Decentralization and confusion about the state of European telecoms: Perceptions versus reality in policy formation abroad

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Abstract

The implications of the experience in Europe with telecommunications policy design and broadband Internet development have become a contested area of policy debate, both in Europe and in other countries. This paper evaluates the manner in which the European experience has been characterized in telecommunications policy debates in Canada about wholesale Internet access regulations. Using broadband Internet speed measurements, we assess the empirical relevance of characterizations of Europe by private interest groups trying to shape public policy in Canada. The analysis highlights the importance of national telecom policies and operator strategies for explaining divergent paths of network development.

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"The mismanagement of broadband in Europe – where state-imposed mandates and top-down regulations have contributed to underinvestment and poor network quality – offers a cautionary tale for Canada as it seeks to develop its innovation agenda."

Macdonald-Laurier Institute, Ottawa, Canada, Aug. 24, 2016[1]

I. Introduction

In addition to its relevance for Europeans, the effectiveness of European telecommunications policy has become a contested area in debates influencing telecom policy design in other countries. Individual European countries, as well as Europe as an aggregated construct, are often used as examples in these debates. For instance, invocations of Europe are very evident in current Canadian discussions on wholesale broadband access, consumer protection, network neutrality, and basic service policies, as divergent stakeholders try to convince policymakers of the success or failure of specific regulatory approaches (CNOC, 2015; Renda, 2015; Serentschy, 2015).

This paper examines how evidence and arguments regarding European approaches to telecommunications policy have been inserted into public consultation processes and policy debates in Canada. We study the relevance of perceptions various private interest groups are trying to create about the state of European telecoms to shape Canadian wholesale access policies using a wide range of indicators of comparative broadband market outcomes. When policymakers are balancing potentially contradictory objectives and outcomes, perceptions of the effectiveness of public policy elsewhere can matter greatly for the design of policies in other countries such as Canada. The analysis explores whether European telecoms are really so mismanaged as to offer a relevant cautionary tale for policymakers and operators in distant and distinct markets searching for more effective strategies to promote development of broadband networks.

The answer to this question is not only relevant in the context of ongoing policy debates about the design of wholesale and retail market policies in Canada, but has broader implications in highlighting the limitations of comparative analysis as a basis for developing public policies that fit local needs and conditions. Although there is always some basis in fact for such comparisons, previous research on the evolution of telecom investments and Internet connectivity indicates that there is no single European experience, with public policy, firm level strategies, and broadband outcomes varying significantly in individual and different groups of countries

[1] From press release from Macdonald-Laurier Institute regarding report entitled "Winners and Losers in the Global Race for Ultra-Fast Broadband". Retrieved from: http://www.macdonaldlaurier.ca/steering-canada-clear-of-europes-disastrous-broadband-strategy-mli-study-by-andrea-renda/

(Lemstra & Melody, 2014). The European experience creates an empirical puzzle, which can be challenging for policymakers in far away places to appr eciate.

On one hand, previous empirical research documents that investments by incumbents have tended to be lower in European countries with relatively more intensive national regulatory frameworks than in those with more streamlined rules and standards (Grajek & Roller, 2012). While confirming the negative correlation between regulatory intensity and capital expenditure levels in telecom network in Europe, further research has documented that EU member countries that have succeeded in developing national regulatory frameworks that promote service-based competition have developed relatively higher quality broadband networks and are further along in the transition from legacy copper/DSL to next generation fibre-to-the-premises FTTP broadband networks (Rajabiun & Middleton, 2015a). This suggests that higher investment inputs do not always translate into a higher rate of progress in network development.

The reasons for this puzzle from Europe are not yet very well understood, but potentially include too little cooperation in fixed cost sharing, too much inefficient duplication in the absence of credible wholesale access obligations, lack of competitive discipline needed to improve service quality, and stranded capital expenditures on legacy assets. While further research is required, existing evidence from Europe clearly illustrates the limitations of the traditional telecom policy framework that assumes the existence of a trade-off between investment and competition incentives, particularly when it comes to deploying advanced technologies requiring irreversible capital expenditures. As summarized in a review of the evidence by the European Parliament, "the relevant point here is whether or not operators are able to translate their capital expenditures into real improvements in the quality of the network" (European Parliament, 2016, p.27).

The complexity of the European experience provides a basis for its use and abuse in policy formation processes by private interests trying to shape public policy. The consequent uncertainties this can create for risk averse decision makers can have real consequences for the development of efficiency enhancing public policies and business strategies that increase the pace of creative destruction in broadband Internet infrastructure development in other countries.

Over the past two years, insights from Europe about the relevance of policies that promote cooperation and risk sharing in network development have played a part in convincing the Canadian telecommunications regulator, the Canadian Radio-television and Telecommunications Commission (CRTC) to recognize that FTTP networks of the future are non-duplicable and should therefore be subject to third parties wholesale access obligations (Rajabiun & Middleton, 2015b). At the same time, the CRTC has closed the door on mandating access to fibre transport facilities, as recommended by rural municipalities, and on Mobile Virtual Network Operators (MVNO). Perceptions of success and failure of public policy and industry practices in Europe in terms of affordability and quality of service continue to play a part in these and other aspects of

telecom policymaking in Canada. We suspect that they may also play such a part in policy formation processes in other advanced and developing countries.

This paper analyzes how the European experience with broadband development has been deployed by private interests trying to influence wholesale access policies in Canada, as well as the extent to which these perceptions comport to reality. Section II provides an overview of the comparative empirical context of policy debates about the design of wholesale access regulations in Canada. Section III documents the construction of the European experience as a tool to shape perceptions of policymakers by interest groups with divergent interests. Section IV uses broadband speed measurements to evaluate the relevance of distinctive constructions of the European broadband policy and network development provided by private interests trying to shape public policy in Canada. In addition to assisting policymakers in Canada to better understand the European experience as a policy benchmark, the paper aims to encourage further research about the diverse experiences within Europe in order to reduce confusion and uncertainty facing policymakers in other countries searching for telecom policies that reflect their local needs and conditions.

II. Context: Broadband network and policy development in Canada

In the early 1990s, Canadian policymakers were among the first in high income countries to recognize that access to essential network infrastructure controlled by incumbent telecom network operators represented a barrier to the development of data services needed to meet the needs of business, and increasingly residential consumers. Despite the relatively early adoption of wholesale and unbundling obligations on incumbents' copper networks in Canada, these early policies were not very effective in promoting service based competition or incentivising incumbent operators to extend broadband connectivity. Nevertheless, initiatives by cable TV providers to invest in their networks to deliver higher speed access, combined with strong demand by Canadian consumers for Internet connectivity, provided a basis for relatively rapid growth in broadband penetration rates. By the early 2000s, Canada has some of the highest broadband penetration rates in advanced economies (Rajabiun & Middleton, 2013).

Much like in the U.S., the past success of infrastructure competition in the early stages of the development of Internet connectivity continues to cast a long shadow over the design of telecom policy in Canada. Unlike the U.S. which abandoned wholesale access obligations on legacy DSL operators in the aftermath of the 2002 financial crisis in order to promote infrastructure investment incentives, the CRTC retained and extended them to cable broadband providers. These regulatory mandates on wholesale access to competing infrastructure providers have not been very successful in promoting service-based competition, due in part to a relatively high regulated wholesale price and lack of control over service quality (i.e. Layer 3 versus 2 control). More than 15 years after access was initially granted to incumbent's copper networks, service-

based competitors, delivering services over copper and cable networks, generate less than 10% of retail market revenues (CRTC, 2015). Importantly however, in Telecom Decision CRTC 2008-17, the regulator chose to forbear from mandating wholesale access to fibre transport and next generation fibre access facilities in order to promote investment in their development.

Wholesale obligations on legacy copper and cable network operators in Canada to cooperate with third parties do not appear to have had a negative impact on the incentives of regional duopolies that dominate the market to invest in telecommunications infrastructure. As documented in Figure 1, intensity of capital expenditure per access path in Canada are amongst the highest in OECD countries; notably, substantially higher than in the U.S., where the FCC has resisted calls for wholesale access mandates in order to promote infrastructure competition and investment in next generation FTTP networks; as well as, countries such as Japan and Korea, where substantive investments in more scalable next generation FTTP networks were made in the late 2000s. This highlights the importance of locally specific considerations in interpreting what investment levels mean for public policy and business strategy.

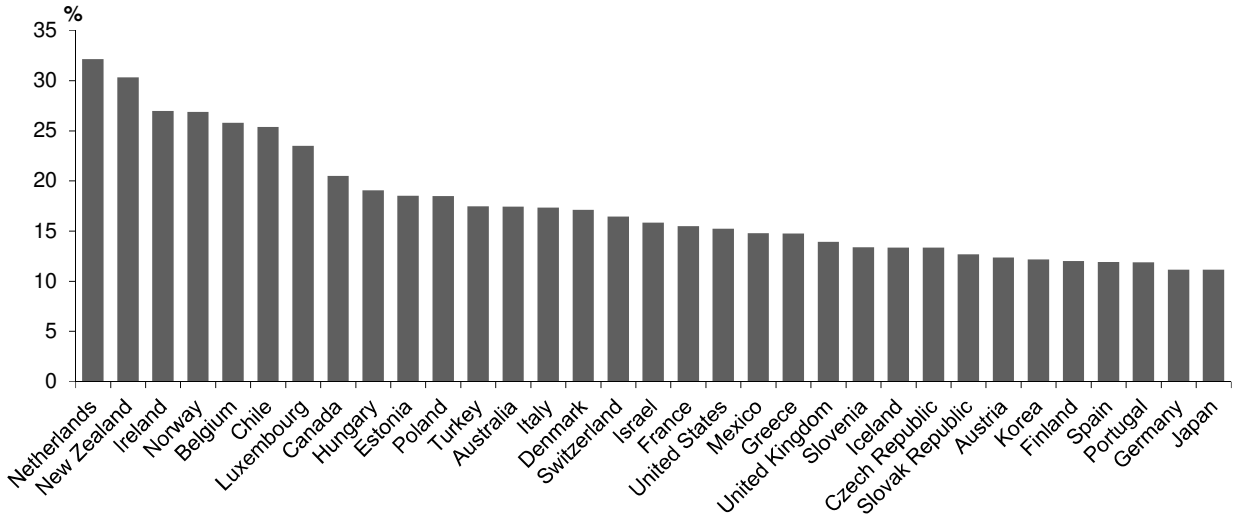

Figure 1. Investment in Telecommunications as % of Revenue
(Source OECD Digital Economy Outlook, 2015, Fig. 2.33; spectrum fees excluded)

More disaggregated data on capital intensity of operators in Canada indicate that cable operators have historically invested a larger proportion of their revenues on their networks relative copper/DSL providers (around 40% versus 25% respectively; CRTC, 2015. Table 5.0.5). Despite some variation across firms and over time within Canada, the capital expenditure level has remained substantially higher than in all but a few other high income countries, even though the CRTC mandates third party wholesale access obligations on legacy copper/DSL and cable operators. What is particularly puzzling about the Canadian experience has been that relatively high capital expenditure levels have not resulted in the delivery of relatively high network speeds or investments in next generation FTTP networks. As documented in Figure 2, average

measured download speeds in Canada have been about average of high income countries, which is around 2 to 3 times lower than leading countries in East Asia and Europe that are further along in the transition to next generation FTTP networks (see Figure 3).

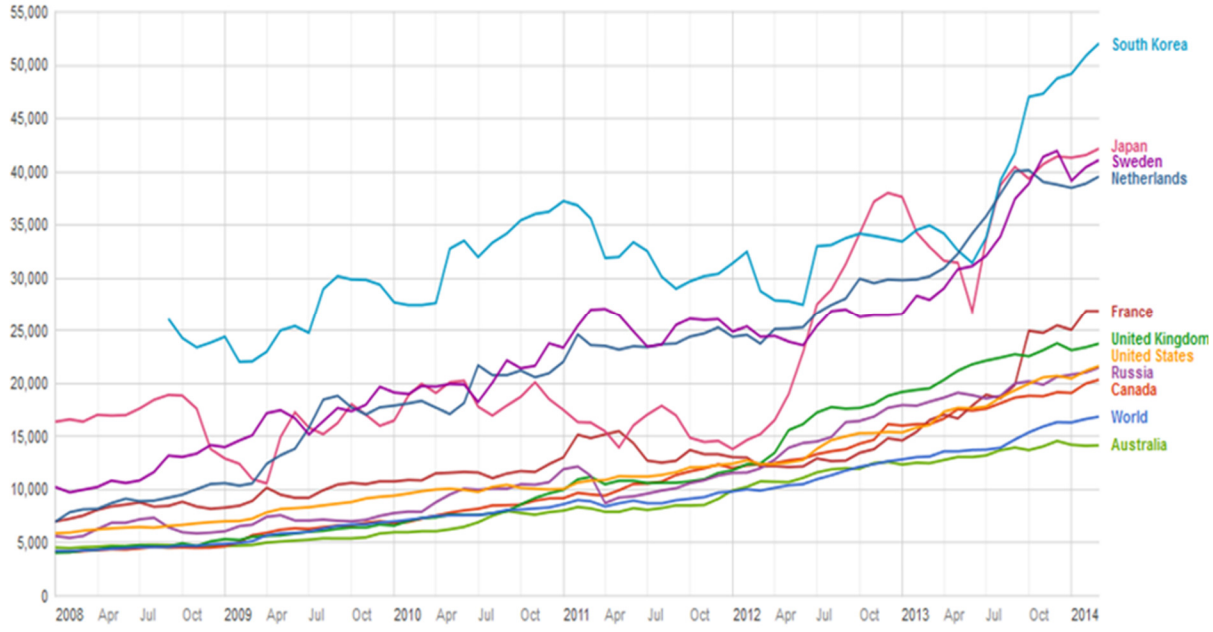

Figure 2. Divergence of Broadband Speeds
(upper bound of average measured download speeds in Kbps. Source: Speedtest/Ookla, Google Public Data Explorer)

Divergence of international outcomes in terms of average broadband network performance noted above highlights the importance of history and technology for explaining how capital inputs are translated into network outcomes. In leading countries in East Asia and Northern Europe, legacy copper platforms were largely decommissioned as FTTP networks were rapidly deployed in the mid to late 2000s. Early investment in early adopter countries such as Japan and Korea has made it relatively less capital intensive for operators in these countries to scale their networks in response to subsequent growth in higher speed connectivity associated with the adoption of advanced Internet content and application services. Essential facilities obligations that incentivise FTTP deployment and minimalize the potential for inefficient duplication help explain why operators in these countries can deliver superior service levels, despite the relatively low capital intensity of their telecom operators in the recent years. In Europe, some leading countries in terms of FTTP deployment have relied on municipal leadership to invest in next generation networks, reduce duplication and promote service based competition (e.g. Sweden, Norway). Others, such as the Netherlands, have instead relied on substantive infrastructure competition on legacy platforms to meet rapidly growing demand for connectivity and the FTTP penetration rate remains below average (i.e. 12% for Netherlands, versus OECD average of around 20%).

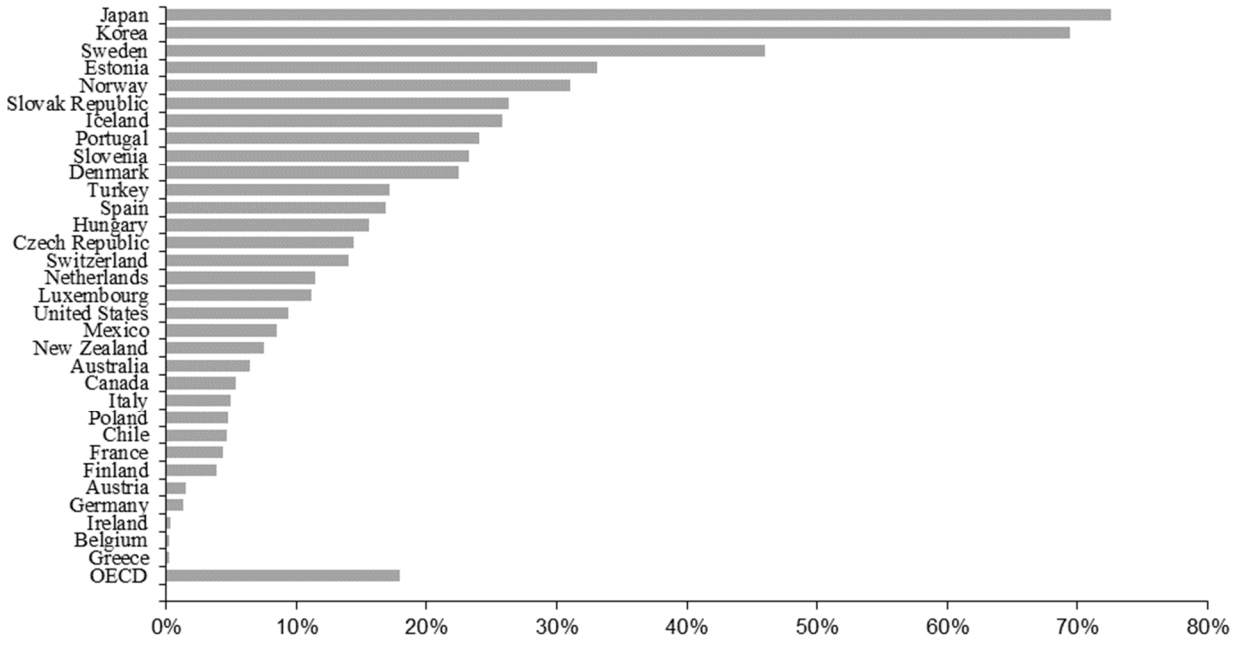

Figure 3: Diffusion of Fiber Access Networks in High Income Countries
Percentage of fibre connections in total broadband subscriptions (2015)
Source: OECD Broadband Statistics, Table 1.10

International comparisons clearly document that forbearance from mandating access to next generation FTTP networks in Canada and the U.S. has not been that conducive to their development outside Atlantic Canada or a few urban centres in the U.S. (Rajabiun & Middleton, 2016). This is particularly the case in Canada, where the FTTP take up rates remain about half of the U.S. and 3 to 4 times lower than the OECD average. Outside Atlantic Provinces and few localized pockets around Canada, access to FTTP remains negligible even in relatively densely populated urban centres of the country as incumbent operators continue to rely on fibre-to-the-node (FTTN) plus last mile legacy connections (i.e. "sweating the copper").

Evidence of the ineffectiveness of the technologically asymmetric regulatory regime that tried to promote broadband capacity growth and FTTP deployment under the CRTC 2008-17 policy framework ultimately resulted in the CRTC reversing course in the CRTC 2015-326 decision. In the 2015 reform, the CRTC extended wholesale access obligations to next generation fibre access facilities and adopted a wholesale pricing framework designed to incentivise investments in them by allowing first movers in FTTP deployment to earn an attractive rate of return on their

irreversible capital expenditures.[2] The extent to which the new framework will succeed in achieving its objectives in terms of FTTP deployment and service quality improvements will not be known for a number of years.

Early evidence nonetheless suggests that CRTC's decision to redesign the wholesale regime appears to have had a positive impact on private sector incentives to invest in them, or at least announce their intentions to do so as a number of large incumbents have subsequently announced large scale FTTP deployment projects soon after the CRTC ruling.[3] The decision by the CRTC to retain a wholesale pricing model that provides an attractive rate of return to investors in network infrastructure (i.e. the so-called Phase II costing methodology) has also been followed by the subsequent declaration of bankruptcy of what was once one of the bigger and more successful service-based competitors that had managed to survive in the Canadian market.[4] These trends highlight the limitations of the standard economic model used by telecom regulators around the world, which assumes wholesale access obligations have a negative impact on investment incentives, or that they are always in the benefit of over-the-top (OTT) service-based competitors

III. Private interests and perceptions of Europe in Canadian telecom policy formation

The policy development process leading to the adjustment to Canada's wholesale access regime in CRTC 2015-326 noted above is particularly interesting as it highlights the importance of enlightened self interest and evolving positions of powerful interest groups in shaping public policy. As expected, consumer advocacy groups and service-based competitors asked the CRTC to reduce wholesale access rates and extend regulatory obligations to FTTP networks; rural communities asked for extending wholesale access obligations to fibre transport facilities; and incumbents copper and cable network providers opposed these proposed reforms, while some of them asked for phasing out existing obligations on legacy platforms (Rajabiun & Middleton, 2015, b). By the end of the proceeding however, cable companies started to recognize that a technologically neutral wholesale access regime that would minimize the potential for inefficient duplication in the transition to next generation FTTP networks might actually be in their private interests. As such, after the CRTC 2015-326 ruling was finally published cable companies have

[2] Authors of this article participated in the CRTC 2013-551 wholesale consultation process, presenting our research on the Canadian and European experience, as well as offering an approach to pricing wholesale services that is intended to limit incentives to invest in legacy platforms and promote those in the long term transition to FTTP.
[3] Bell Gigabit Fibe internet service launched in Ontario, Quebec, CBC News, August 5 2015. Available at: http://www.cbc.ca/news/technology/bell-gigabit-fibe-internet-service-launched-in-ontario-quebec-1.3187499
Rogers announces Ignite Gigabit internet, 4K sports broadcasts, CBC News, Oct 5, 2015. Available at: http://www.cbc.ca/news/business/rogers-internet-1.3256745
Telus boosts Vancouver's internet network with $1B upgrade, CBC News, Oct 2, 2015. Available at: http://www.cbc.ca/news/canada/british-columbia/telus-upgrade-vancouver-1.3254403
[4] Primus in court creditor protection as it seeks to revamp mission, The Globe & Mail, January 21, 2016. Available at: http://www.theglobeandmail.com/report-on-business/primus-in-court-creditor-protection-as-it-seeks-to-revamp-mission/article28297128/

actually opposed Canada's telecom incumbents in a number of subsequent appeals to the CRTC decision.[5]

The rest of this section documents how various private interests involved in Canada's wholesale policy formation process have characterized the European experience with policy and network broadband development in order to shape how policymakers conceive the public interest in Canada. The analysis is not an exhaustive assessment of all references to Europe in the CRTC consultations and subsequent appeals, but aims to capture the range of contradictory conceptualizations of a complex reality in a far away place utilized to influence policy formation by local interests. For example, we ignore discussions regarding the importance of wholesale access to transport facilities for rural communities, an argument in the original proceeding which the CRTC essentially ignored in its final decision in CRTC 2015-326.

Furthermore, it is important to note that most of the submissions to the CRTC 2013-551 consultation that ultimately led to the CRTC 2015-326 framework provided the regulator with evidence regarding Canada and local challenges created by the CRTC 2008-17 regulatory framework in terms of affordability and quality of Internet access services in the country.[6] Particularly in the early stages of the process, only a small number of participants incorporated international evidence in their arguments. For example, initial submissions by consumer advocacy groups OpenMedia and the Public Interest Advocacy Centre (PIAC) focused primarily on implications of the wholesale regime under review for the affordability and quality of services in Canada. Rural communities and educational institutions highlighted the importance of open and affordable access to transport facilities to improve affordability and service quality at the retail level in their communities. As the regulatory process involved a number of stages and provided for replies by the parties to each others' arguments, questions about the relevance of international experiences, particularly those relating to U.S. and Europe, became more pronounced in the latter stages of the proceeding. Following the decision, Bell Canada's multiple and simultaneous appeals and petitions to overturn key elements of the CRTC ruling argued that the decision would result in the same negative outcomes as present in Europe. Given the wide range of documentation on the record of the original proceeding, we focus only a selected set of submissions and expert reports presented to the CRTC to better capture the range

[5] See e.g. submissions by Cogeco Cable in response to the ultimately unsuccessful petition to the federal cabinet by Bell to overturn the decision of the independent regulator. Available at: https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/DGTP-002-2015-Cogeco.pdf/$FILE/DGTP-002-2015-Cogeco.pdf
Or that by Rogers Communications, the biggest cable broadband provider in Canada, in response to the ultimately unsuccessful appeal by Bell for the CRTC to limit the range of potential third parties that are eligible for wholesale access to those with revenues below $500 million per year. Available at: https://services.crtc.gc.ca/pub/ListeInterventionList/Documents.aspx?ID=226484&en=2015-1216-1&dt=i&lang=e&S=C&PA=t&PT=pt1&PST=a

[6] Access to the text of all written and oral submissions to the proceeding available at: http://crtc.gc.ca/eng/archive/2013/2013-551.htm

of analytical constructs of Europe employed by particular groups of interest to shape the development and implementation of the new CRTC wholesale regime:

Infrastructure providers:

Cable operators: As noted, cable operators in Canada were originally opposed to extending wholesale access obligations but became more pliant when recognizing that a technologically neutral regime that provides an attractive rate of return on very high speed next generation networks might be in their benefit; with various cable companies opposing various appeals and petitions by Bell to overturn key elements of the CRTC 2015-326 ruling. At the initial stages of the proceeding, Rogers, the largest cable network operator in Canada commissioned an expert report on the international experience trying to capture "The Incentive Effects of Wholesale Unbundling Regulation on Investment" (Wallsten, 2014). Based on the assumption that the so-called "ladder of investment" theory represents the logical underpinning of wholesale access obligations and on selective international evidence, the first submission by Rogers used this report to highlight that few European countries impose wholesale access obligations on cable providers (excluding Denmark). It then utilizes this fact to argue that the CRTC should "phase out" wholesale access obligations on cable providers in order to:

> *"provide entrants with the opportunity and incentive to move up the ladder of investment and thereby promote the development of facilities-based entry. It would also send the correct investment signals to existing and potential suppliers of wholesale and retail services."*[7]

In contrast to Roger's invocation of European experience to justify its initial position to the CRTC, the second largest cable broadband provider in Canada, Shaw, focused its intervention on the challenges that regulatory asymmetry creates for them in their competition with incumbent DSL operators, emphasizing that

> *"network carriers require the flexibility to innovate to meet consumer demand without onerous or restrictive regulation that interferes with normal business operations and expansion in the marketplace. Achieving this balance requires a flexible, market-driven, consumer-focused and balanced regulatory regime."*[8]

Copper/DSL operators: Bell, the largest vertically integrated infrastructure operator in Canada, attached a set of expert reports to its CRTC submission that describe a stark contrast between the U.S. and Japanese experience on the one hand, and the state of affairs in Europe, on the other:

[7] Rogers Communications first intervention in CRTC 2013-551, page iii, paragraph ES14.
[8] Page 13, First intervention by Shaw cable to CRTC 2015-551.

> *"The elimination or reduction of mandated access obligations in the U.S. has supported extensive investment in facilities by U.S. carriers…….The opposite situation has prevailed in Europe, where mandated access has depressed investment and caused many European countries to fall behind in the race to deploy next generation networks. As Attachment 3 explains, the economic literature "strongly supports the hypothesis that access regulation does not promote, and may hamper, telecommunications investment and broadband penetration" and specifically that "reliance on access regulation seems to have had a negative impact on investment in new broadband networks." As a result, "Europe lags behind the US, Canada and Japan in terms of investment, speed, and penetration of fast and ultra-fast broadband."*[9]

Beside the fact that Japan actually used wholesale access regulation very successfully to promote FTTP deployment in the mid to late 2000s, the idea that Europe somehow lags behind according to certain measurements promoted by Bell offers an excellent example of how a complex reality can be easily simplified by narrow interests trying to shape public policy. The fact that investment inputs are emphasized by the incumbent as a measure of outcomes also represents a key in the standard regulatory model operators tend to promote, which assumes the existence of a trade-off between competition and investment incentives in the development of network infrastructure. While the CRTC did not find the evidence provided by Bell regarding the international experience compelling, in its subsequent appeals of the CRTC ruling, Bell continues to utilize essentially the same evidence and arguments that suggest to the reader there is a strong divide between North America and an aggregated construction of the European experience.

In addition, a further submission by Bell adds a legal opinion to the aggregated construction of Europe by arguing that "*under EU regulation, ILECs in Canada would not be subject to mandatory network sharing*" (Renda, 2015, p. 2). Although this characterization of high-level EU directives is factually correct, it hides the substantial regulatory autonomy EU members retain in the implementation of telecom policy in general, and essential facilities access regulations in particular. This autonomy allows individual member states to adopt implementation strategies that meet their local needs and conditions, an option that is not available to lower levels of government in Canada. It is also precisely what has allowed various countries around Europe to deploy essential facilities regulations as a tools for promoting investment and service-based competition, while reducing the potential for inefficient duplication in both fixed and mobile network development. Assuming that access regulation causes low FTTP deployment incentives, Renda (2015, page 3) summarizes this perspective on Europe for the federal cabinet in Canada:

[9] Pages 32-34, First intervention by Bell to CRTC 2015-551.

"*Overall, the situation is close to disastrous: countries that have relied extensively on access regulation, like the United Kingdom, today feature 1% coverage of FTTP……*".

Telus, the incumbent in Western Canada, also provided submissions and expert reports during the multiple stages of the policymaking and appeals processes that offer a similar dichotomy between an aggregated construct of Europe, leading East Asian countries, the U.S. and Canada. Despite the fact that for some reason the CRTC exempted Telus from the scope of its wholesale decision, Telus provides an expert report that draws the following inference from the European experience for policy development in Canada, in support of Bell's appeal to cabinet to overturn the CRTC decision:

"*In the light of the CRTC decision 2015-326, ironically the policy trajectories in Canada and Europe are going in different directions; While Europe – recognizing its policy failures - is heading towards a more investment friendly environment, Canada has put in place a decision that would adopt failed European policies. This route would obviously be detrimental for the country."* (Serentschy, 2015, page 6.)

In its submission, Telus centralizes the purported failures in the wide range of arguments it outlines in support of Bell, a company with which Telus has extensive private network sharing agreements in the delivery of business services and the mobile sector that enable both companies to reduce the costs of delivering retail services by sharing network assets which would be inefficient to duplicate:

"The (CRTC 2015-326) TRP [Telecom Regulatory Policy] should therefore be overturned for three reasons. First, international experience demonstrates that mandated access leads to lower investment levels by all providers in the market (both entrants and incumbents) which in turn leads to lower levels of network quality and innovation. Citizens, companies, and countries suffer under such policies. This gap in network investment levels is acutely illustrated when the US and Europe are compared. Capital spending per communications path by incumbent telecommunications companies in the US is, on average, nearly double that of the EU-15, as a result of the US Federal Communication Commission's ("FCC") refusal to mandate access to broadband networks. Europe has many poor quality networks and no equivalent of Google, Apple, Amazon or Facebook. All of Europe is paying the price of misguided communications policies."[10]

[10] Telus submission to the Governor in Council in support of Bell's petition to overturn the CRTC 2015-326 decision, page 5.

Access seekers:

Canada's regulatory environment has not conducive to the development of service-based competition and market share of non-incumbents is below 10% in terms of market revenues. A number of this class of firms participated in the proceeding as individual companies, primarily documenting challenges caused for their business models by unreasonably high wholesale prices caused by CRTC's cost plus markup approach (a.k.a. Phase II costing) which is designed to provide infrastructure operators with an attractive rate of return to promote investment in essential facilities. Representing a number of service-based competitors, the Canadian Network Operators Consortium (CNOC), instead recommended that the CRTC should learn from the Europe and adopt an Equivalence of Input (EoI) approach to wholesale pricing:

> *"Indeed, The European Commission ("EC") has identified EOI as the "surest way to achieve effective non-discrimination."98 A robust EOI regime, therefore, should represent the next stage in Canada's telecom regulatory framework."*[11]

It is important to note that CRTC ultimately did not adopt this recommendation, retained Phase II costing, and in fact shortened the amortization period incumbents can use to calculate wholesale costs from 10 to 5 years under the new regime. In addition, CNOC used the international experience as an empirical basis for arguing why the CRTC should provide its members with access to next generation FTTP networks:

> *"Canada has been a laggard in the deployment of FTTP networks compared to Europe, Asia, and Australia……."*[12]

Having failed to achieve their objectives in terms of wholesale pricing reforms that would reduce their costs, the CNOC group of service providers took serious issue with the manner in which the European experience was characterized by Bell in its subsequent appeal of the CRTC 2015-326 decision to the federal cabinet. CNOC (2015) details a number of factual errors in the supporting document provided by Bell that warns of the "disastrous" consequences of following European style policies, urging policymakers to be:

> *"….especially cautious of international comparative evidence with the EU given that the EU consist of 28 different member states each with distinct economic, social, cultural, political, legal and regulatory environments."*[13]

[11] CNOC, First submission to CRTC 2013-551, page 77. Please note that the CRTC ultimately did not adopt this recommendation, retained Phase II costing, and in fact shortened the amortization period incumbents can use to calculate wholesale costs from 10 to 5 years under the new regime.
[12] CNOC, First submission to CRTC 2013-551, page 112.
[13] CNOC (2015), page 9.

III. Diversity of outcomes: From investment inputs to network outcomes

The idea of Europe as a homogeneous place where bad public policies cause developmental failures in broadband markets is obviously a hyperbole designed to achieve a specific purpose by particular groups of private interests trying to shape public policy. The fact that the CRTC rejected calls by service-based competitors to adopt the "European" EoI wholesale pricing model, as well those by incumbents not to extend wholesale access obligations to next generation FTTP networks suggests that these efforts were not successful in this case. However, use of such semantic strategies to reduce a complex reality for a political purpose is both common in various areas of policymaking and can have real consequences on policy outcomes. Even if it is obvious why particular interest groups may utilize selected evidence to create a perceived reality that helps achieve their objectives, this "noise" from contradictory comparative assessments can create some uncertainty about what policies and strategies are relevant given local conditions and needs.

High income countries such as Canada might be able to afford policy errors that can come from confusion and uncertainty about what the right policies might be to promote private sector incentives to meet growing demand for Internet connectivity. This is however not the case for lower income developing countries where Internet access remains confined to small groups of urban elites. Extending Internet access infrastructure to the billions of people that are on the other side of the "digital divide" requires understanding what type of public policies promote private sector incentives to make irreversible capital expenditures in network infrastructure and private sector efficiency in translating capital inputs into network outcomes. To help in the search for efficiency enhancing policies that promote private sector incentives to deliver Internet access services, the rest of this section expands on the high-level discussion of the puzzling relationship between investment inputs and network outcomes outlined in Section II to contextualize the policy debate in Canada.

As large network operators tend to emphasize in policy debates, international evidence is pretty clear about the relatively high capital expenditure levels of North American versus European telecoms (Orange, 2015; Bell, 2015). Fixed expenditures on networks in Canada have clearly been higher than the U.S. and all but a handful of European countries (Figure 1 above). Despite the capital intensity of the Canadian operators however, network capacity growth has substantially lagged other advanced economies that are further along in the transition to more scalable next generation FTTP networks. In the U.S. FTTP diffusion rates are somewhat higher than in Canada, but remain localized and average network performance growth has been about average, even though relatively high capital expenditures are going into the system. The high degree of capital intensity in the two countries partly reflects the relatively unique histories of technological competition and differentiation among dominant operators in the two countries. The availability of higher speed cable broadband appears to have had a negative impact on the

incentives of legacy DSL/FTTN network operators have to compete with them by investing in FTTP networks that would enable them to offer higher speed and margin broadband services.

Utilization of investment inputs as a measure of policy success, use of advertised versus actual speeds, and erroneous inferences from the local and comparative evidence, have the potential to cause significant confusion and uncertainty for decision makers. To mitigate this, we utilize data from the M-Lab Network Diagnostic Test (NDT) network measurement platforms to provide a relatively comparable and detailed look at the reality of Internet connectivity and the perceptions promoted by private sector interests.[14] In terms of absolute speed measurements, the NDT test generates relatively lower test speeds than other commonly cited commercial testing platforms such as Ookla's Speedtest (utilized in Figure 2 above) or SamKnows. Among other reasons, this is because NDT does not account for multiple simultaneous HTTP connections, which can lead to an underestimate, while Speedtest and SamKnows aggregate test results into an average in a manner that can lead to substantial over-estimation of network quality relative to real use conditions. The M-Lab NDT results are generated via a standard-based methodology using "off net" measurements and represent a relatively realistic picture of the user experience than the others.[15] Nevertheless, it is important to note that particular approaches to speed measurements represent distinctive windows into the complex and differentiated world of Internet connectivity, and are therefore likely to contain complementary information.

To provide a high-level overview of connectivity that abstracts away from technological diversity of broadband, Figure 4 maps measured median download and upload speeds as of the beginning of 2016 for a selected group of relatively high-income countries.[16] Operators in countries on the top right tend to deliver higher and more symmetric connections, which partly reflects their relatively higher rate of transition from legacy copper and cable to next generation FTTP in these countries (see Figure 3 above). The leading European countries are mostly in the North and Eastern European accession countries, where obligations to interconnect with third parties have complemented a faster rate of technological change relative to larger Western and Southern countries. Although the Scandinavian experience is somewhat unique as it required significant municipal leadership, the contrast between "old" and "new" Europe is particularly important to recognize in interpreting evidence and constructions of Europe in telecom policy. Under intense lobbying from large West European incumbents, as a condition of EU accession countries in Eastern Europe had to adopt relatively pro-competitive regulatory regimes, whereas local powers have been more successful in resisting the development of efficiency enhancing

[14] The M-Lab platform enables users to test their connections and collect a large set of metrics regarding their connection quality and potential variables that might explain it (Web 100 statistics). We use Google Public Data Explorer for median measured speeds and the RIPE NCC bandwidth widget to characterize distributions of test results. See: https://www.measurementlab.net/

[15] i.e. "Off net" means measurements are conducted between the test devise and a server outside the ISP of the person conducting the test. Consequently, in absolute terms, M-Lab speed measurements tend to be lower than most other broadband speed tests utilized in policy research and discussions.

[16] Please note that some relevant European and East Asian countries are not included due to limitations of the data.

regulatory arrangements that promote technological change from legacy copper to next generation FTTP networks (Rajabiun & Middleton, 2015b; Serdarević et al., 2016).

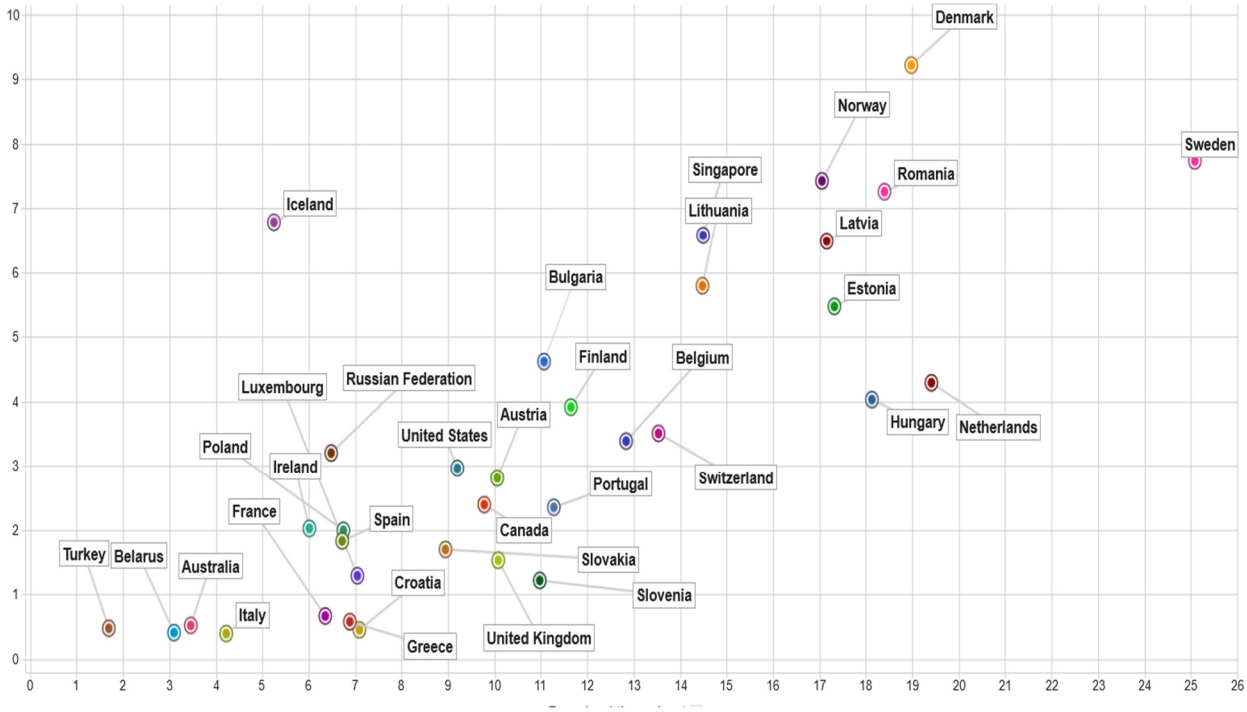

Figure 4. Broadband Network Speeds in Selected High Income Countries, 2016.
(Source: M-Lab, Google Public Data Explorer; median measured speeds Mbps; x axis: download speed; y axis: upload speed)

In addition to distinctive paths in the co-evolution of states and markets across Europe, it is important to note that the leading cluster of countries are relatively smaller in terms of geography and population, with relatively highly educated populations. To the extent that education, demand, and willingness to pay for Internet access might be correlated, this might also be a factor in explaining why an institutional environment has evolved that supports superior connectivity. The smaller size of these jurisdictions might also have a role to play by making central government regulators more accountable for their decisions and encourage them to adopt efficiency enhancing policies that support infrastructure development. Operators in larger, lower income countries in the EU and at the edge of Europe such as Italy, Poland, France, and Turkey deliver some of the lowest broadband speeds to their customers. The same hypothesis might explain some of the observed differences between Portugal and Spain. Although this requires further research, the evidence suggests improving broadband infrastructure in larger countries may require some degree of regional and municipal leadership by lower levels of government, which might have stronger incentives to improve their digital infrastructure than central government regulators. The extent which well-organized and resourceful private interests are able to shape national regulations will matter greatly for the range of options that are available to both public and private sector entities willing to invest in improving broadband infrastructure for their communities and businesses.

According to the M-Lab data, median download and upload speed delivered by operators in North America is somewhere in the middle of the diverse experiences in Europe. Given the relatively high degree of cable broadband penetration in Canada and the U.S. (more than half of all fixed connections) and relatively low FTTP deployment (Figure 3), these country level results are driven primarily by investments by legacy cable platforms to upgrade their network capacity to deliver higher speeds than legacy DSL/FTTN operators in these countries can deliver. There is little evidence to suggest that Internet connectivity is superior in North America relative to Europe, or vice versa. Despite relatively high investment levels by legacy network operators in U.S. and Canada, their median performance is only marginally better than large EU members that have also lagged behind in fostering private sector incentives to deploy new technologies. Countries with institutional arrangements that have enabled the incumbents to "sweat the copper" as a business strategy tend to have developed subpar broadband networks. A notable exception to this appears to be the Netherlands, where relatively high investments in legacy networks are associated with relatively high measured speeds.

Figure 5 provides a historical perspective on divergent paths of network outcomes that is the subject of various conjectures about the successes in North America and failures in Europe in the policy literature. Median speeds as measured by the M-Lab test bed document a clear divergence in network development outcomes since the late 2000s. Most advanced economies ended the first stages in the development of broadband networks in the 2000s with median speeds of around 5 Mbps. In the more recent stages of the development of connectivity, service providers in Europe have increasingly diverged in the connectivity speed they are managing to deliver in the face of rapidly growing demand by end users for network intensive content and application services. In countries with institutional arrangements that have helped them further along in the transition to scalable next generation FTTP networks, operators have managed to increase the amount of capacity they provision relatively faster as demand has grown (i.e. Northern and Eastern/Central Europe). Where Free Cash Flows (FCF) from legacy platforms have inhibited incentives of operators to decommission them and extend access to FTTP (Western, Southern Europe, North America), capacity gaps have increased relative to the leading cluster of European countries where a combination of policy and business innovation has fostered a higher rate of creative destruction from legacy to next generation broadband technologies.

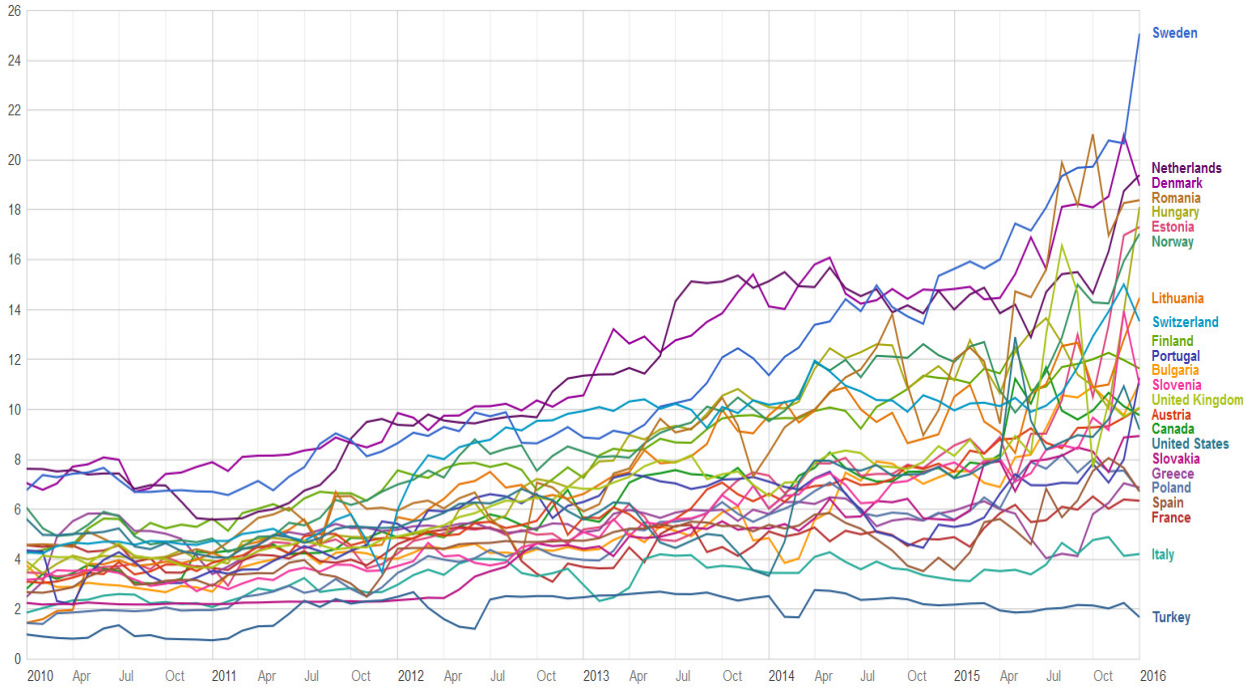

Figure 5. Broadband Network Speeds in Selected High Income Countries, 2010-2016.
(Source: M-Lab, Google Public Data Explorer; median measured download speeds Mbps)

Country level indicators documented above hide significant complexity and differentiation in the delivery of Internet connectivity. For example, in theory, upgrading legacy copper and cable networks to advanced standards (VDSL, DOCSIS 3.1) should enable operators to deliver higher speed connectivity. In practice, actual connection speeds can vary significantly from theoretical maximums of particular technologies for a number of reasons, including under-investment in upstream network assets by operators leading to congestion, distance to the fibre node, user equipment limits, and price/service quality differentiation strategies of operators aimed at segmenting the market to maximize revenues. The rest of this section presents and analyzes the distribution of country level broadband speed measurements discussed above to capture the relationship between perception and reality in competing conceptualizations of European experience in Canadian telecom policy formation.

The analysis is only preliminary and focuses on selected countries that represent distinctive paths of market development and technological change. Figures 6-14 document the distribution of bandwidth tests conducted by M-Labs distributed system of test servers, which capture "off net" capacity provisioned for particular user connections. Samples represent unique IP addresses for tests conducted over a 30 day prior to August 20th, 2016, compiled using the RIPEstat Observed Bandwidth Capacity Widget.[17] Bandwidth test distribution patterns in Canada represent our baseline frame of reference; the Netherlands and Denmark represent European country with relatively high infrastructure competition, investment levels, FTTP penetration, and higher

[17] https://stat.ripe.net/

measured speeds than Canada; U.K., Germany, France, and Italy represent countries that exhibit relatively low median speed levels and incentives to deploy next generation FTTP networks have remained low, even relative to Canada. U.S. has a broadly similar degree of infrastructure competition as Canada, but double the FTTP penetration rate. Among European countries Sweden is furthest along in the long term transition from legacy to next generation broadband networks.

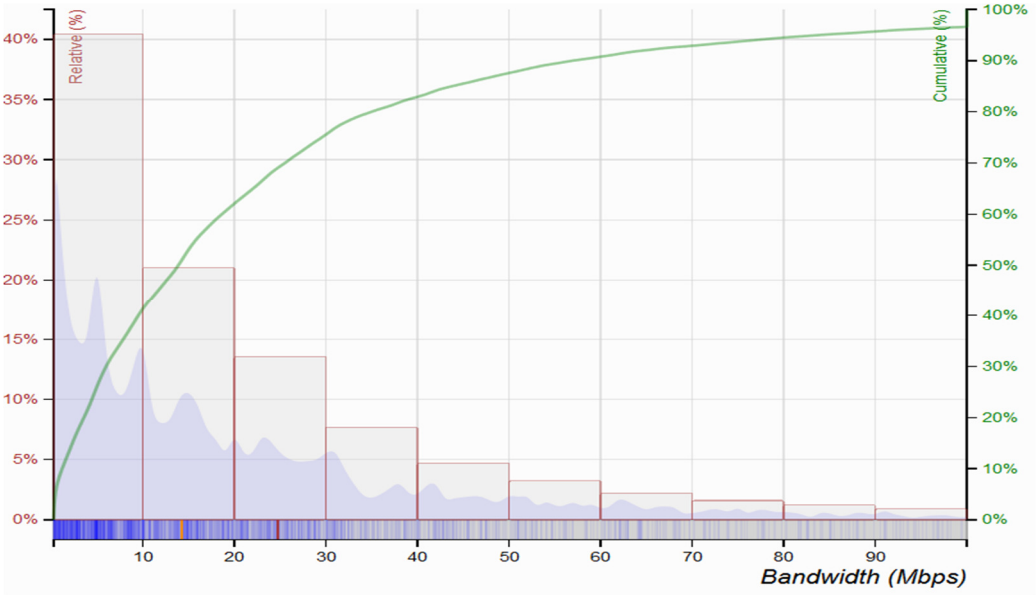

Figure 6. Distribution of Network Capacity in Canada (n=23,363)

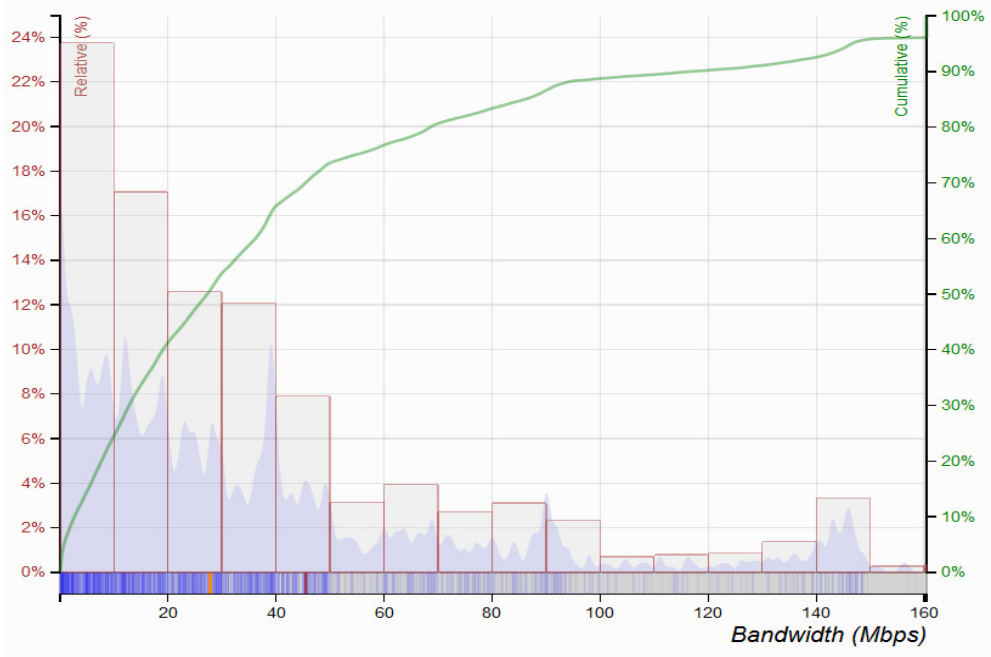

Figure 7. Distribution of Network Capacity in the Netherlands (n=13,007)

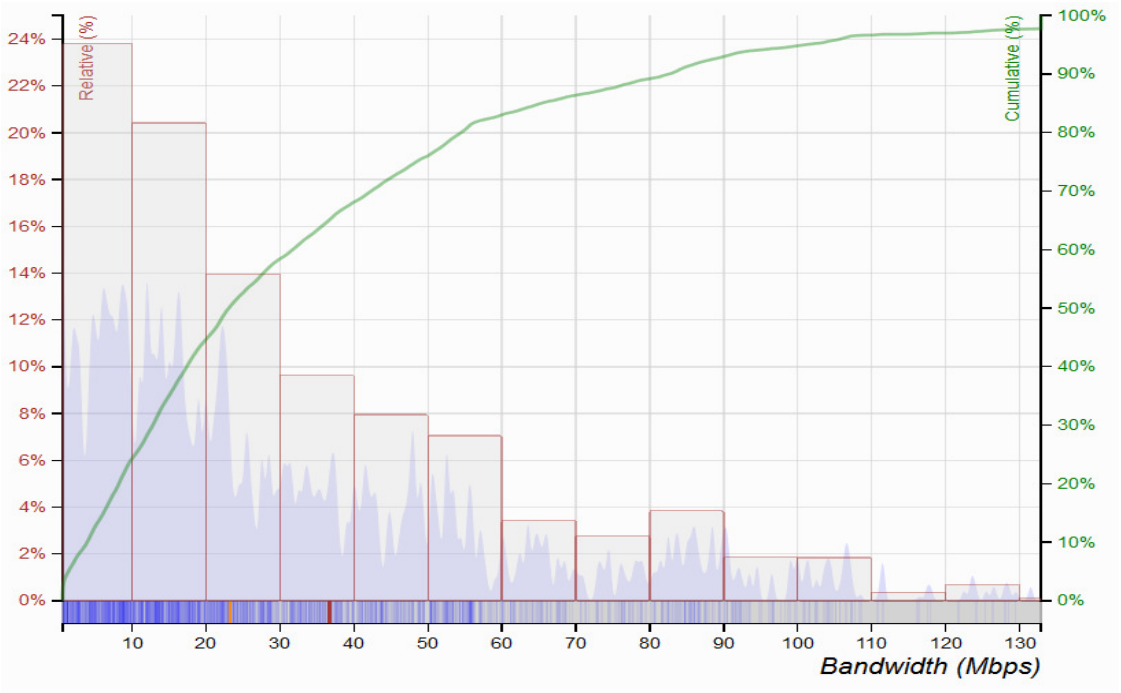

Figure 8. Distribution of Network Capacity in Denmark (n=3,358)

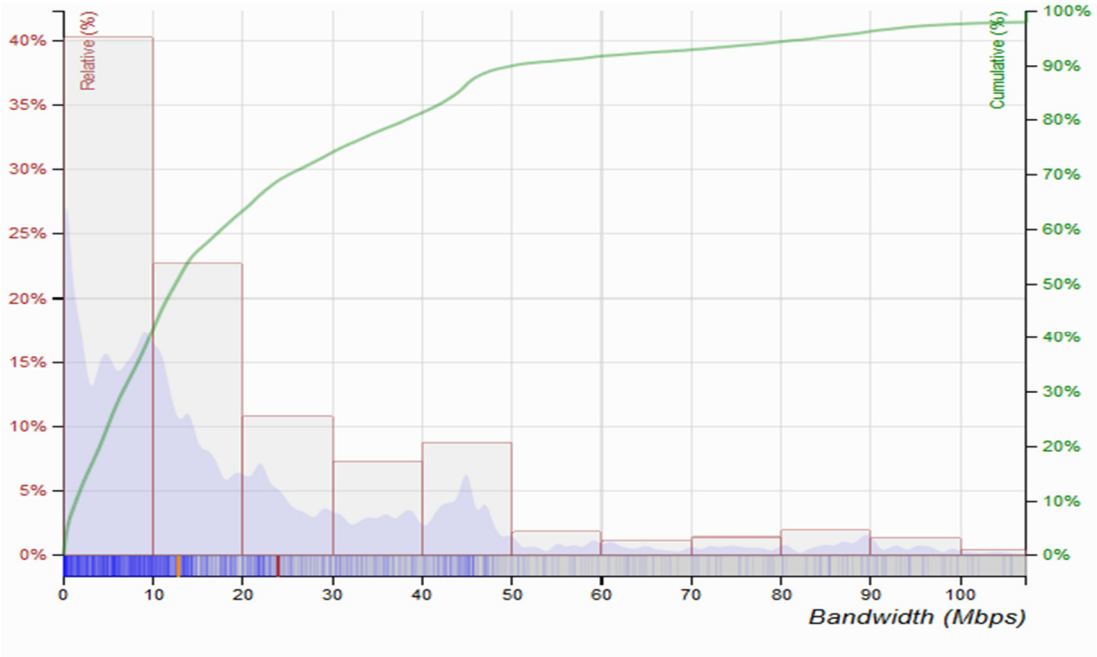

Figure 9. Distribution of Network Capacity in Germany (n=14,908)

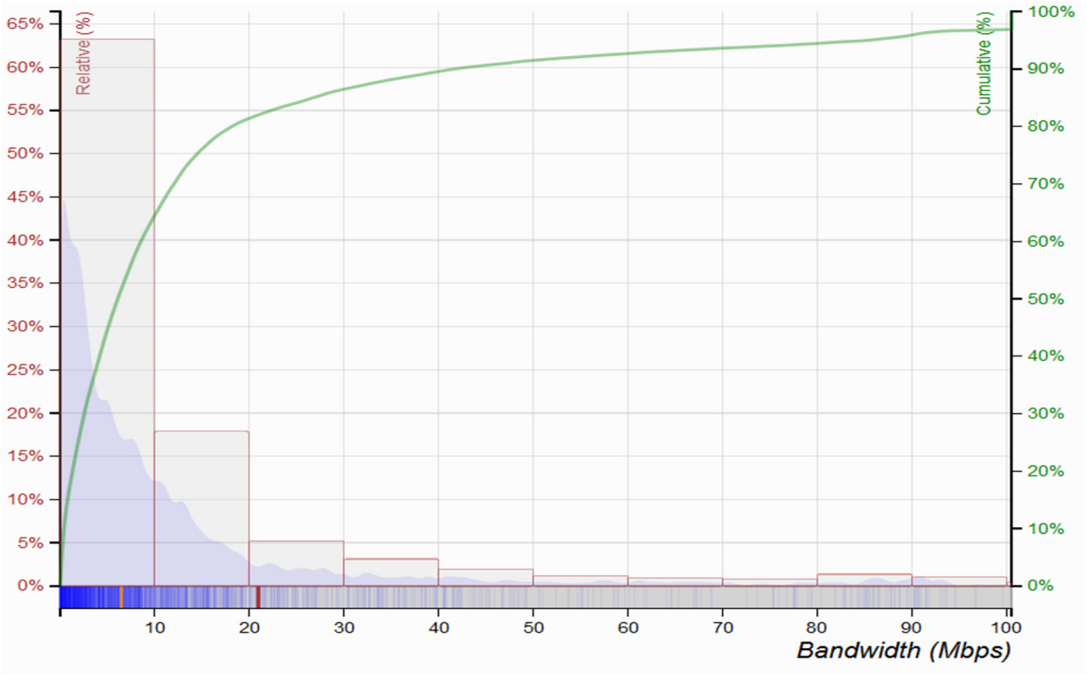

Figure 10. Distribution of Network Capacity in France (n=23,731)

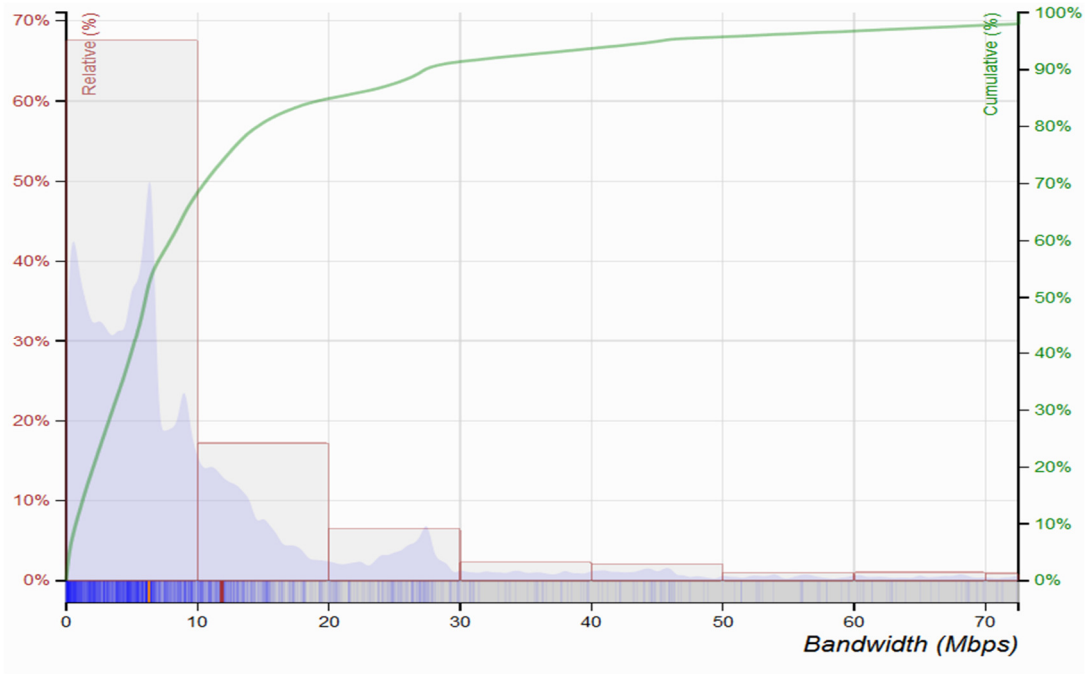

Figure 11. Distribution of Network Capacity in Italy (n=40,728)

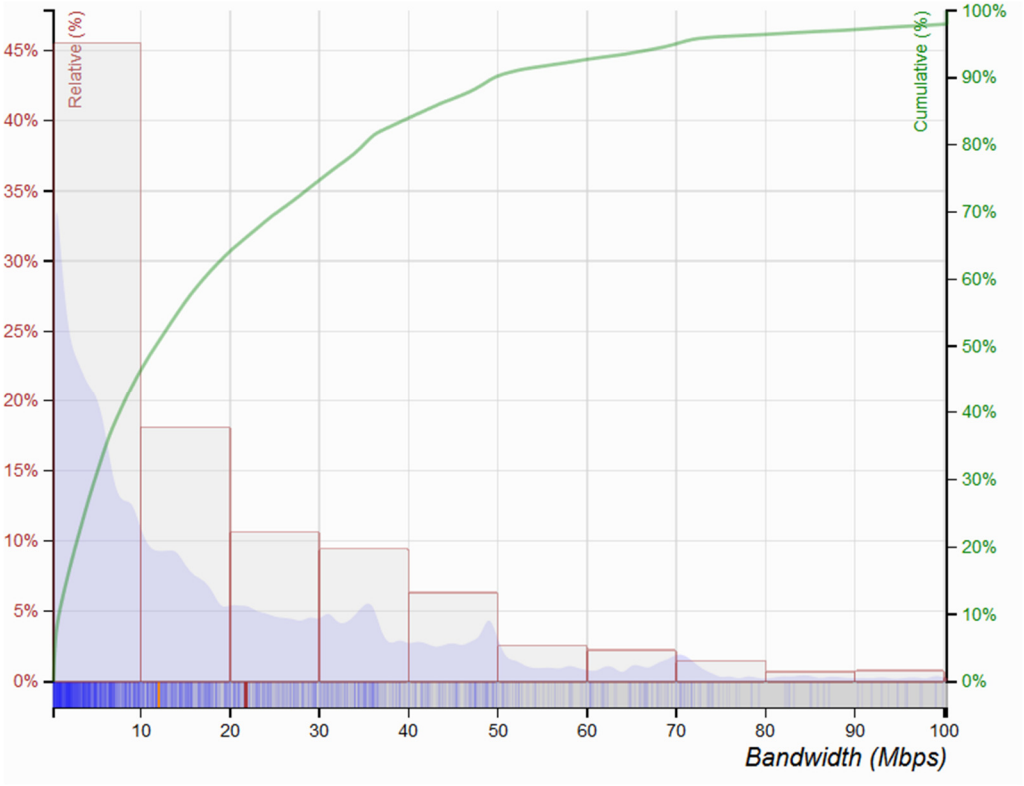

Figure 12. Distribution of Network Capacity in the UK (n=46,627)

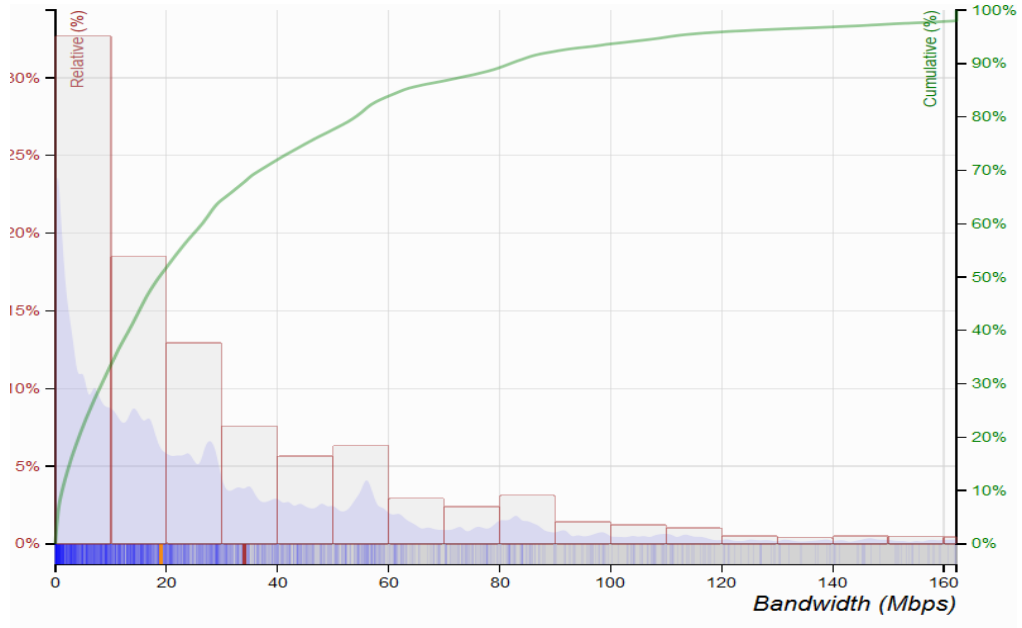

Figure 13. Distribution of Network Capacity in the US (n=99,999)

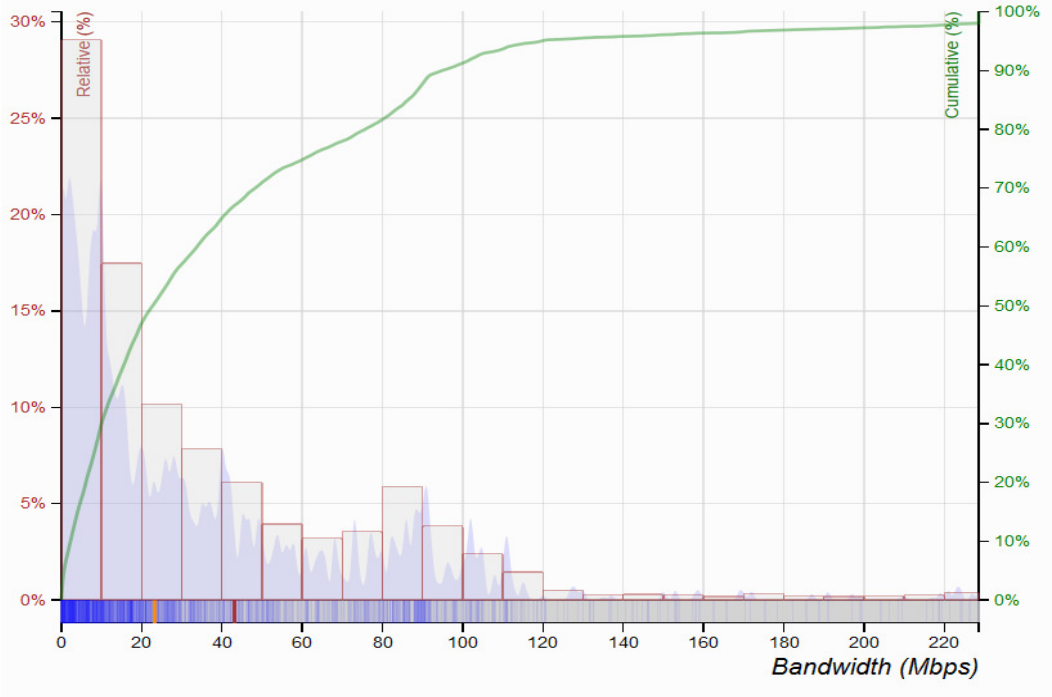

Figure 14. Distribution of Network Capacity in the Sweden (n=5,287)

Distribution of network outcomes in Canada illustrate limited access to higher speed connections, relative to Sweden, the Netherlands, Denmark, U.S. and even Germany, where FTTP penetration remains very low. For example, in Canada around 25% of connections were above 30 Mbps, which is around half of the nearly 50% of connections in the Netherlands, Sweden, and Denmark. Higher speed connections are more prevalent in the U.S. than Canada, but their proportions in U.K. and Germany are broadly similar to Canada. This is somewhat surprising given the heavy reliance on copper/DSL in the two countries compared to Canada where more than 50% of subscribers use cable broadband networks that can theoretically achieve higher speeds than DSL. In France and Italy where reliance on legacy copper/DSL technologies remains substantive, connections with above 30 Mbps of capacity represent only around 15% and 10% of the total respectively. In addition to a lack of access to higher speed options in these two countries, the majority of connection (~ 65%) were below 10 Mbps. This is substantially higher than other European countries where operators have also adopted a "sweating the copper" strategy such as U.K. and Germany (~40-45% of connections). Proportion of connections on the low speed basic service end of the market (below 10 Mbps) in Canada are about the same as U.K. and Germany at ~40%, but higher than U.S. (~35), Sweden (~30%), and Netherlands and Denmark (~25%).

There is little doubt the quality of broadband Internet connectivity in some European countries such as Italy and France is lagging behind U.S., Canada, and other European countries. This can create the perception that Europe is lagging behind North America and "European" policies

should therefore be avoided. There is little evidence to support this hypothesis as there are many European countries in which operators are delivering higher quality services than either Canada or the U.S. The fact that measured connection speeds in some countries with relatively low investment inputs and more reliance on legacy copper/DSL based broadband technologies, such as U.K. and Germany, are not substantially lower than those in Canada (and just slightly below the U.S.) further suggests infrastructure competition among legacy network operators may not be the most efficient model for translating investment inputs into network capacity enhancements. In order to shed further light on the complexity of the broadband ecosystems that can be hidden by aggregation of real world measurements into average and medians, future research could analyze how the distribution of network outcomes has evolved across countries with distinct policy regimes, market conditions, and business strategies of infrastructure operators.

IV. Conclusion

Although in certain European countries' past regulatory errors may have accentuated the incentives of incumbent operators to "sweat the copper" rather than invest in network capacity users demand, there is little evidence to suggest the European experience as a whole is such a disaster relative to Canada. The fact that relatively high investment inputs in Canada have not translated into FTTP diffusion and average performance (as measured by speed) remains at about the EU average (but 2 to 3 times below leading countries in Europe and Asia) suggests that infrastructure competition among legacy network operators may not be a very efficient arrangement for promoting innovation and creative destruction in the transition from sunset to sunrise technologies. The Canadian experience lends supports to previous research on Europe, which suggest policies that promote private sector cooperation and risk sharing can reduce the potential for inefficient duplication and encourage infrastructure operators to increase their rate of transition from legacy to next generation broadband platforms.

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