the costs of maintaining such obligations on advanced Internet Protocol (IP) enabled networks they now employ to deliver converged broadband and broadcasting services. It is relevant to note that affordability concerns with respect to broadcasting distribution undertakings have been recently addressed by the CRTC with the mandate of a “skinny basic” TV service package that involves a predefined minimum level of service (i.e channels) for a predefined price the Commission determined to be reasonable (CRTC, 2015b).

countries do employ some form of wholesale access and interconnection obligations on the operators of essential facilities in order to promote service-based competition and reduce the potential for inefficient duplication of facilities.¹¹ By reducing the costs of network deployments and potentially increasing the threat of entry, an effective wholesale policy framework can have an impact on the affordability of retail services. On the other hand, if the regulated price of wholesale access is too low or too high, it can reduce affordability of services at the retail level by inhibiting fixed capital formation or foreclosing service-based competition.

In addition to the impact of sector-specific external and domestic regulations on the operation of the industry, various national and lower levels of government have employed industrial policies such as subsidies, tax incentives, public investments and procurement guarantees to help private operators cover the fixed costs of network deployment, particularly in high-cost areas where private sector incentives to invest in delivering services at affordable prices are limited or non-existent.¹² This class of measures can improve affordability of access by allocating part of the risk associated with irreversible investments in fixed network assets to the public sector. However, these measures can also be costly by hampering public revenue generation; misallocating scarce public funds; locking public sector entities into expensive long-term procurement contracts; and distorting market competition.¹³ The potential adoption of cross-subsidies intended to improve rural connectivity and the affordability of services for low-income citizens represents an area of considerable debate in various countries, including Canada.

Policies encouraging or obliging providers to offer more transparent signals about price, service quality, and other terms and conditions in their retail offerings also have affordability implications. Without clear and accurate information on service quality and price it is difficult for consumers to choose services that best suit their requirements, leading to a transfer of consumer surplus to service providers.¹⁴ Legal restrictions on misleading advertising and other abusive marketing practices are particularly relevant when considering the affordability of services for low-income users, who are more likely to opt for lower cost plans that carry hidden costs (e.g. low data caps, overcharges and recurring fees).

As we discuss in further detail in Section 2 below, there are a variety of other policy instruments and approaches that operators can also utilize to address affordability concerns in particular markets. It is useful to note international evidence on telecommunications policy shows higher income countries tend to have adopted a broader array of regulatory instruments and policy measures for achieving their policy objectives.¹⁵ These policies include various combinations of mandated wholesale access, supply- and demand-side subsidies, and consumer protection regulations, but do not generally include a universal service obligation for broadband. The question of broadband and universal service has come under particularly intense debate in high-income countries such as Canada, where broadband access has already become an essential enabler of social and economic activities for the great majority of the population.

¹¹ For a discussion of international evidence see Rajabiun & Middleton (2015a). For an overview of dilemmas in the design of wholesale access obligations in Canada see Rajabiun & Middleton (2015b).

¹² Rajabiun & Middleton (2013a & 2013b).

¹³ Rajabiun & Middleton (2013b), Wu (2014).

¹⁴ Rajabiun & Middleton (2015c), Sluijs et al. (2011).

¹⁵ Perkins (2014), Waverman & Koutroumpis (2011).

From global to local perspectives on measuring affordability

The persistence of affordability as a policy problem in high-income countries may seem puzzling when we consider the global digital divide, and the much higher cost of broadband access relative to income in developing countries compared to advanced economies. Indeed, estimates compiled by the Broadband Commission for Digital Development indicate that Internet access costs around 30% of average monthly income in low-income developing countries, while costing just 2% of average monthly income in high-income countries.¹⁶ Communications services in advanced economies cost less than the affordability target threshold of 5% of income as defined by the UN Broadband Commission.

This picture may suggest that a combination of past policies and market forces have resolved affordability concerns in high-income countries. Nevertheless, questions of access to affordable services, particularly with respect to high-cost rural communities and low-income populations, have become more pronounced over the past few years, as the use of fixed and mobile networks has become more prevalent. Both supply-side and demand-side inequities appear to influence gaps in affordable access to broadband connectivity. These inequities include low-cost urban vs high-cost rural areas on one hand, and income disparities and digital literacy on the other.

Two developments in the evolution of broadband connectivity in advanced economies help explain why affordability of access has emerged as an economic policy problem:

- **Feasibility:** Over the past decade, a combination of private-sector investment and public initiatives has helped extend service availability and improve access to fixed and mobile broadband to a large majority of the population in high-income countries. These advances in turn reduce the anticipated costs of adopting a universal access mandate, as well as the costs of making further public investments to ensure that low-income individuals and those who live and work in high-cost communities can also participate in the digital economy.¹⁷ In other words, with time and progress, the adoption of policies that ensure access to those with limited means or who live in under-served communities has itself become more affordable.

¹⁶ The UN Broadband Commission has defined a broadband affordability threshold target of 5% or less of per capita income. See Broadband Commission for Digital Development (2013), pp. 44-45, Figure 6. In this report, the term high-speed is the first concept that is introduced and “affordable” the second (p. 8). Availability, affordability, and accessibility represent the three basic elements of the manner in which policy and business aspirations are characterized in this broad report covering the diverse range of countries that make up the UN. Based on the assumption that broadband access becomes affordable when it costs less than 5% of disposable income, this means that around 4 billion people in the case of fixed access and 2.5 billion in terms of mobile connectivity cannot afford to participate in the digital economy. In other words, outside of high and higher middle income countries, lack of investment in coverage and capacity of communications systems makes them both inaccessible and unaffordable to much of the world’s population.

¹⁷ In lower income countries where the scope of coverage and affordability gaps remains extensive, the scope of the problem is too large to fix by simply adopting a universal access mandate or by diverting scarce public resources from the provision of other public goods such as health and education. Public policies and efficiency enhancing regulations that attract domestic and international capital into digital infrastructure of developing countries will be required for addressing these divides, which also explains why lower income countries tend to have a smaller set of public regulations in place and tend to exercise substantive forbearance in the hope of promoting private capital formation in deploying infrastructure needed to connect communities outside of a small subset of high income urban areas.

- **Essentiality:** The economic literature on the evolution of demand for Internet service provides a more fundamental explanation as to why affordability of communications services is a growing policy concern in high-income countries with high penetration and usage rates, such as Canada, the U.S, Japan and many EU countries. During the early development of broadband networks, demand by early adopters for the luxury of connectivity is relatively price-inelastic.¹⁸ As broadband penetration rates increase from ~5% to 30%, however, demand becomes relatively price elastic (i.e. consumers become more price-sensitive), and as a result the pricing strategies of operators become particularly critical for extending penetration.¹⁹ For example, in this later stage of market development, operators have some incentive to engage in practices such as price discrimination and bundling in order to expand their market share by attracting low-income consumers with more affordable service packages. However, as penetration rates begin to reach a maximum threshold (roughly 70% to 90%), demand becomes increasingly inelastic to price. In other words, demand becomes less sensitive to prices as broadband becomes more of a necessity. That in turn reduces the incentives of suppliers to offer discounted prices, because it becomes harder to gain market share simply by reducing prices.²⁰ Inelasticity of demand stemming from the growing essentiality of access creates both motive and opportunity for providers to increase prices without facing substantive losses in terms of foregone revenues.

Over the past decade, the transition of broadband from a luxury to a necessity in advanced economies has transformed the broadband policy problem. It has evolved from a focus on improving limited network coverage in high-cost communities to more general concerns about the affordability and service quality of offerings generated by market forces in both rural and urban areas. As sensitivity of demand to higher prices by the average consumer declines, the limited scope for competition in network industries such as telecommunications tends to make affordability a growing constraint on vulnerable communities and those with limited means, as service providers have reduced incentives to offer discounted prices to those with low incomes. For instance, low-income consumers who must contend with usage-based pricing and data caps are more likely to restrict their use of bandwidth-intensive Internet content and applications compared to those with higher incomes, which can widen digital and potentially broader economic disparities between the two groups. In any general framing of affordability as a policy objective, it is imperative that its relevance to average consumers, for whom access has become essential, be recognized alongside its more obvious relevance to underserved communities and vulnerable populations that lag behind in network access and use.

Most of the discussion in this report focuses on the affordability of fixed broadband service, in recognition of the fact that broadband provides the platform of choice for the deployment of thousands of different kinds of online applications, products and services. At the same time, the affordability of legacy voice services also remains a policy concern, while mobile connectivity is an area of growing importance in both advanced and developing countries.

¹⁸ i.e. changes in price have a relatively small impact on quantity demanded.

¹⁹ Galperin & Ruzzier (2013), World Bank (2014).

²⁰ Surveys suggest that affordability represents a constraint to adoption for around one third to one half of the remaining 10 to 30% of the population in advanced economies without fixed broadband access at home. See Carare et al (2015). Notably, they document that price elasticity of demand for non-adopters tends to be lower than previously expected, illustrating that it becomes more difficult to increase penetration by reducing prices in relatively mature markets.

- **Demand-side considerations:** Survey research from industrialized countries, where access to broadband is widespread, suggests some consumers, particularly older ones, continue to rely heavily on traditional voice services.²¹ For example, evidence from Japan, where fibre-to-the-premises broadband (FTTP) and 4G mobile are widely deployed and used, suggests that willingness to pay for traditional voice telephony services remains strong.²² The research on Japanese consumers' willingness to pay for various communications services indicates in particular that: i) mobile access does not induce all consumers to discontinue landline access; ii) consumer willingness to pay for FTTP is higher than for traditional voice service; and iii) willingness to retain mobile data services is higher than for FTTP. While FTTP represents a long-term functional substitute for voice telephony, fixed and mobile data services tend to complement each other in terms of consumer preferences for connectivity. Whether consumers in countries that lag behind Japan in the transition to FTTP and 4G mobile networks exhibit similar preferences is a question to be answered once next-generation networks (NGNs) become more widespread. Nevertheless, without alternatives that can deliver functionally equivalent services, even relatively advanced high-income countries may not be able to afford suspension of legacy commitments to universal access to voice telephony. |
- **Supply-side considerations:** Operators around the world are increasingly deploying next-generation fixed and mobile networks. In this environment, maintaining basic services such as voice, low-speed data and emergency services on legacy networks becomes increasingly costly. Transitioning legacy services to next-generation IP platforms will contain the costs of maintaining them. Nevertheless, doing so is likely to require significant public investment in fibre access and transport facilities, particularly in high-cost areas where private-sector incentives to deploy FTTP and 4G networks might be limited, even in the long run.²³ Therefore, public policies will be needed that encourage private-sector investments in FTTP networks in communities prone to market failures. This step will have to precede the lifting of universal service commitments regarding telephony in order to avoid disruptive effects on individuals and businesses that continue to consider legacy services essential.

The nature and magnitude of the gaps that require some sort of policy remediation can vary significantly across countries and even across regions of the same country. Generally speaking, gaps associated with the digital divide tend to reflect other social and economic inequities.²⁴ Access to affordable communications services is essential if disadvantaged groups are to benefit from enhanced educational, employment and social engagement opportunities. To that extent, reducing affordability as a barrier to adoption and use may help counteract existing economic disparities. As a communications policy objective, affordability can therefore be viewed as a manifestation of broader social and political commitments to enhance opportunities for economic participation in inherently unequal societies.

It is also important to note that affordability-related policies are made more complex by the degree of overlap among vulnerable populations. For example, high-cost rural communities, where private-sector

²¹ The extent to which this is the case with respect to various legacy and next-generation communications services in Canada is currently subject to a survey under Phase II of the CRTC 2015-134 consultation process. It is important to point out however that attempts to extrapolate essentiality from survey responses only capture perceived essentiality, which may not be accurate due to limited information on the part of respondents and methodological choices in the design of specific surveys.

²² Nakamura (2013).

²³ Mitomo (2014).

²⁴ Howard et al. (2010), McConnaughey et al. (2013).

incentives to invest in network infrastructure are limited, also tend to have lower income residents.²⁵ Similarly, individuals with severe disabilities tend to have substantially lower than average incomes, while disabilities that reduce income tend to grow with age and have a disproportionate impact on women.²⁶ Vulnerable individuals, such as those with disabilities, as well as low-income seniors and youth, live in both urban and rural communities. Thus, achieving affordability as a policy objective is likely to require a combination of policy strategies that enhance the incentives for private-sector providers to meet the needs of under-served communities in both rural *and* urban areas.²⁷

While low incomes and high costs represent two main barriers to affordability, the definition of affordability as a legal objective and its manifestations as an economic constraint vary from country to country. Furthermore, different countries and regions within them can exhibit substantially different patterns of income inequality, geographies, and local market conditions in terms of prices, service quality and competition. Aggregated country-level indicators of affordability measured as the ratio of expenditures to disposable income, commonly employed in communications and other industries, have some utility. At the same time, they also have the potential to conceal significant affordability constraints on access and use for particular segments of the population. Just as private-sector incentives to enter higher cost rural communities can reduce the range of low-cost offerings and service quality levels relative to urban centres, so too the use of country-level price indices or consumer expenditure estimates may lead to underestimates of affordability as an economic constraint in rural communities. By the same token, average levels of consumption and income may not be relevant for measuring affordability for vulnerable groups such as persons with disabilities or children from low-income households, who have a higher than average need for connectivity resources to enable them to use bandwidth-intensive applications or prepare homework assignments.

Developing disaggregated indicators that provide a more fine-grained mapping of broadband market conditions in relation to socioeconomic disparities can be valuable for identifying gaps in affordability, as well as other policy objectives such as reliability and service quality. Targeted studies aimed at developing a better picture of demand for and affordability of services available to vulnerable groups can improve programs intended to enhance equality of opportunity.

Recent research indicates aggregated country-level communications price indices have significant informational value in predicting growth of the broader information and communication technology (ICT) sector.²⁸ Since cost barriers affect both individual users and businesses trying to reach them, making broadband services affordable can generate positive externalities by reducing the costs of doing business with users entering the digital economy and who are in the market for productivity-enhancing ICT services. Similarly, affordable access to broadband can help reduce the cost of delivering government

²⁵ Townsend et al. (2013). Access to Internet at home for students from low income households in rural communities represents a notable example of this aspect of the problem. See submission by the Elementary Teachers' Federation of Ontario (ETFO) to CRTC 2015-134 consultations.

²⁶ See Media Access Canada/Access 2020 Coalition (2015b).

²⁷ Although beyond the scope of this report as we focus on elements of the problem in terms of telecom policy in Canada, it is relevant to note that competition authorities can also play a role in enhancing affordability of communications services by enforcing general laws against anticompetitive and misleading advertising in the sector, limiting the scope for mergers and acquisitions likely to lead to a substantial increase in prices.

²⁸ See Ayanso & Lertwachara (2015). Using data for 120 countries between 2008 and 2012, they find that past and current affordability has a strong predictive value for future levels of ICT development, and therefore argue "governments can leverage the ICT pricing information to plan the level of their future ICT adoption and usage proactively" (p.395).

services to low-income and other vulnerable populations (e.g. education, healthcare, social services). Accounting for such externalities represents a challenge to policymakers in advanced economies responsible for addressing concerns about the affordability and capacity of broadband infrastructure that enables the broader ICT economy.

The range of price/quality combinations available in particular markets can provide an informative picture of the options facing individuals and businesses with limited ability to pay for premium services. The incentives of operators to offer low-cost options is often limited in both the early stages of market development, when only a small number of early adopters value a given service sufficiently to pay for it, and in mature markets where the service has become essential to most consumers. Monitoring the evolving pricing structure of the industry offers an important window into understanding affordability as an economic constraint on consumers. To the extent that more affordable communications services are crucial to the growth of the broader ICT economy, network access price and quality information can be particularly valuable to policymakers trying to promote productivity growth and economic development.

Penetration rates and utilization levels of particular technologies and services can also serve as useful indicators of affordability. For example, in areas where next-generation fibre access networks have been deployed, setting prices substantially higher than those for legacy²⁹ DSL and cable broadband services is likely to discourage consumers from subscribing to the new platform. Low take-up rates can therefore signal to investors that the prices operators are charging are too high and a longer pay-back period will be required in order to make the services affordable for a larger set of buyers. However, penetration rates can also be highly misleading as an indicator of affordability. For services whose penetration rates are already high, such as legacy voice, data and broadcasting services, a decline in take-up does not necessarily imply a deterioration in affordability, since consumers may be switching to next-generation broadband networks for the communications and media services they require.

While potentially useful as indicators of affordability in the early to intermediate stages of network development, penetration rates become increasingly uninformative as indicators of market outcomes and policy effectiveness in advanced economies, where penetration rates are reaching a maximum threshold. Furthermore, penetration rates do not account for the fact that those with lower incomes tend to allocate a larger proportion of their disposable income to services that have become essential for a large majority of the population. If price levels are too high or there is limited price discrimination on the low-cost side of the market, high penetration rates may not relieve low-income consumers from having to ration other necessities in order to remain connected.

In the presence of usage-based pricing, penetration rates can also be highly misleading as indicators of the capacity of market forces to satisfy demand, as in the case of long distance calling services.³⁰ In the fixed and mobile broadband markets in Canada, usage-based billing, data caps, ancillary fees and “excessive” use overcharges are common, particularly for low-cost plans. Thus, detailed firm-level revenue estimates, rather than advertised subscription prices, are likely to provide a more realistic basis for estimating the total expenditures made by individuals, households and businesses on their

²⁹ Fixed-line broadband Internet access was initially provided over copper (using DSL technology) and cable networks. These legacy networks are being replaced with fibre-optical networks, referred to as advanced or next-generation networks.

³⁰ In the case of telephone services, in Telecom Decision CRTC 96-10 the Commission determined that “the national telephone penetration rate is the key indicator of overall affordability. It considers, however, that statistics on telephone penetration rates by household income group and by province would be useful as they would assist in identifying the regions and income brackets where affordability concerns may lie.” (Section V, paragraph 3).

communications services. While consumers with high incomes may be able to afford “all you can eat” premium packages, complex pricing schemes and usage caps on low-cost packages can create affordability barriers for consumers with limited means who wish to take advantage of the increasingly bandwidth-intensive applications offered over the Internet

The standard approach to measuring affordability is to evaluate it as the proportion of income that consumers have to allocate to necessities such as food, shelter, utilities and communications services. To highlight the relevance of the general economic and legal perspectives on affordability discussed above, Table 1 provides an overview of data compiled by the CRTC showing communications expenditure levels by income groups in Canada.³¹ Relative expenditures for communications services, including telephone, TV, Internet and mobile wireless, decline significantly as income grows, suggesting that this group of services represents a necessity that those with lower incomes cannot afford to forgo. The magnitude of the affordability gap is significant, as those with lower incomes spend nearly two times more of their income on communications services than the average, and four times more than the highest income quintile.

Table 1. Expenditures on Communications Services in Canada (2013)

(Source: CRTC CMR, 2015, Table 2.0.3)

	Income quintile					
	First	Second	Third	Fourth	Fifth	Average
<i>Average annual income</i>	\$18,582	\$41,105	\$64,854	\$98,634	\$199,702	\$84,575
<i>Expenditures as % of annual income</i>	8%	5%	4%	3%	2%	3%

Although certain legacy services such as landline service and emerging ones such as ultra-HD TV may represent luxuries that only higher income individuals can afford, fixed and mobile Internet access can deliver functionally equivalent voice and media services. Consequently, they present viable substitutes for lower income individuals who cannot afford to pay for the entire range of services.³² Table 2 provides an overview of the development of demand for different types of communications services between 2011 and 2014 in terms of average annual growth in expenditures.

In broad terms, expenditures on legacy wireline telephone services have been declining rapidly for all income groups, but this decline has been particularly pronounced for those with the lowest incomes. Television expenditure growth has been positive but low for most income groups, with the exception of the lowest income quintile, where it declined. These trends support the hypothesis that these services are becoming luxuries to those with limited means. On the other hand, expenditures on wireline and mobile Internet access services have experienced sustained and rapid growth, particularly for those with lower incomes. The fact that those with lower incomes are willing to increase their expenditures at a higher rate indicates their strong willingness to pay for fixed and mobile services, which have become essential to their social and economic participation.

³¹ CRTC (2015c), Tables 2.0.3 & .4.

³² According to the analysis by PIAC (2015) there is some evidence of this substitution effect among lower income Canadians as paying for all four services would cost a substantially larger proportion of incomes of the lowest income quintile than the estimated 8% noted in Table 1.

Table 2. Growth in Communications Expenditures

(Average annual growth in %; 2011-2014 - Source: Estimates based on data in CRTC
CMR 2015 Table 2.0.4

	First quintile	Second quintile	Third quintile	Fourth quintile	Fifth quintile	Average
<i>Wireline telephone</i>	-9	-4	-5	-8	-5	-6
<i>Mobile wireless</i>	11	9	10	8	9	9
<i>Internet</i>	11	10	9	10	9	9
<i>TV</i>	-2	1	2	1	2	1

2. Public and private sector approaches to affordability

This section provides an overview of public policies and private-sector strategies that influence affordability as an economic constraint. It presents a range of policy options suitable for minimizing the effects of affordability as an economic constraint on access and use. The discussion emphasizes potential linkages between public policy and market incentives to overcome the two basic barriers to affordability: low incomes and high costs. Policy instruments and private-sector approaches discussed below are intended to illustrate some of the options and challenges typical of developed markets such as Canada, and do not represent a comprehensive list.

Public policy instruments: From network coverage to affordability and service quality

During the 1980s and 1990s, public policies that hastened the erosion of the regulated monopoly model were typically justified in terms of consumer welfare gains and affordability considerations, particularly in the business telephone and long distance sub-sectors. Development of dial-up and then broadband networks on top of telephone and cable TV networks in the late 1990s and early 2000s provided the basis for rapid growth in the coverage and penetration of broadband to residential and business premises. Having started regulatory reform early and with the benefit of nationwide cable-TV networks that could provide broadband services, Canada experienced some of the fastest broadband penetration growth rates in this period.³³ By the mid-2000s, however, policymakers started to recognize that the private-sector incentives to deploy broadband in rural communities were limited, initiating a wide range of programs intended to address market failures in the provision of transport and access infrastructure in under-served communities.³⁴

Although some provinces (e.g. Alberta) and municipalities (e.g. Calgary, Coquitlam) have invested directly in transport and middle-mile network facilities, subsidies intended to stimulate private-sector incentives to provide services at affordable rates have been the primary instrument for extending network

³³ OECD (2015). Historical Penetration Rates, Fixed and Wireless Broadband, G7 (June 2015).

³⁴ Rajabiun & Middleton (2013b).

coverage and improving speeds in higher cost rural communities. The focus of these public-private partnerships has been on extending coverage and speeds in under-served communities. Affordability considerations have been incorporated into some programs through contractual commitments to charge consumers in high-cost rural communities prices comparable to those in low-cost urban areas, as well as by negotiating wholesale discounts on satellite services serving remote communities.³⁵

In addition to these rural subsidies, regulations mandating wholesale access to existing broadband infrastructure have served as the primary policy instrument used by policymakers in Canada, as well as many other advanced economies. The aim of such regulations is to promote affordability by encouraging service-based competition on top of legacy DSL and cable networks. These policies have, however, been relatively ineffective in promoting service-based competition in Canada, particularly in the residential market for broadband services, as the non-incumbents' share of the national market has remained below 10% of total revenues.³⁶ At the same time, attempts over the past few years to introduce competition into the market for mobile services by encouraging entry also appear to have been unsuccessful, making it increasingly feasible for dominant operators to increase prices, often simultaneously.³⁷

We review various private-sector strategies for addressing affordability problems in the marketplace in the second part of this section. Based on our review of the literature and related public initiatives, we describe actual and potential public-sector approaches for achieving affordability policy objectives that appear to be helpful in reducing affordability constraints (see the Appendix for examples of affordability initiatives in other sectors and jurisdictions).

- **Public access:** Over recent decades, a common approach to enhancing access to affordable services has been to open networks owned by public entities to use by others. Free access in schools, libraries and other venues through public Wi-Fi networks helped introduce a generation of users to the Internet and remains a tool for ensuring that affordable services are available in both urban and rural communities. This type of public access policy is likely to be critical for those who cannot afford either mobile wireless services or fixed communications access at home (or do not have a stable address).³⁸
- **Tax credits:** Both supply- and demand-side tax credits represent viable tools for enhancing affordability of services for consumers. On the supply side, various countries, including Canada, provide for accelerated depreciation of fixed capital expenditures in telecommunications.³⁹ By creating incentives for increasing network capacity, accelerated depreciation can help improve affordability in the long term, on the condition that network providers pass on some of the savings to their customers. However, special privileges for the sector as a whole or with respect to particular services have the capacity to distort competition and produce diminishing marginal

³⁵ For example, efforts by the Eastern Ontario Wardens' Caucus (EOWC)/Eastern Ontario Regional Networks (EORN) address coverage and capacity gaps with a combination of transport and access network subsidies.

³⁶ See van Gorp, A., & Middleton, C. (2010). The degree of competition is somewhat higher in the higher margin business market for access services (CRTC, 2015c).

³⁷ See CBC News (2016).

³⁸ But as Middleton (2007) and Humphry (2014) note, providing access to communications services in public places is not a substitute for ensuring affordable access on personal communication devices in consumers' preferred locations.

³⁹ The Conference Board of Canada (2015) has recently recommended increasing the Capital Cost Allowance (CCA) on telecommunications equipment from 30 to 50% to boost investment, particularly in the wireless sector.

returns.⁴⁰ Tax policies aimed at promoting demand among the working poor through credits can directly boost affordability and potentially encourage both adoption and use.

Such policies do little, however, to address affordability constraints on the most vulnerable low-income groups with little income to tax, as well as those who fall outside the cut-off thresholds of the official social safety net. Nevertheless, in mature markets where penetration and adoption are reaching a maximum threshold, international evidence suggests that demand-side measures such as direct tax credits to end-users could be more effective in increasing take-up than policies intended to stimulate investment in supply.⁴¹ To the extent that demand becomes price-inelastic as particular services become more essential in mature markets, the benefits of both supply- and demand-side tax measures tend to decline. Moreover, it is not evident whether they will outweigh the costs in revenue loss, and the competitive and tax system distortions they inherently involve.

- **Vouchers:** A more refined approach to reducing affordability constraints on the most vulnerable is to employ vouchers that cover all or part of the costs of services that individuals consider essential. Relative to tax breaks with uncertain benefits and potentially distortionary effects, vouchers can be designed in a manner that minimizes potential interference with market forces by allowing end-users some control over the services they require and the suppliers they choose. There are a variety of ways that funds for such vouchers can be collected from the public and industry, including through fees on services in low-cost urban areas. To minimize the total cost of such programs and ensure they target the most vulnerable, standards for needs-based assessment would have to be developed so that vouchers can be distributed through social service agencies and community organizations having direct contact with recipient groups.⁴² Given the potential for the development of secondary markets with vouchers, however, implementation of control mechanisms that ensure they are distributed to and used by those who need them the most will be critical for their success. One way of minimizing the administrative and monitoring costs of a voucher scheme is to utilize thresholds from other social services programs to define eligibility (e.g. unemployment, disability status), and to distribute this type of demand-side subsidy directly to those who need it most through established social services agencies.
- **Infrastructure subsidies:** Since the late 1990s, Canadian policymakers have recognized that public investment in backbone facilities can make it more feasible to provide service to rural and remote areas at a reasonable cost.⁴³ Although proposals for building national open-access backbones have not been adopted at the federal level, various provinces and municipalities have, since the early 2000s, subsidized or invested directly in the transport and middle-mile networks required to close physical gaps in network coverage and capacity.⁴⁴ In its report on the utilization of broadband investments in response to the 2008 financial crisis, the OECD argued that allocating public investments to transport tends to have a positive impact on the welfare of a larger number of consumers than subsidies to extend or upgrade last-mile access networks.⁴⁵

⁴⁰ In other words, increasing capital cost allowance above a certain threshold will tend to generate more of a deadweight loss in terms of lost tax revenue relative to gains in terms of increased investment levels.

⁴¹ Belloc et al. (2012).

⁴² For an example of such a proposal for targeting low income Canadians with severe and very severe disabilities, see Media Access Canada/Access 2020 Coalition's further submission to the CRTC 2015-134 consultations.

⁴³ See final report of the National Broadband Task Force (2001).

⁴⁴ Rajabiun & Middleton (2013a).

⁴⁵ OECD (2009).

The availability of high-capacity, reasonably-priced transport facilities will continue to play an important role in efforts by lower levels of government to improve affordability and quality of service in communities prone to private-sector under-investment in infrastructure and limited competitive discipline.⁴⁶

- **Competition policy:** Regulatory measures that shape the scope for market competition remain an important instrument for improving affordability. For example, reducing the regulated rates paid by smaller service providers, municipalities and large organizations for wholesale broadband access can have a positive effect on affordability at the retail level. Most advanced countries, with the notable exception of Canada, allow substantial foreign investment in their communications service providers. Foreign ownership restrictions and other regulatory barriers to competition are likely to have a negative effect on affordability as they reduce the threat of entry and range of potential suppliers. Standard instruments of competition policy and merger review can be employed to enhance service affordability by limiting the scope for coordinated price increases and structural changes likely to result in a substantive transfer of welfare from consumer to producer. In order to restrict the range of anti-competitive practices that provide profitable opportunities for the providers of essential network facilities, various countries around the world have also adopted structural separation mandates for both legacy and next-generation networks.⁴⁷
- **Consumer protection:** Given limited scope for competition in the markets for network access, as well as variability and uncertainty in service features, providers do not always deliver the speeds they advertise in order to attract customers.⁴⁸ Over the past decade, various governments have adopted voluntary rules and standards to promote contract transparency and encourage operators to inform users about their network management practices. Beyond the network neutrality debates, it is important to recognize that information asymmetries between sellers and buyers can have a particularly negative effect on low-income and less educated users. To the extent these groups have incentives to opt for low-cost plans, they are particularly susceptible to attempts by some operators to engage in misleading advertising and other abusive practices in order to take market share from their competitors. Since low-cost plans also tend to have more hidden fees, the application of general or sector-specific regulations intended to protect the average consumer are likely to be particularly important in protecting low-income consumers.
- **Standards setting:** The setting of price and service quality standards can present an effective tool for ensuring that vulnerable individuals have access to some minimum level of service at a price policymakers determine to be reasonable. A notable example of this approach to addressing affordability concerns in Canada has been the decision by the CRTC to require broadcasting distribution entities to offer one relatively unbundled basic TV service package at a price it considered appropriate.⁴⁹ The adoption of network control technologies which enable

⁴⁶ See for example approaches adopted by the Eastern Ontario Wardens' Caucus (EOWC) with the Eastern Ontario Regional Network (EORN) model and the proposed plan by the Western Ontario Wardens' Caucus (WOWC) for deploying the South West Integrated Fibre Project (SWIFT) in order to extend, upgrade, and reduce the costs of transport facilities. <https://www.eorn.ca/en/index.asp> ; <http://swiftnetwork.ca/>

⁴⁷ See Bruno (2012)

⁴⁸ See Rajabiun & Middleton (2015c), SamKnows (2015).

⁴⁹ CRTC (2015). Broadcasting Regulatory Policy 2015-96.

operators to guarantee a minimum level of service to end-users allows for the adoption of a similar approach in the case of fixed and mobile broadband networks.

- **Universal access obligations:** One major policy question under consideration in various advanced economies is whether or not to place legal obligations on service providers to offer mandated services.⁵⁰ In contrast to aspirational targets, the adoption of such obligations requires operators to deliver a certain level of service to all citizens, regardless of where they live, and in many cases regardless of their ability to pay. Universal access mandates may have some positive impact by enhancing the incentives of private-sector operators to invest in more affordable services, but unfunded mandates lack credibility as a policy instrument. Consequently, if universal access obligations are to be employed to address inequities in access, then funding mechanisms must be developed that provide a viable basis for cross-subsidizing the provision of affordable access to essential services, especially in high-cost and low-income communities. Questions regarding the mechanisms for collection and distribution of public funds needed to address coverage, capacity and affordability gaps also represent an important area of debate in countries considering the adoption of universal access obligations.⁵¹ It is worth noting that minimum service standards and future aspirational targets are not mutually exclusive, and in fact both can be utilized to balance short- and long-term basic service objectives.

Private-sector strategies

The impact of various public policy instruments on affordability is likely to depend to a large degree on the characteristics of particular markets, as well as on how committed policymakers are to pursuing potentially conflicting policy objectives, such as pricing discipline and investment incentives as they relate to dominant operators. Understanding private-sector approaches to delivering affordable services, and the ways they evolve in response to demand conditions, is critical for evaluating public policy options for achieving affordability as a legal objective. Private-sector strategies relevant for the provision of affordable access to those with lower incomes include the following:

- **Pricing strategies:** The most common private-sector approach to improving the affordability of a particular service is for a firm to reduce the prices it charges its customers. Incentives for particular sellers to do so depend on the price elasticity of demand shown by consumers for a particular service (among other factors such as the degree of actual or potential competition). In the first stage of the market penetration of a communications platform, early adopters tend to be willing to pay a premium for the luxury of access to satisfy their subjective preferences, making demand relatively price-inelastic. This tendency limits the incentives of sellers to reduce their prices to improve the affordability of what is a luxury for the few.

⁵⁰ At the time of writing the CRTC's review of basic telecommunications services (TNC CRTC 2015-134) was underway. Although adoption of binding universal access obligations has remained limited, many advanced economies have been exploring the need and potential costs of adopting this policy strategy. See e.g. European Commission (2012) and Federal Communications Commission (2010).

⁵¹ In the Canadian context, the CRTC 2015-134 consultations have provided a wide range of perspectives on the operational elements of a universal service funding mechanism, with larger service providers arguing that any funds should be allocated from the federal budget, while consumer groups and rural municipalities have proposed developing an industry-funded mechanism.

This situation is currently prevalent in many low-income developing countries, where access is restricted to those with high incomes living in urban centres. Demand starts to become more price elastic beyond a 3-5% penetration threshold, which can enhance the incentives of some operators to reduce their prices in order to expand their market share as a means for recovering the fixed costs allocated to deploying their networks. Above penetration rates of 20% to 30%, however, elasticity of demand starts to decline as the service in question becomes a necessity for a larger proportion of the population. In maturing markets, where penetration rates start to reach a maximum threshold, demand becomes increasingly price-inelastic. In turn, the growing essentiality of a service tends to limit the incentives of service providers to reduce prices to enhance affordability in order to expand their market share. This pattern helps explain why affordability has emerged as a policy concern in countries that otherwise appear to be very advanced in terms of network adoption and use indicators.

- **Price variety:** Another fundamental private-sector approach to increasing affordability is to charge different prices for essentially the same good or service. Price discrimination becomes a feasible strategy in service industries particularly when: i) consumers attach different values to the same services; ii) there is limited scope for reselling and arbitrage; and iii) there are differentiated providers.⁵² Broadband markets in high-income countries tend to satisfy the first and second of these criteria. On the other hand, the extent to which differentiated providers have incentives to enter the market and meet the heterogeneous demand profiles of particular end-users can be limited by scale economies and structural dominance. Evidence on the range of prices available in high-income countries suggests that the degree of price discrimination varies significantly.⁵³ Recent research suggests that, in addition to the positive impact of income, education and speeds on demand, having a larger variety of service tariffs has had a significant and positive impact on broadband penetration.⁵⁴ Nevertheless, this result is based on a global

⁵² For an overview of the literature see Lambrecht et al. (2012). In neoclassical economic models, there is an implicit assumption that the choices about a tariff option and consumption level are made simultaneously, but in practice consumers are also uncertain about their own preferences, as are firms about those of consumers, and preferences can evolve over time. Uncertainty reduces consumer welfare relative to producer welfare. Different tariff regimes have distinct advantages and disadvantages for generating information/revealing preferences. Overall, consumers are uncertain about their demand, but learn about service quality and usage. New industrial organization models that emphasize the costly and asymmetric nature of information on the interface of supply and demand indicate that having different plans available in the market is not sufficient to ensure efficient price discrimination. For a notable example of how efforts to develop a pricing system that induces efficient price discrimination by the seller in order to make the service more affordable for buyers see discussion of the economic logic of the Google AdWords system in Varian (2012). In general, starting from a unique price, then moving to price discrimination economic theory predicts that i) “a necessary condition for welfare to increase is that total output increases”, and ii) “if the profitability of the new output exceeds that of the old output valued at the new prices then welfare must increase.” This theoretical perspective is particularly relevant in the context of discussion about broadband adoption in maturing markets where it is becoming increasingly difficult to increase total output, at least in terms of additional subscribers on the edge of the digital divide.

⁵³ See Table 4.1. of the OECD Broadband Statistics, available at: <http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm>

⁵⁴ See Haucap et al. (2015). Theoretically, the impact of price discrimination is ambiguous: In neoclassical industrial organization models price discrimination in the consumer market should lead to an expansion in output as it allows suppliers to serve low value consumers without reducing prices charged to high value ones. In the presence of information costs/bounded rationality/strategic management, on the other hand, consumers don't always have the right information and can make mistakes; sellers also don't always have the incentives to be truthful, potentially leading to too much confusion in the presence of too much variety/too many tariffs.

sample that includes both developing and high-income countries. In more mature markets where demand becomes inelastic, the incentives of operators to engage in price discrimination are likely to diminish, particularly with respect to low-cost offerings.

While further research will be required to better understand the determinants and consequences of price discrimination in maturing broadband markets, international data suggests that in mature digital economies such as those of Canada, the United States, the Netherlands, France, Norway and Iceland, low-cost options in the market tend to be relatively limited.⁵⁵ Although the higher incomes in these countries make communications and other basic services more affordable in general terms, the lack of low-cost options increases concerns about the ability of low-income groups to access services. As described later in this report, the evolution of broadband prices in Canada over the past few years provides a clear example of this wider trend.

- **Bundling and unbundling:** Broadband access to the Internet has become essential in part because broadband is inherently multipurpose, allowing end-users to access a wide range of services. Since building broadband networks involves large initial fixed costs, owners often have incentives to attempt to generate additional revenue from the sale of bundled complementary services, in many cases delivered over the same broadband networks (e.g. voice over IP telephone service, Internet protocol television).⁵⁶ Recent research shows that socio-economic factors have a strong influence on consumer choices about bundles, making them more attractive to high-income consumers.⁵⁷ Providing discounts on unbundled fixed and mobile data services might be a viable approach to improving service affordability for those with lower incomes who cannot afford to pay for services other than broadband access.⁵⁸ For example, users with disabilities such as hearing or vision impairments may not be able to access and use all the services they are offered in bundles, even though they may have to pay for these services in order to receive a discount (e.g. having to buy a mobile voice plan in order to obtain mobile data service).
- **Innovation:** Economic history suggests that in the long term, technological and business model innovations are likely to be the primary drivers of affordability and the commodification of goods and services that were once luxuries affordable to only a few.⁵⁹ In the communications industries, rapidly growing demand for network resources has created strong incentives for a wide range of technological innovations to help reduce costs and improve the quality of service on broadband

⁵⁵ Lower income OECD members such as Turkey, Portugal, and Slovenia tend to have the broadest range of prices in higher income countries. Table 4.1. OECD Broadband Statistics.

⁵⁶ Bundling can be viewed as an instrument for price discrimination (McAfee et al., 1989). Bundling has the potential to lead to sub-optimal consumer choices by limiting the incentives to consider sunk cost ex ante (Soman & Gourville, 2001).

⁵⁷ See: Srinuan et al. (2014), Üner et al. (2015).

⁵⁸ Feedback on bundling by low-income Canadians suggests that discounts are usually not significant, their purported benefits can be misleading, and they can allow service providers to lock consumers into long-term contracts for products customers do not necessarily require (Public Interest Advocacy Centre, 2015). Surveys from the UK lend some support to the affordability concerns raised about bundling in Canada, highlighting a positive correlation between bundling and tendency of lower income and older consumers to face problems paying for their services (Ofcom, 2014).

For evidence relating to the willingness of consumers to select among phone, TV, and Internet service as standalone products or bundles see Sobolewski & Kopczewski (2015).

⁵⁹ Schumpeter (1942).

platforms.⁶⁰ Cost reductions realized by deploying advanced technologies are likely to be the primary long-term driver for improving affordability and quality of access. In addition, over the past decade a wide range of efficiency-enhancing virtual control technologies has emerged that enable firms to share the fixed cost of deploying new technologies; allocate scarce resources such as spectrum more efficiently; and minimize the potential for inefficient duplication.⁶¹ A notable example of this approach in Canada concerns the arrangements among regional incumbents enabling them to enter certain market segments where another incumbent has a physical footprint so as to deliver nationwide services.⁶² The rapid growth in the utilization of mobile virtual network operators (MVNOs) in both advanced and developing countries (excluding Canada) represents a broader example of the capacity of new network virtualization technologies to enable the sharing of fixed costs. This growth also stimulates capital formation in deploying advanced mobile networks, while simultaneously improving their affordability.⁶³

Whether or not service providers in particular countries have incentives to engage in any of the private-sector strategies noted above depends on local market conditions, as well as on a variety of other firm-specific business considerations. In the long term, adoption of new technologies and efficiency-enhancing business models is likely to be the key driver in improving affordability and service quality. In the short to medium term, however, competition, and the industrial and universal access policies noted above, might be required for achieving affordability as a policy objective.

Inevitably, policy interventions involve risks and trade-offs. General-purpose competition policies, as well as those related to consumer protection and well-designed minimum standards, can promote affordability for large numbers of consumers. On the other hand, they can also generate credible threats of reduced investment by private-sector operators who fear that such policies will hamper their profitability. Subsidies for high-cost communities prone to market failures, and for low-income groups, may alleviate some of the concerns motivating proposals for the adoption of universal access obligations. But they will do little to improve competitive discipline and the affordability of services for the average consumer. Therefore, a balanced approach that includes both general policy instruments and targeted measures is likely to be needed for reducing affordability as an economic constraint on low-income consumers and those who live and work in high-cost areas prone to market failures.

The list of public- and private-sector approaches described above is not exhaustive (see Appendix for other examples of public-sector approaches). As the discussion emphasizes, the effects of public- and private-sector approaches on affordability are highly interrelated. If there were strong incentives for the private sector to adopt advanced technologies and deliver affordable services to both urban and rural communities, then industrial subsidies targeting rural under-investment and market failures would not be necessary. They could even entail redundancy and waste. In practice, however, this is not the case, since cost and revenue considerations mean that private-sector incentives to meet demand for network capacity in rural areas are less attractive than the incentives to invest in urban centres. Without public policies that encourage private-sector investment through a combination of inducement and threats, the magnitude of the urban-rural digital divide is likely to grow. This trend is a particular problem in the case

⁶⁰ In terms of delivering higher speed connectivity on both legacy copper and cable platforms, as well in terms of next-generation fixed fibre and 4G+ mobile networks.

⁶¹ See e.g. Juniper Networks (2015), Li et al. (2014), NEC (2013).

⁶² For example in terms of mobile or business access services. Details often these types of private arrangements are not publicly available.

⁶³ See Cricelli et al. (2012). Karippacheril et al. (2013), Kiiski (2006) and Kim & Park (2004).

of vertically integrated service providers, who can often earn higher rates of return on capital expenditures in many other types of ventures than they can from rural infrastructure projects. Similarly, if all service providers acted transparently in specifying price, quality and other key terms of the retail contract, and did not have competitive incentives to engage in abusive sales practices, consumer protection regulations would become superfluous. Consequently, a wide range of other factors that are not discussed in this review, including hard to quantify corporate cultural factors, can play an important role in determining whether it is in the public interest to implement particular policy measures.

In mature markets where demand for an increasingly essential service becomes price-inelastic, the extent to which operators offer low-cost options of sufficient quality can have an important effect on the affordability of access with respect to low-income adopters (i.e. the growing majority) and non-adopters (i.e. the shrinking minority) alike. This outcome leads to diminishing returns on gains in market share by lowering prices as a strategy, inducing dominant operators to increase prices and reduce price discrimination in the low-cost end of the market. In this context, wholesale access policies that encourage price and quality differentiation might be the most effective method for stimulating market forces in a manner that meets the needs of different classes of users, including those with low incomes. The literature suggests that although technological and business process innovations are likely to be the primary drivers of access to lower cost and higher quality broadband services, the design of both the public policies and private-sector business strategies outlined above will likely shape affordability as an economic constraint on consumers in the short to medium term.

3. The digital divide and vulnerable populations

Affordability is generally defined as a combination of pricing and income variables. Broad public- and private-sector strategies that help improve the affordability of communications services as described above have an impact on the pricing variables that go into defining and measuring affordability as one of the aspects of an evolving digital divide. Differences in income that shape affordability tend to mirror broader socio-economic divides at the global and local levels. To the extent that access to basic communications services such as the Internet helps enhance employment and income opportunities, public policies and private-sector strategies that reduce affordability as an economic constraint have the potential to counteract broader socio-economic disparities. As a policy objective, affordability of Internet access can be viewed as another manifestation of efforts to reduce gaps in opportunities for economic participation in societies with observed inequalities in outcomes.

In this section we focus on socio-economic divides in terms of affordability of access to broadband networks as enablers of voice, data, video, cloud and other ICT applications. Our analysis moves from global considerations to a discussion of policy instruments that have been proposed as a solution to the multifaceted digital divides that continue to disenfranchise many Canadians.

Global divides

As noted earlier, the UN Broadband Commission has conducted research on the extent of gaps in the affordability of Internet access at the global level and suggested that services in a particular country should be considered affordable when they cost less than 5% of average income.⁶⁴ This threshold is useful for offering a high-level benchmark for understanding the magnitude of the global digital divide in

⁶⁴ Broadband Commission for Digital Development (2013, 2014).

terms of affordability across the range of UN member countries. According to these estimates, broadband access represents less than 2% of average income in high-income countries, but costs more than 30% of average income in low-income developing countries.⁶⁵ Studies of the magnitude and evolution of the global digital divide in terms of the quality of service further highlight substantial gaps in the quality of service among higher and lower income countries.⁶⁶ Existing research has not identified substantive evidence to support the hypothesis that low-income countries have been catching up with high-income ones in terms of either affordability⁶⁷ or quality⁶⁸ of access to Internet connectivity.

As geographic coverage and penetration issues have been resolved, fixed and mobile broadband services have become more of a necessity for the majority in high-income countries. Attention has been turning accordingly to affordability and the application of minimum service standards. Beyond the basic fact that smaller gaps are easier to address, research on the intersection of supply and demand in the evolution of Internet connectivity indicates that significant differences in affordability of services persist, even among high-income countries. For example, affordability of service expressed as the additional incremental cost for 1 Mbps (i.e. for a faster connection) tends to be substantially lower in high-income economies that are further along in the transition to next-generation fibre (e.g. Japan and Korea) than in advanced countries where operators are lagging in the deployment of FTTP networks (e.g. U.S. and Canada).⁶⁹ Although further research is required, this evidence lends support to the hypothesis that in the long term, adoption of next-generation broadband technologies able to deliver ultra-fast symmetric connections will be critical for reducing quality-adjusted prices for consumers. It is not evident whether technological changes alone will be sufficient to improve consumer welfare across the existing socio-economic divides characteristic of certain countries.

Affordability thresholds such as the 5% share of income used by the Broadband Commission might be helpful in identifying the scope of the problem and monitoring progress across different countries. However, using such arbitrary thresholds in cross-country assessments of policy can create the misleading impression that affordability should not be considered a concern in high-income countries where, on average, broadband access costs less than 2% of average income. The impression left by macro-level affordability thresholds can conceal inequalities in the distribution of income within a particular population. It can also conceal the degree of price differentiation that ultimately influences the affordability of services from the perspective of consumers with low or no income.⁷⁰

Cost differences across the urban-rural divide also make macro-level affordability thresholds unhelpful, as private-sector incentives to build networks and compete for customers in high-cost markets tend to be limited compared to low-cost urban centres.⁷¹ Extending access in under-served communities to services that are closer to the quality and price available in urban areas is likely to require sustained public-sector commitments. Without such commitments, the business case for investing in rural network infrastructure is likely to lag behind low-cost urban centres, which could well exacerbate the magnitude of the urban-

⁶⁵ In terms of average subscription costs relative to average per capita Gross National Income(GNI).

⁶⁶ Rajabiun & Middleton (2014).

⁶⁷ Zhang (2013).

⁶⁸ Rajabiun & Middleton (2014).

⁶⁹ Bischof et al. (2014), Figure 10, p. 81.

⁷⁰ There is some evidence to suggest that inequality as measured by the Gini Coefficient has slowed broadband penetration growth (Zhang, 2013).

⁷¹ Satellite broadband services are available in rural and remote markets today, but these services are very expensive on a capacity-adjusted basis and are not as stable as fixed and hybrid fibre/wireless platforms in terms of connection quality.

rural digital divide. This problem is likely to affect not only developing countries where rural connectivity remains very limited, but also advanced economies where public subsidies and other policies have been used to stimulate private-sector incentives to extend access to some form of Internet connectivity. Utilizing macro-level affordability thresholds can lead to a large under-estimation of the scope of affordability as an economic constraint on high-cost and low-income populations. This discrepancy is particularly the case regarding affordability indicators based on average income measures for countries or regions where inequalities in wealth and opportunity are more pronounced.⁷²

Canadian divides

The evolution of the digital divide in Canada is broadly consistent with findings from international research showing that digital inequalities tend to mirror existing socio-economic disparities, but at the same time broadband Internet access helps overcome existing disparities.⁷³ Canada is a country where strong consumer demand for broadband resulted in rapid growth in penetration rates compared to many other high-income countries.⁷⁴ As a result, the causes and consequences of the digital divide in Canada have been a contested area of research for more than a decade. Early debates focused primarily on disparities in access to the Internet, digital literacy and the availability of relevant content.⁷⁵ Although some provincial governments (Alberta and British Columbia) had started to adopt their own strategies on access to affordable broadband, by the mid-2000s federal policymakers were also starting to recognize that market forces were not sufficient to resolve remaining gaps in rural coverage. The response was the implementation of a variety of infrastructure subsidy programs.⁷⁶

Since then, a combination of private- and public-sector investments has helped reduce Canada's digital divide in terms of the geographic coverage of broadband. But adequate bandwidth remains a concern in many rural parts of the country, including those that have received public subsidies in the past. In cases where private-sector incentives to reinvest in network capacity are not sufficient, the growing consumer demand for network resources can precipitate congestion on network facilities, which in turn degrades actual service quality levels (i.e. speeds) relative to the "best effort" rates specified in retail contracts between operators and subscribers. Where such private-sector incentives are limited because of high costs or low revenues relative to a provider's reservation rate of return on capital expenditures, this gap tends to get larger over time. If rural communities are to benefit from price/quality combinations approximating those on offer in low-cost urban centres, then it is likely that public subsidies and other private-sector inducements will be needed to contain the growth of supply-side bottlenecks.

As broadband coverage issues have been resolved, the policy issues stemming from the digital divide have increasingly shifted from the problem of rural coverage to the emerging problems of affordability and service quality, in both rural and urban Canada. While we focus in this report on affordability issues, it is worth noting that the price component of affordability indicators is best viewed on a quality-adjusted basis using fine-grained indicators of *actual* measured service quality (i.e. upload and download speeds, latency, etc.), rather than the rates advertised by service providers. Locally or nationally defined basic service standards and affordability thresholds offer benchmarks for mapping the capacity gaps that can

⁷² e.g. China, Russia, United States, most of sub-Saharan Africa and Latin America. See UN Human Development Indicators.

⁷³ See Ivus & Boland (2015), Longford et al. (2012) and Pant & Hambly (2014)

⁷⁴ OECD (2015).

⁷⁵ For an overview of early discussions see Howard et al. (2010).

⁷⁶ Rajabiun & Middleton (2013b).

be expected to affect the end-user experience. These standards can also help set priorities for the allocation of scarce public resources intended to resolve market failures.

Research on Canada's digital divide offers some insights into the emergence of affordability as a policy problem in broad terms, as well as with respect to subgroups of the population facing serious affordability constraints in accessing the communications services they require.⁷⁷ From a long-term innovation perspective, limited incentives to deploy FTTP networks in Canada are likely to pose a major barrier to making broadband usage more affordable on a quality-adjusted basis. As noted earlier, international evidence suggests that the transition from legacy DSL and cable broadband to fibre is likely to matter significantly in terms of affordability for higher speeds and improved network capacity. Relative to legacy platforms, end-to-end fibre connections offer vast improvements in capacity, speeds and symmetry, allowing the delivery of content and applications with a guaranteed minimum level of reliability. In addition to documenting the persistence of the digital divide, the literature has increasingly recognized that geographic network coverage is not in itself enough to ensure widespread access and use.⁷⁸

The research shows that broadband penetration rates continue to be substantially lower among low-income Canadians (e.g. 60% for the lowest income quintile versus over 95% for the highest income quintile). It also confirms the tendency of subscribers on low incomes to engage in fewer activities online relative to those with high incomes.⁷⁹ While lack of interest or low skill levels partially explain lower adoption and use among low-income individuals, cost remains a dominant motive for why low-income Canadians do not use the Internet.⁸⁰ Nevertheless, the growing essentiality of broadband and increases in the inelasticity of demand to price, along with country-specific factors, enable incumbent operators in Canada to charge prices that are higher than offerings by their counterparts in most other advanced economies. International comparisons also suggest that the range of low-cost options available in the Canadian market tend to be relatively limited, meaning that low-income households are likely to have fewer affordable options in service plans than their counterparts in other advanced economies.⁸¹

Higher prices and the limited range of low-cost options in the Canadian market partly explain demand patterns noted in Table 2 above, showing that growth in expenditures on fixed and mobile access has been somewhat higher for the lowest income group than average. Growth in average per-subscriber broadband revenues has been increasing in Canada at around three times the rate of the general Consumer Price Index (CPI) over the past few years.⁸² This trend helps explain why affordability has grown as a policy concern.

⁷⁷ Landry & Lacroix (2014).

⁷⁸ McConnaughey et. al (2013).

⁷⁹ See Haight, Quan-Haase & Corbett (2014). They also found that "recent immigrants to Canada are significantly less likely to have internet access; however, among those online they have a higher level of online activity than earlier immigrants and Canadian born residents." (p. 515). As this research is based on data from the 2010 Internet Use survey the results may be somewhat dated.

⁸⁰ Statistics Canada (2013).

⁸¹ In other words, limited price discrimination on the lower cost end of the market. See Table 4.1. OECD. Broadband Statistics.

⁸² For the total sample collected by the CRTC CMR (2015), average monthly revenues have increased from 40\$ to 50\$ between 2010 and 2014. This implies an annual average growth in access prices of over 6% per year. Since 2010 average broadband price growth rates in Canada have been 3 times the general inflation rate in terms of the Statistics Canada's estimated of the general Consumer Price Index (CPI), which has increased at a rate of around 2% over the same period.

Moreover, data on the evolution of service provider revenues compiled by the CRTC since 2010 provides evidence of significant price increases in broadband plans offering low speeds at relatively low cost. Per-user revenues for plans at the low end have been increasing, while those for faster services have remained steady.⁸³ Indeed, the Canadian experience indicates there has been a significant growth in prices for relatively lower cost packages in the market, with per-subscriber revenues across service tiers with very different advertised speeds converging at around \$50 per month for fixed broadband Internet services and around \$60 for faster services (≥ 50 Mbps advertised speeds) and mobile plans.⁸⁴ This trend supports the hypothesis that the growing essentiality and declining price elasticity of demand in maturing markets such as Canada create incentives for dominant operators to reduce price differentiation at the low-cost end of the market, especially once penetration rates start to reach a maximum threshold. Reduced price differentiation in both fixed and mobile access services partly explains why their affordability for low-income vulnerable populations has emerged as a policy concern.

The dramatic reduction in broadband pricing variety in Canada is consistent with more general concerns about the rapid growth rate of retail prices, providing justification for public policies intended to improve the affordability of broadband services. At the same time, the rising price levels in the low-cost segment of the market will likely make it harder to induce non-adopters to pay for and use the Internet as a basic communications platform.⁸⁵ Rising prices and declining variety in service plans suggest that dominant operators in the Canadian market are both willing and able to increase average prices and to reduce pricing variety, as fixed and mobile connectivity becomes more and more essential for participation in social, cultural and economic activities.

Given its multifaceted nature and continued relevance to consumers, affordability has been increasingly raised as an issue by researchers and stakeholder groups in debates about the design of Canada's federal regulatory strategy. Affordability has also been an issue in a wide range of debates before the CRTC over the past few years, including discussions on the effectiveness of the wholesale regulatory framework in promoting incentives to invest in FTTP networks; adoption of codes of conduct aimed at empowering consumers; accessibility of services by Canadians with disabilities and those that live in high-cost communities; and, most recently, in the context of basic service consultations in which

⁸³ Revenue performance indicators compiled in Table 5.3.6 of the 2015 CRTC Communications Monitoring Report (CMR) illustrate that average revenues from packages with relatively low advertised speeds (1.5 to 4 Mbps) grew from 34\$ per month in 2010 to 48\$ in 2014. In contrast, reported monthly revenues for service packages with advertised rates of 16 to 49 Mbps in terms of download speeds remain at around 52\$ according to this data. Please note that these prices exclude modem rentals and potentially other ancillary fees. They are also based on "best effort" rates service providers advertise, rather than actual speeds they deliver. Since actual speeds can be substantially lower than up to xMbps rates specified in retail contracts, future data collection efforts that associated total revenue (including all subscription, modem, overcharges, and other hidden fees) with measures of actual speeds (and potentially other indicators of service quality) end users experience on congestible broadband networks (i.e. in peak traffic periods between 6-12 PM).

⁸⁴ The CRTC CMR 2015 data indicates price differences in terms of services across urban and rural communities are not significant, but there are fewer low cost options in rural communities. Recent data illustrates that declining price variation across available service packages has also been a feature of the market for the provision of mobile services in Canada (CRTC CMR, 5015, Section 5.5.0, f).

⁸⁵ While some of the so-called non-adopters may not be doing so due to limited financial resources, digital literacy, or may simply not be interested, others may utilize mobile or public access points of access to conduct tasks that increasingly have to be completed online (e.g. public library, at the neighbours). Data collection efforts and future research will be required to decompose and better understand the complexity of this group and design policies that increase access and usage of non-adopters.

questions about the reclassification of broadband as an essential service are at the centre of the debate.⁸⁶

It is beyond the scope of this report to provide a thorough analysis of evidence compiled by stakeholders on affordability in these proceedings. Yet it is important to stress that the ways in which affordability is defined as an economic constraint shapes the kinds of public- and private-sector approaches that will be formulated for achieving affordability as a policy objective. In broad terms, stakeholder perspectives on affordability are associated with the two types of affordability constraints, as caused by high costs and low incomes respectively:

- **High costs:** Large operators that dominate the provision of fixed and mobile network access offer broadly similar prices across their coverage territories, which include both urban and rural areas. It may not, therefore, be immediately evident what affordability has to do with this element of Canada's digital divides. However, in an environment with rapidly growing demand for network resources by end-users, limited incentives to invest in network capacity and new technologies in high-cost areas mean that the actual service levels rural customers receive can be substantially lower than in urban centres, where private-sector incentives to reinvest in network capacity in response to demand are higher. In other words, on a quality-adjusted basis, rural customers with low incomes can end up paying the same price for a service with lower quality. While this discrepancy can be explained by inherent cost differences arising from geography, the statutory definition of affordability in Canada stipulates that federal policies should be designed in a manner that overcomes such rural and regional differences. The Canadian and international experiences suggest that public subsidies for access and transport capacity are likely to remain necessary for improving private-sector incentives to deliver affordable and sustainable broadband services to these communities.⁸⁷ The extent to which public subsidies translate into consumer welfare gains (i.e. superior price/quality combinations) in rural broadband infrastructure programs depends on the design of particular programs, including *ex ante* contractual and *ex post* monitoring of the performance that private partners actually deliver in return for receiving public subsidies in those communities.⁸⁸

Ex post monitoring is particularly important because improved network capacity also tends to increase consumer demand, which in turn can cause congestion and reduce actual service quality on broadband networks. This outcome can only be avoided if service providers are induced to reinvest a sufficient part of operating cash flows into further capacity growth.⁸⁹ Service providers tend to underplay this aspect of the digital divide by emphasizing advertised speeds, while lower levels of government are increasingly utilizing network measurement tools to map and target real-world coverage and capacity gaps in access and transport infrastructure at a

⁸⁶ See submissions to CRTC TNC 2012-557 on the wireless code of conduct, CRTC TNC 2013-551 on wholesale access and CRTC TNC 2015-134 regarding access to basic services focusing on retail market considerations.

⁸⁷ See McMahon et al. (2014). Submissions by The First Mile Connectivity Consortium (FMCC) and Eastern Ontario Warden's Caucus (EOWC)/(EORN) to the CRTC 2015-134 consultations provide a detailed analysis of challenges in extending fixed and mobile broadband access of sufficient coverage and quality in rural and remote communities.

⁸⁸ Rajabiun & Middleton (2013b). For a discussion of the international experience in design and delivery of least cost subsidy programs to improve affordable access in under-served communities see Wu (2014).

⁸⁹ Importantly, whether the urban-rural digital divide is mapped using advertised "best effort" or actual speeds delivered can have a significant impact on perceived scope of private sector incentives to invest in relatively high cost, low return, and low income rural and remote communities.

disaggregated level.⁹⁰ Since lower levels of government have limited resources for digital infrastructure development, investment by higher levels of government that improve the private-sector business incentives to reinvest in rural connectivity will continue to remain essential for ensuring the scope of the urban-rural digital divide does not widen.

- **Low incomes:** To the extent incomes in rural and remote communities tend to be lower than in urban centres, public policies and business ventures that improve affordable rural connectivity may resolve some of the concerns about the affordability of access.⁹¹ They will not, however, resolve the needs of other vulnerable groups in rural communities.⁹² Furthermore, roughly 20% of Canada's population live in rural communities, whereas the majority of low-income individuals live in urban centres. Thus, supply-side policies intended to stimulate private-sector investments in improving network coverage and capacity in rural communities are not likely to be sufficient to reduce affordability constraints on the low-income vulnerable groups that span the urban-rural digital divide. In terms of the impact of low incomes on the adoption and use of communications services, Canadians with disabilities have been one of the main constituencies to emphasize the importance of affordability in the design of communications and broadcasting policy in Canada.⁹³

There are two main reasons for the sharp interest of the disabilities community in affordability, which helps demonstrate the complexity of the problem. On one hand, the development of accessible ICTs opens a wide range of opportunities for persons with different types of disabilities to engage in social and economic activities.⁹⁴ Nevertheless, having a disability is itself a major factor in unemployment and low income. Individuals with severe and very severe disabilities report median incomes that are only about half of those reported by individuals with moderate disabilities or without a disability.⁹⁵ Persons with disabilities may be more willing to pay for higher quality services because of the value these services provide, but having low (or no) disposable income makes it challenging to afford these services. Private-sector practices such as data caps, throttling third-party services and the offer of discounts only on service bundles (some components of which may be unusable by persons with particular disabilities) impose further affordability barriers. Unbundling strategies by operators that allow individuals to pay only for services they actually want and can use, such as data-only mobile subscriptions and pre-paid plans, have the capacity to resolve some of the affordability concerns for those with disabilities, or low incomes in general. Unbundling allows low-income consumers to make choices about what

⁹⁰ Regional associations of municipalities in Eastern and Western Ontario have been relatively active in developing institutional capacity needed to identify gaps in fixed and mobile broadband infrastructures that are available to residents, businesses, and visitors. See <https://www.eorn.ca/en/index.asp> ; <http://swiftnetwork.ca/>

⁹¹ For example, affordability of access to data services by higher income households, businesses, and public sector organizations in rural communities.

⁹² Such as students from low income families. See submission by the Elementary Teachers' Federation of Ontario (ETFO) to CRTC 2015-134 consultations. Rural infrastructure subsidies also improve the affordability of broadband as a business input, for instance into old industries such as agriculture and tourism, as well as in new businesses requiring connectivity. To the extent that broadband translates into higher wages and new jobs in under-served rural and remote communities, it can further enhance its affordability by increasing incomes.

⁹³ Media Access Canada (MAC)/Access 2020 Coalition of Disabilities Stakeholders (2015a).

⁹⁴ The example of video calling for those with hearing impairments to operationalize sign language represents a notable example of relatively high demand for network resources, symmetry, and service quality required in utilizing applications that enable those with disabilities. A variety of other assistive, educational, and otherwise enabling technologies safety and security are now available that are also network intensive and increasingly require symmetric connectivity speeds and minimum service level guarantees to be utilized in a safe and reliable manner.

⁹⁵ Media Access Canada (MAC)/Access 2020 Coalition (2015b).

services to procure with their limited resources that meet their individual needs and preferences. Public policies that encourage private-sector price differentiation and unbundling, so that low-cost options of sufficient quality are on offer, are likely to have the greatest impact in terms of affordability improvements for low-income adopters and non-adopters alike.

Nevertheless, such policies are unlikely on their own to ensure sufficient service quality is available at an affordable price to the most vulnerable individuals, such as those with severe disabilities or children growing up in low-income households who need Internet access at home to study. This recognition has led to proposals for an industry-funded subsidy mechanism to help cover some or all of the hardware and services needed to ensure persons with severe or very severe disabilities and very low or no incomes can participate in the digital economy.⁹⁶ Advocacy groups with a broader consumer interest mandate have also been emphasizing concerns about affordability over the past few years.

For example, a coalition of consumer advocacy groups working under the umbrella of the Public Interest Advocacy Centre (PIAC)/Affordable Access Coalition (AAC) have studied the problem of affordability for low-income Canadians, which has led them to call for adoption of a multipronged cross-subsidy mechanism intended to resolve both rural market failures in infrastructure deployment and affordability concerns for low-income populations.⁹⁷ Other stakeholders have highlighted the relatively high prices and lack of price discrimination on the low-cost end of the Canadian market for Internet access services, recommending the adoption of a basic service package for fixed and mobile access that ensures all consumers are able to access a minimum level of service at a price the CRTC considers appropriate.⁹⁸ The CRTC itself has recently adopted this approach to addressing affordability concerns in respect to television broadcasting services by mandating regulated entities offer any customer a basic service package at a specified price/quality combination.⁹⁹

Based on CRTC data collection efforts in this area, Section 1 above (Table 1) demonstrates that Canadians in the lowest income quintile tend to allocate a substantially larger proportion of their income to communications services than middle- and high-income households (two times more than middle quintile and four times more than highest income quintile). This fact suggests communications resources represent an economic necessity in general terms. Furthermore, Table 2 documented that expenditures on fixed and mobile Internet access by the lowest income group have been growing faster than for high-income groups over the past few years, an observation that can be readily explained by data on the evolution of price levels and reduced price discrimination in the market discussed in the previous section. We hypothesized that these observations indicate that fixed and mobile broadband access have already

⁹⁶ Although social assistance to those with severe disabilities varies across provinces, average income across the country for this group is around \$10,000 per year. Given an average broadband monthly subscription price of \$50, an individual would have to spend over 5% of their income just on fixed broadband access. Adding mobile and broadcasting would reduce affordability of communications services substantially less affordable than this threshold. Please note that disabilities tend to be more prevalent among older adults and women, so addressing affordability consideration from a disabilities perspective has the potential to also address other aspects of the multifaceted digital divide in terms of affordability of access.

⁹⁷ Public Interest Advocacy Centre (2015) and submission by the Affordable Access Coalition to CRTC 2015-134 proceedings.

⁹⁸ This proposed approach is similar to the approach taken by the CRTC in addressing affordability concerns for access to basic TV services, but for fixed and mobile broadband access. See OpenMedia submission to CRTC 2015-134 consultation process. OpenMedia has also called for a structural separation mandate and mandated MVNOs in order to improve affordability of fixed and mobile services.

⁹⁹ In this context, “quality” represents the set of channels on offer for the price in the mandated “skinny basic” TV package. See Broadcasting Regulatory Policy CRTC 2015-96.

become an essential resource, or an economic necessity, the affordability of which merits policy attention. Evidence compiled by PIAC/AAC affordability stakeholders supports this hypothesis by showing that, much like those with high incomes, low-income Canadians perceive both fixed and mobile access as essential, and some have to cut back on expenditures on other essential services such as food, clothing and healthcare to pay for Internet access.

Using data on low-income consumers on the verge of bankruptcy, PIAC/AAC's research indicates that limited capacity to pay induces consumers with low incomes to cut back on the range of services they pay for. While it would cost those in the lowest income group on average 16% of their income to purchase all four telecommunications services (phone, TV, mobile, fixed Internet), in practice they spend around 8% of their incomes on communications services.¹⁰⁰ In the presence of tight budget constraints, the revealed preferences of low-income consumers appear to be stronger for keeping fixed and mobile access over legacy phone and TV services. This trend is consistent with the hypothesis that broadband services have become an essential resource even for those living in poverty, while a separate home phone and traditional TV subscriptions are becoming luxuries that only the more affluent can afford. The extent to which those with lower incomes can forgo these luxuries, among other factors, will depend on the extent to which they can obtain broadband services of sufficient quality and capacity at a price that is not too exacting on the limited budgets they have for procuring basic communications services and other necessities.

4. Findings and recommendations

This report was commissioned by the CRTC in order to provide a review of the literature on affordability in the communications industries, with a particular focus on broadband Internet connectivity in Canada. Section 1 outlined various approaches to defining affordability, including its construction as both an economic constraint on consumption and a legal policy objective. The international experience suggests that affordability remains a particularly pernicious problem for adoption in developing countries, but that it has also grown as a policy concern in a number of high-income countries, where the vast majority already rely on fixed and mobile broadband. Section 1 further discussed different approaches to measuring affordability as an economic constraint and evaluating policy instruments that could be employed to mitigate its effects. Section 2 provided an overview of various public- and private-sector strategies for improving affordability relevant for communications and other industries. Section 3 reviewed the literature and data on affordability as an element of the digital divide globally and in Canada. The CRTC also asked us to “highlight analytical approaches and practices best suited to use in the Canadian communications industries”, including “recommendations on how to define affordability, including appropriate parameters and indicators.”

Given that affordability is stipulated as an explicit policy objective under both the *Telecommunications and Broadcasting Acts*, assessing which approaches are best suited to Canada is at least in part a matter of the legal interpretation of competing objectives in these statutes, which is beyond the scope of this report. The perceived magnitude of affordability gaps and the level of commitment to equality of opportunity for vulnerable groups also influences which analytical approaches, indicators and policy instruments are considered appropriate for measuring affordability as an economic constraint and for reducing such constraints as a policy objective. Similarly, political commitments to providing equal opportunity for all

¹⁰⁰ See PIAC (2015). Page 74, Table 9. Table 1 of this report above, Section 1.

citizens to access essential resources such as Internet connectivity are difficult to assess and beyond the scope of this report.

What is clear from the literature is that there are significant differences in how affordability functions as an economic constraint in developing countries, where access to the Internet remains a luxury for most people, compared to high-income countries where it has become a necessity for the vast majority of the population. While rising penetration rates in developing countries may indicate that services are becoming more affordable for a larger number of people with low incomes, in advanced economies such as Canada, where fixed and mobile penetration rates are reaching a maximum threshold, high penetration rates do not necessarily imply that affordable services of sufficient quality are available to those with low incomes or those living in high-cost areas.

In developing countries, aggregate broadband and mobile penetration rates may represent an informative indicator of affordability; in mature markets, however, they become increasingly uninformative as indicators of market outcomes or policy effectiveness. Furthermore, in the presence of usage-based pricing, employing penetration rates as a proxy for affordability can be thoroughly misleading, since low-income subscribers can restrict their use of the Internet because they consider additional usage as unaffordable. Despite the fact that affordability may represent a barrier to adoption in maturing markets that can be addressed through particular policy measures, penetration rates become increasingly uninformative as an indicator of affordability when assessed as a barrier to broadband access and use, which now serves as the basic platform for the consumption of thousands of different ICT applications and services.

This observation is particularly relevant in communications policy design when we consider that affordable access to high-capacity and high-quality services (i.e. unlimited vs capped, with high upload and download speeds, low latency, etc.) enables low-income users to reduce their spending on legacy voice and broadcast services, thereby reducing their expenditures on communications and media services overall. This type of “cord cutting” has the potential to improve affordability by dramatically reducing the costs of communications services for low-income users who cannot afford the luxury of, for example, a separate home phone or ultra-HD television service. The inexorable trend away from separate, free-standing delivery platforms to convergence on IP networks has the potential to substantially reduce affordability as an economic constraint. At the same time, this benefit to end-users poses a risk to the revenue streams that the operators may be able to generate from their infrastructure through service bundling, since that allows customers who do not want or cannot afford premium bundles the option to pick and pay for services that meet their individual preferences.

Wholesale access and retail policies that enhance private-sector incentives to offer a wider range of prices on the low-margin service packages, and to unbundle their offerings, are likely to have an impact in terms of improved affordability on a larger number of low-income consumers. However, these policies will not necessarily resolve affordability constraints associated with the higher cost of provisioning rural network infrastructure and limited competition. Infrastructure subsidies that stimulate private-sector incentives to build and deliver affordable services of sufficient quality will remain relevant for ensuring that the urban-rural digital divide does not widen in the medium to long term.

Furthermore, broad competition and consumer protection policies that help improve the range of low-cost options in the market, and inform consumers about what they are paying for, are not likely to be sufficient for mitigating affordability constraints on the most vulnerable segments of the population, such as persons with severe disabilities, children from low-income households and marginalized ethnic groups. Tax credits may help improve affordability of access for the working poor, but they will not benefit those with very little

or no income. Some form of targeted demand-side subsidies, for instance using vouchers or targeted discounts, are likely to be necessary for reducing affordability as an economic constraint on the ability of the most vulnerable groups to participate in the full range of social and economic activities.

The literature typically measures affordability as the proportion of income that consumers have to spend to procure particular goods and services. The level and range of prices, distribution of income, penetration rates of particular technologies, service quality levels and other indicators of market outcomes can also provide informative signals about the nature of affordability as an economic constraint on access to and use of broadband networks. Given the challenges in accessing reliable household consumption surveys, the levels and structure of prices and revenues represent a relatively simple leading indicator of affordability. Exogenous factors with an adverse impact on employment and wages, or other shocks that increase income inequality, will also affect the ability of vulnerable groups to pay for necessities such as communications services.

In terms of concrete affordability thresholds and indicators, the available data indicates that low-income Canadians allocate a substantially larger proportion of their income to communications services, but at the same time ration the range of services they pay for in order to reduce the overall burden on their budgets. If we assume that fixed broadband and mobile online services represent functional substitutes for legacy voice and broadcasting, this pattern provides some explanation of the expenditure growth patterns outlined above in Table 2. Prices and revenues for Internet subscriptions have become less varied over the past few years, converging to around \$50 for fixed Internet and \$60 for mobile per month. It is therefore reasonable to assume that a consumer requiring access to the two services has to allocate roughly \$1,200 per year to the purchase of the broadband services that enable them to forgo legacy phone and TV subscriptions.¹⁰¹ Based on the standard 5% expenditure share of the income affordability threshold level used by the UN Broadband Commission and some stakeholders in Canada,¹⁰² then those with incomes below \$24,000 per year would find basic communications services unaffordable.¹⁰³ It is important to keep in mind that this threshold income level is substantially higher than the annual average income level for the lowest income quintile of around \$18,500, which indicates that a significant proportion of Canadian households in the lowest income quintile fall well below this threshold level of affordability. Some of these may be non-adopters with little interest in participating in the digital economy, while for others affordability is likely to pose a substantive barrier to both adoption and use of broadband as a platform for connecting to the services and applications that meet their individual needs.

Given the decline in price variation of low-cost connectivity options available for low-income Canadians, as well as the rapid growth in expenditures on connectivity by this group over the past few years, we do not find it surprising that affordability has become an issue for many stakeholders and policymakers. On one hand, the growing essentiality of these services makes them relatively price-inelastic, while on the other, service-based competition remains limited in both fixed and mobile markets. There is therefore little reason to expect that, at least in the short term, market forces will evolve in a manner that mitigates affordability as an economic constraint on low-income adopters and non-adopters alike. In the long term,

¹⁰¹ This number would of course be higher in the case of households with multiple users, or if a particular user requires higher than average bandwidth and service reliability. Consequently, with these estimates we are only sketching a minimum affordability threshold for reference.

¹⁰² PIAC/AAC (2015) have proposed an affordability threshold of between 4-6% for Canada.

¹⁰³ If we were to exclude mobile access from the basket and consider fixed broadband as a necessity, then the corresponding minimum income level for affordability at the 5% threshold would be half of \$24,000, or \$12,000 per year. To equate broadband affordability for low income Canadians to average affordability rates of 2% for advanced economies as estimated by the UN Broadband Commission, then relevant minimum income level given price and income profile of Canada would be \$30,000.

the evidence from economic history and the evolution of broadband networks in advanced economies indicate that technological upgrades to next-generation fibre networks are likely to be the primary driver for improving affordability on a quality-adjusted basis. Between these short-term constraints and long-term technological imperatives, the various public- and private-sector strategies outlined in Section 2 can be considered potential instruments for mitigating affordability as a constraint on the adoption and use of communications services by those with very limited or no income.

Appendix

Examples of public sector affordability initiatives in other sectors and jurisdictions

Private-sector providers of necessities and luxuries alike have some incentive to promote affordability through “sales,” allowing goods and services of high value to be purchased at a price that is purportedly affordable. Discounts for youths and seniors represent common examples of these private-sector strategies that try to enhance demand by improving its affordability. Yet in practice, these so-called market forces are not always sufficient to mitigate affordability as a constraint on procuring goods and services that are now considered essential in advanced economies. The existence of market failures in terms of affordable access has led to the development of a wide variety of public sector initiatives that aim to reduce affordability as an economic constraint on those with limited means to access services that enable them to overcome existing socio-economic disparities.

While the main focus in this report has been on issues of affordability in communications particular attention to Canada, public-sector initiatives that aim to improve the affordability of necessities such as food, shelter, education, healthcare, transportation and utilities such as electric power are common in high-income countries and across Canada. Different levels of government have developed programs intended to enhance affordability of access to goods and services considered essential, covering some or all of these sectors. These initiatives can differ widely in their design, scope and implementation.

The various models can be viewed in terms of their three primary features: the nature and mandate of the organization supporting a given program; how this organization raises resources needed to achieve its objectives, and the criteria used to identify recipients, establish eligibility, and allocate the subsidies intended to reduce affordability constraints on vulnerable individuals and groups.

As for the organization undertaking particular initiatives, affordability programs may be operated by different levels of governments; arm’s length agencies like regulatory tribunals; and public or semi-public utilities such as power and transport providers. In Canada, besides federally supported initiatives, most public-sector affordability initiatives are supported and provided by provincial and municipal governments, which are ultimately responsible for delivering social and business infrastructure under Canada’s constitutional arrangements.

In terms of eligibility, many established programs use criteria based on individual or household income, sometimes in combination with household composition (especially number of persons in household). As an alternative to the use of income, some programs use proxies, i.e. eligibility for another social assistance program such as school lunches or medical care. A further criterion that may overlap with income or proxies is membership in a designated class, such as residents in rural and remote areas; seniors over a certain age threshold; and employment and disabilities status.

Some illustrative examples and links to some relevant programs and proposals are provided below.

Universal Service Fund (USF) in the United States

The Universal Service Fund (USF) in the United States is a long-established program introduced in 1985, which remains at the centre of funding efforts by the federal government to address market failures in the provision of basic communications services. The USF supports four separate assistance programs: Connect America Fund, Low income (Lifeline), Rural health care, and Schools & Libraries Program (E-Rate). Recently, the Federal Communications Commission (FCC) has been reviewing the Lifeline program and assessing if subsidies devoted almost exclusively to landline voice telephone service should be redirected at least in part to making residential broadband connectivity affordable to many of the same citizens who benefit from the original programs. At this writing, the regulatory review of the Lifeline program undertaken by the FCC has reached the stage at which a draft order is under consideration by the Commission. The order in question - *Rules to Modernize Lifeline Program to Provide Affordable Broadband for Low-Income Americans* - incorporates several changes to the original Lifeline framework.

The Lifeline program uses proxies for eligibility criteria in place of means testing based on income. Five social assistance programs have been so used to determine eligibility. These are: SNAP, the Supplemental Nutrition Assistance Program; SSI or Supplemental Security Income, a United States government program for low-income people who are aged 65 or older, blind, or disabled; Medicaid, a program for families and individuals with low income and limited resources; Veterans Pension, for veterans of the US Armed Forces who did not qualify for military retired pay; and Tribal programs, which give federally recognized Indian tribes the flexibility to design welfare, jobs and child welfare programs.

<https://www.fcc.gov/general/universal-service-fund>

Cross-sector programs and price concessions in Australia

Australia is one jurisdiction in which pursuing affordability objectives in telecommunications is shared across separate public- and private-sector programs, through the central government and Telstra. The Canberra authorities provide a telephone allowance to subsidize the cost of both voice and Internet service, based on whether a citizen receives certain income support payments, including disability pension, single parent payment, widow allowance and youth allowance.

<https://www.humanservices.gov.au/customer/services/centrelink/telephone-allowance>

Independent of this government program, incumbent service provider Telstra has implemented its own set of corporate programs for subscribers who meet particular eligibility criteria. Its Community Programs cover several classes of subscribers: Access for Everyone, for those who are, for example, unemployed or undergoing financial hardship, as well as programs for the disabled, indigenous Australians, seniors and those living in remote or rural areas.

<https://www.telstra.com.au/aboutus/community-environment/community-programs>

Telstra's Financial Hardship Policy sets out solutions for recipients who may be having difficulty paying their telephone bill.

<https://www.telstra.com.au/aboutus/community-environment/community-programs/adversity-financial-hardship>

Despite these public and private initiatives, affordability of access for low-income vulnerable populations in Australia remains a concern. The magnitude of these affordability gaps has led for calls on the federal government to mandate a discount system for broadband access to those with limited means, such as discounts on essential utilities under the regulatory authority of lower levels of government.

See: South Australian Council of Social Service (2015). Sacoss Cost of Living Update No. 22 March Quarter 2015. <http://www.sacoss.org.au/new-report-calls-concession-re-think-telecommunications>

Competition policy and mandates in the United Kingdom

Having imposed a structural separation mandate on the incumbent operator, the U.K. has tried to promote affordability of access to fixed and mobile services primarily by promoting competition. Ofcom, the U.K. communications regulator, launched its Strategic Review of Digital Communications in March 2015. It is mainly concerned with issues directly affecting consumers, such as ensuring better quality of service from network operators, as well as better broadband and mobile coverage; the introduction of automatic compensation for subscribers; and making switching providers easier for mobile customers. Ofcom is explicitly mandated under its enabling legislation to further the interests of citizens in relation to communications matters, and to further the interests of consumers in relevant markets, where appropriate by promoting competition.

<http://media.ofcom.org.uk/news/2016/digital-comms-review-feb16/>

Affordability programs in other sectors

In the case of other essential services, both provincial and municipal governments, as well as utilities and other service providers, have developed a wide variety of programs intended to support affordability of access to necessities by low-income vulnerable populations. Such programs are especially prominent in the provision of electric power, water and housing.

In Toronto, for example, the utility operator Toronto Hydro operates the Low-Income Energy Assistance Program (LEAP), which was developed by the Ontario Energy Board (OEB) to assist low-income customers with their energy bill payments. Unlike continuing subsidies typical of universality programs, LEAP provides a one-time annual grant of up to \$500. Toronto Hydro funds the program through its customer rates. The eligibility criteria for LEAP combine three factors: after-tax household income; household size tabulated against income; and receipt of either a past due bill or disconnection notice from Toronto Hydro.

<http://www.torontohydro.com/sites/electricsystem/corporateresponsibility/pages/lowincome.aspx>

Most hydro-electric utilities also offer subsidies, rebates or other support intended not only to assist customers experiencing financial hardship, but also to promote lower energy consumption and environmentally friendly practices. For example, Manitoba Hydro offers its Power Smart Affordable Energy Program that is intended for both homeowners and renters on limited incomes who may otherwise assume that energy-efficient upgrades are too costly or difficult. As with the Toronto Hydro program, eligibility is determined (aside from nature of the housing) by a maximum total household income level for specified household sizes.

https://www.hydro.mb.ca/your_home/affordable_energy/

Comprehensive provincial programs

At the provincial level, most government-sponsored affordability programs are offered as part of a wide range of services for many different categories of recipients. In British Columbia, for example, the government provides a comprehensive guide to social assistance programs, many though not all of which are provincially financed. The aim of the BC programs is not necessarily to ensure affordability, since some are designed, for example, to help secure employment for out-of-work recipients. The BC programs include assistance for housing, transportation and food security, as well as a number of social assistance programs such as child care, skills training, student loans, support for persons with disabilities, resources for seniors and health care. Eligibility for any of these programs is determined by level of income as reported on annual tax returns.

http://www.mcf.gov.bc.ca/supporting_affordability/

Multilevel programs: Affordable housing

For federal, provincial, and municipal governments in Canada the provision of affordable housing has led to the development of a wide range of programs that aim to improve affordability.

<https://www.cmhc-schl.gc.ca/en/inpr/afhoce/fuafho/iah/afhopracca/>

Bibliography

- Affordable Access Coalition. (2015). *Phase 1 Invention Regarding Telecom Notice of Consultation CRTC 2015-134 Review of Basic Telecommunications Services*. Available at: <https://www.piac.ca/wp-content/uploads/2015/07/Affordable-Access-Coalition-TNC-2015-134-14-July-2015-FINAL.pdf>
- Ayanso, A., & Lertwachara, K. (2015). An Analytics Approach to Exploring the Link Between ICT Development and Affordability. *Government Information Quarterly*, 32(4), 389-398.
- Belloc, F., Nicita, A., & Rossi, M. A. (2012). Whither Policy Design for Broadband Penetration? Evidence from 30 OECD Countries. *Telecommunications Policy*, 36(5), 382-398.
- Bischof, Z. S., Bustamante, F. E., & Stanojevic, R. (2014). Need, Want, Can Afford: Broadband Markets and the Behavior of Users. In *Proceedings of the 2014 Conference on Internet Measurement* (pp. 73-86). ACM. Available at: <http://conferences2.sigcomm.org/imc/2014/papers/p73.pdf>
- Broadband Commission for Digital Development (2013). *The State of Broadband 2013: Universalizing Broadband*. Geneva: ITU/UNESCO. Available at: <http://www.broadbandcommission.org/Documents/bb-annualreport2013.pdf>
- Broadband Commission for Digital Development. (2014). *The State of Broadband 2014: Broadband for All*. Geneva: ITU/UNESCO. Available at: <http://www.broadbandcommission.org/documents/reports/bb-annualreport2014.pdf>
- Bruno, C. (2012). *Functional Separation and Economies of Vertical Integration in European Fixed Telecoms* (No. 03). Working Paper. HERMES Research Centre. Available at: http://www.hermesricerche.it/elements/WP_12_03_CB.pdf
- Cadman, R., & Dineen, C. (2008). Price and Income Elasticity of Demand for Broadband Subscriptions: A Cross-Sectional Model of OECD Countries. *SPC Network*. 19, 03-08.
- Calvo, A. G. (2012). *Universal Service Policies in the Context of National Broadband Plans*. OECD Digital Economy Papers, No. 203, OECD Publishing, Paris.
- Canadian Radio-Television and Telecommunications Commission (1996). *Telecom Decision CRTC 96-10: Local Service Pricing Options*. Available at: <http://www.crtc.gc.ca/eng/archive/1996/dt96-10.htm>
- Canadian Radio-Television and Telecommunications Commission (2012). *Telecom Notice of Consultation CRTC 2012-557: Proceeding to Establish a Mandatory Code for Mobile Wireless Services*. Available at: <http://www.crtc.gc.ca/eng/archive/2012/2012-557.htm>
- Canadian Radio-Television and Telecommunications Commission (2013). *Telecom Notice of Consultation CRTC 2013-551: Review of Wholesale Services and Associated Policies*. Available at: <http://www.crtc.gc.ca/eng/archive/2013/2013-551.htm>

- Canadian Radio-Television and Telecommunications Commission (2015a). *Telecom Notice of Consultation CRTC 2015-134: Review of Basic Telecommunications Services*. Available at: <http://crtc.gc.ca/eng/archive/2015/2015-134.htm>
- Canadian Radio-Television and Telecommunications Commission. (2015b). *Broadcasting Regulatory Policy CRTC 2015-96*. Available at: <http://www.crtc.gc.ca/eng/archive/2015/2015-96.htm>
- Canadian Radio-Television and Telecommunications Commission. (2015c). *Communications Monitoring Report*. Available at: <http://www.crtc.gc.ca/eng/publications/reports/PolicyMonitoring/2015/cmr.htm>
- Carare, O., McGovern, C., Noriega, R., & Schwarz, J. (2015). The Willingness to Pay for Broadband of Non-Adopters in the US: Estimates from a Multi-State Survey. *Information Economics and Policy*, 30, 19-35.
- CBC News (2016) "Wireless Rates Rise With Hikes In Internet, Home Phone Ahead" CBC News, Jan 19, 2016. Available at: <http://www.cbc.ca/news/business/telcos-rate-hikes-1.3410425>
- Conference Board of Canada (2015). From Landline to Mobile Broadband: Tax Drivers of Investment for Canada's Telecom Industry. Available at: <http://www.conferenceboard.ca/e-library/abstract.aspx?did=7567>
- Cricelli, L., Grimaldi, M., & Ghiron, N. L. (2012). The Impact of Regulating Mobile Termination Rates and MNO–MVNO Relationships on Retail Prices. *Telecommunications Policy*, 36(1), 1-12.
- Eastern Ontario Warden's Caucus (EOWC)/Eastern Ontario Regional Network (EORN) (2015). *Phase 1 Invention Regarding Telecom Notice of Consultation CRTC 2015-134 Review of Basic Telecommunications Services*.
- Elementary Teachers' Federation of Ontario (ETFO). (2015). *Phase 1 Invention Regarding Telecom Notice of Consultation CRTC 2015-134 Review of Basic Telecommunications Services*.
- European Commission (2012). *Broadband Availability and Affordability*. Luxembourg: Publications Office of the European Union. Available at: <https://ec.europa.eu/digital-single-market/en/news/broadband-availability-and-affordability-within-universal-service>
- Federal Communications Commission (2010). Connecting America: The National Broadband Plan. Washington, DC: FCC. Available at: <http://download.broadband.gov/plan/national-broadband-plan.pdf>
- First Mile Connectivity Consortium (FMCC) (2015.) *Phase 1 Invention Regarding Telecom Notice of Consultation CRTC 2015-134 Review of Basic Telecommunications Services*.
- Galperin, H., & Ruzzier, C. A. (2013). Price Elasticity of Demand For Broadband: Evidence From Latin America and the Caribbean. *Telecommunications Policy*, 37(6), 429-438.
- Haight, M., Quan-Haase, A., & Corbett, B. A. (2014). Revisiting the Digital Divide In Canada: The Impact of Demographic Factors on Access to the Internet, Level of Online Activity, and Social Networking Site Usage. *Information, Communication & Society*, 17(4), 503-519.

- Haucap, J., Heimeshoff, U., & Lange, M. R. (2015). The Impact of Tariff Diversity on Broadband Penetration—An Empirical Analysis. *Telecommunications Policy*. doi:10.1016/j.telpol.2015.09.005
- Houthakker, H. S. (1957). An International Comparison of Household Expenditure Patterns, Commemorating the Centenary of Engel's Law. *Econometrica, Journal of the Econometric Society*, 532-551.
- Howard, P. N., Busch, L., & Sheets, P. (2010). Comparing Digital Divides: Internet Access and Social Inequality in Canada and the United States. *Canadian Journal of Communication*, 35(1), 109-128.
- Humphry, J. (2014). *Homeless and Connected – Mobile Phones and the Internet in the Lives of Homeless Australians*. Sydney: University of Sydney and Australian Communications Consumer Action Network. Available at: <http://accan.org.au/grants/current-grants/619-homeless-and-connected-mobile-phones-and-mobile-internet-in-the-lives-of-families-and-young-people-experiencing-homelessness>
- Ivus, O., & Boland, M. (2015). The Employment and Wage Impact of Broadband Deployment in Canada. *Canadian Journal of Economics*.
- Juniper Networks. (2015). "Building Your Business Case for Network Virtualization". White Paper. Available at: <https://www.juniper.net/assets/us/en/local/pdf/whitepapers/2000612-en.pdf>
- Karippacheril, T. G., Nikayin, F., De Reuver, M., & Bouwman, H. (2013). Serving the Poor: Multisided Mobile Service Platforms, Openness, Competition, Collaboration and the Struggle For Leadership. *Telecommunications Policy*, 37(1), 24-34.
- Katz, R. L., & Berry, T. A. (2014). *Driving Demand for Broadband Networks and Services*. Switzerland: Springer.
- Kessides, I., Miniaci, R., Scarpa, C., & Valbonesi, P. (2009). Toward Defining and Measuring the Affordability of Public Utility Services. *World Bank Policy Research Working Paper Series*.
- Kiiski, A. (2006). "Impacts of MVNOs on Mobile Data Service Market." *17th European Regional ITS Conference*.
- Kim, B. W., & Park, S. U. (2004). Determination of the Optimal Access Charge for the Mobile Virtual Network Operator System. *ETRI journal*, 26(6), 665-668.
- Laffont, J. J., & Tirole, J. (2001). *Competition in Telecommunications*. MIT press.
- Lambrecht, A., Seim, K., Vilcassim, N., Cheema, A., Chen, Y., & Crawford, G. S. (2012). Price Discrimination in Service Industries. *Marketing Letters*, 23(2), 423-438.
- Landry, K. M., & Lacroix, A. (2014). *The Evolution of the Digital Divides in Canada*. Paper presented at the Telecommunications Policy Research Conference, Arlington, VA. Available at: <http://ssrn.com/abstract=2418462>
- Li, S., Huang, J., & Li, S. Y. R. (2014). Dynamic Profit Maximization of Cognitive Mobile Virtual Network Operator. *IEEE Transactions on Mobile Computing*, 13(3), 526-540.

- Longford, G., Clement, C., Gurstein, G., & Shade, L. R.. (2012). "Connecting Canadians? Community Informatics Perspectives on Community Networking Initiatives." In *Connecting Canadians: Investigations in Community informatics*, 3-34.
- McAfee, R. P., McMillan, J., & Whinston, M. D. (1989). Multiproduct Monopoly, Commodity Bundling, and Correlation of Values. *The Quarterly Journal of Economics*, 104(2), 371-383.
- McConnaughey, J. W., Goldberg, R. M., Neogi, P. K. & Brocca, J. (2013). "Digital Haves and Have-Nots: Internet and Broadband Usage in Canada and the United States." Paper presented at Telecommunications Policy Research Conference, Arlington, VA. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2241819
- McMahon, R., Hudson, H., & Fabian, L. (2014). The First Mile Connectivity Consortium and Digital Regulation in Canada. *The Journal of Community Informatics*, 10(2).
- Media Access Canada (MAC)/Access 2020 Coalition of Accessibility Stakeholders. (2015a). "Basic Services: Setting the Bar For Canadians With Disabilities." *Phase 1 Invention Regarding Telecom Notice of Consultation CRTC 2015-134 Review of Basic Telecommunications Services*.
- Media Access Canada (MAC)/Access 2020 Coalition of Accessibility Stakeholders. (2015b) Undertaking regarding Broadcasting and Telecom Notice of Consultation CRTC 2015-239, Review of the Structure and Mandate of the Commissioner for Complaints for Telecommunications Services Inc. in Response to Request for Information at the CRTC Oral Hearing Regarding the Size, Distribution, and Economic Resources of Canadians with Disabilities.
- Middleton, C. A. (2007). A Framework for Investigating the Value of Public Wireless Networks. Paper presented at the Telecommunications Policy Research Conference, Arlington, VA. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2118153
- Milne, C. (2006). "Improving Affordability of Telecommunications: Cross-Fertilisation Between the Developed and the Developing World." Paper presented at the Telecommunications Policy Research Conference, Arlington, VA. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2104397
- Milne, C. (2009). "Towards Defining and Measuring Affordability of Utilities—A Discussion Paper", Public Utilities Access Forum, UK.
- Mitomo, H. (2014). "Provision of Universal Broadband Service In Japan: A Policy Challenge Toward A Sustainable ICT Infrastructure." In 20th ITS Biennial Conference, Rio de Janeiro 2014: The Net and the Internet-Emerging Markets and Policies, no. 106846. International Telecommunications Society (ITS).
- Nakamura, A. (2013). Retaining Telecommunication Services When Universal Service Is Defined By Functionality: Japanese Consumers' Willingness-To-Pay. *Telecommunications Policy*, 37(8), 662-672.
- National Broadband Task Force (NBTF). (2001). "The New National Dream: Networking the Nation for Broadband Access." Available at: <http://publications.gc.ca/collections/Collection/C2-574-2001E.pdf>

- NEC. (2013). "RAN Sharing". White Paper. Available at:
http://www.nec.com/en/global/solutions/nsp/lte_sc/doc/wp2013-3.pdf
- OECD (2009). "The Role of Communication Infrastructure Investment In Economic Recovery." Available at: <http://www.oecd.org/sti/broadband/42799709.pdf>
- OECD (2015). Historical Penetration Rates, Fixed and Wireless Broadband, G7 (June 2015).
<http://www.oecd.org/sti/broadband/1.7-BBPenetrationHistorical-G7-2015-06.xls>
- OECD (2016). Broadband Statistics: <http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm>
- Ofcom. (2014). "Affordability of Communications Services Essential for Participation" (December 2014). Available at:
http://stakeholders.ofcom.org.uk/binaries/research/affordability/Essential_Comms_Services.pdf
- OpenMedia. (2015). *Phase 1 Intervention Regarding Telecom Notice of Consultation CRTC 2015-134 Review of Basic Telecommunications Services*. Available at:
https://openmedia.org/sites/default/files/openmedia-crtc2015-134-interventiontwo-final_0.pdf
- Pant, L., & Hambly, H. (2014). "Outcome Analysis of Rural Broadband Programs: A Study of Rural Small Businesses and Community Organizations Served By Phase One of the Eastern Ontario Regional Network—A High Speed Internet Initiative." *Queen's University, Kingston, Ontario: The Monieson Centre, Queen's School of Business*.
- Perkins, S. (2014). Cross-National Variations in Industry Regulation: A Factor Analytic Approach with an Application to Telecommunications. *Regulation & Governance*, 8(1), 149-163.
- Pike, R., & Mosco, V. (1986). Canadian Consumers and Telephone Pricing: From Luxury to Necessity and Back Again?. *Telecommunications Policy*, 10(1), 17-32.
- Public Interest Advocacy Centre (PIAC). (2015). "No Consumer Left Behind". A Canadian Affordability Framework for Communications Services in a Digital Age. Available at: <http://www.piac.ca/wp-content/uploads/2015/03/PIAC-No-Consumer-Left-Behind-Final-Report-English.pdf>
- Rajabiun, R., & Middleton, C. (2013a). Multilevel Governance and Broadband Infrastructure Development: Evidence from Canada. *Telecommunications Policy*, 37(9), 702-714.
- Rajabiun, R., & Middleton, C. (2013b). Rural Broadband Development in Canada's Provinces: An Overview of Policy Approaches. *The Journal of Rural and Community Development*, 8(2), 7-22
- Rajabiun, R., & Middleton, C. (2014). "Institutional Variety and Internet Infrastructure Development: The Net and The Internet: Emerging Markets and Policies." 20th ITS Biennial Conference, Rio de Janeiro 2014: The Net and the Internet-Emerging Markets and Policies, no. 106892. International Telecommunications Society (ITS), 2014.
- Rajabiun, R., & Middleton, C. (2015a). Regulation, Investment and Efficiency in the Transition to Next Generation Broadband Networks: Evidence from the European Union. *Telematics and Informatics*, 32(2), 230-244.

- Rajabiun, R., & Middleton, C. (2015b). Public Interest in the Regulation of Competition: Evidence from Wholesale Internet Access Consultations in Canada. *Journal of Information Policy*, 5, 32-66.
- Rajabiun, R., & Middleton, C. (2015c). Lemons on the Edge of the Internet: The Importance of Transparency for Broadband Network Quality. *Communications & Strategies*, (98), 119.
- SamKnows (2015). *Quality of Broadband Services in the EU October 2014*. Luxembourg: Publications Office of the European Union. Available at: <https://ec.europa.eu/digital-agenda/en/news/quality-broadband-services-eu>. DOI: 10.2759/770879
- Schumpeter, Joseph A. (1942). *Capitalism, Socialism and Democracy*. Routledge, 2013.
- Sluijs, J. P., Schuett, F., & Henze, B. (2011). Transparency regulation in broadband markets: Lessons from experimental research. *Telecommunications Policy*, 35(7), 592-602.
- Sobolewski, M. & Kopczewski, T. (2015). "Measuring Reservation Prices for Bundles of Fixed Telecommunications Services." 6th European Regional Conference of the International Telecommunications Society (ITS), Madrid, Spain.
- Soman, D., & Gourville, J. T. (2001). Transaction Decoupling: How Price Bundling Affects the Decision To Consume. *Journal of Marketing Research*, 38(1), 30-44.
- Srinuan, P., Srinuan, C., & Bohlin, E. (2014). An Empirical Analysis of Multiple Services and Choices of Consumer In the Swedish Telecommunications Market. *Telecommunications Policy*, 38(5), 449-459.
- Statistics Canada (2013). Canadian Internet Use Survey, 2012.
- TekSavvy Solutions Inc. (2015). *CRTC TNC 2015-134: Response to Request TekSavvy(Middleton) 14Aug15-01*.
- Townsend, L., Sathiaselalan, A., Fairhurst, G., & Wallace, C. (2013). Enhanced Broadband Access as a Solution to the Social and Economic Problems of the Rural Digital Divide. *Local Economy*, 28(6), 580-595.
- UN Human Development Indicators: <http://hdr.undp.org/en/content/income-gini-coefficient>
- Üner, M. M., Güven, F., & Cavusgil, S. T. (2015). Bundling of Telecom Offerings: An Empirical Investigation In the Turkish Market. *Telecommunications Policy*, 39(1), 53-64.
- van Gorp, A., & Middleton, C. (2010). The Impact of Facilities and Service-Based Competition on Internet Services Provision in the Canadian Broadband Market. *Telematics and Informatics*, 27(3), 217-230.
- Varian, H. R. (1992). *Microeconomic Analysis*. Norton, 3 edition.
- Varian, H. R. (2012). Revealed Preference and its Applications*. *The Economic Journal*, 122(560), 332-338.
- Waverman, L., & Koutroumpis, P. (2011). Benchmarking Telecoms Regulation—The Telecommunications Regulatory Governance Index (TRGI). *Telecommunications Policy*, 35(5), 450-468.

World Bank (2014). "Achieving Affordability" in Broadband Strategies Toolkit.

Wu, I. (2014). Maximum Impact for Minimum Subsidy: Reverse Auctions for Universal Access In Chile and India. *info*, 16(5), 46-58.

Zhang, X. (2013). Income Disparity and Digital Divide: The Internet Consumption Model and Cross-Country Empirical Research. *Telecommunications Policy*, 37(6), 515-529.