

Investment and Competition Effects
Creating Mandated Access for MVNOs through Public Wi-Fi Networks

Margaret Sanderson

**Investment and Competition Effects from
Creating Mandated MVNO Access to Wireless Networks in Canada by
Redefining MVNO Networks to Include Public Wi-Fi**

Prepared for Bell Mobility

by

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About the Author

Margaret Sanderson is a Vice President of the economic consulting firm Charles River Associates. She heads the firm's global Antitrust and Labor Group, which is comprised of the Antitrust & Competition Economics practice, and the Labor & Employment practice. Ms. Sanderson joined Charles River Associates in August 1998, and was made the Antitrust & Competition Economics practice leader in December 2006. Prior to joining Charles River Associates, Ms. Sanderson was Assistant Deputy Director of Investigation and Research within the Economics and International Affairs Branch of the Competition Bureau. Ms. Sanderson has over 25 years of experience examining the competitive effects of firm conduct between her work at the Competition Bureau and at Charles River Associates. She has published a number of articles and made presentations concerning a variety of issues in the field of antitrust economics. In addition to competition cases, Ms. Sanderson has assessed regulatory issues in the telecommunications and broadcasting sectors and has undertaken work in respect of securities regulation. She has prepared expert reports for submission to Canadian and U.S. courts, and for Canadian regulatory authorities on competition and regulatory matters. Ms. Sanderson has a Master of Science degree in Economics and Quantitative Methods from the University of Toronto.

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1. Introduction

This report is filed in response to the Canadian Radio-television and Telecommunications Commission (“Commission”) Telecom Notice of Consultation CRTC 2017-259, *Reconsideration of Telecom Decision 2017-56 regarding final terms and conditions for wholesale mobile wireless roaming service*. In the current proceeding the Commission will determine whether to broaden the definition of “home network” for wireless carriers to include Wi-Fi when determining eligibility for access to wholesale roaming on other providers’ wireless networks at regulated rates. In Telecom Regulatory Policy CRTC 2015-177 *Regulatory framework for wholesale mobile wireless services*, the Commission mandated wholesale roaming, which allowed end users of regional carriers¹ with a “home” network to access services on the “host” network of a national carrier² at rates determined by a Phase II costing process.³ In Telecom Regulatory Policy CRTC 2015-177, the Commission explicitly declined to mandate wholesale access to wireless networks for mobile virtual network operators (“MVNOs”).⁴ Instead, the Commission upheld its policy that mandated wholesale roaming is not available to providers without any investments in radio spectrum or radio access network (“RAN”).⁵ The Commission concluded that mandating wholesale access for MVNOs would discourage investment in wireless network infrastructure.

Although CRTC 2015-177 did not allow MVNOs to have direct regulated access to national networks, it did allow MVNOs that had entered into commercial agreements with a regional carrier to also enter into arrangements with those regional carriers whereby the regional carrier would re-sell to the MVNO regulated roaming services that the regional carrier acquires from a national carrier.⁶ In turn, Ice Wireless, a regional carrier with wireless network infrastructure

¹ Regional carriers include Ice Wireless, Freedom Mobile, Eastlink, Sasktel, and Videotron, among others.

² National carriers are Bell, Rogers and TELUS.

³ Telecom Regulatory Policy CRTC 2015-177, “Regulatory framework for wholesale mobile wireless services,” paragraph 139.

⁴ An MVNO is a wireless provider that does not own spectrum or operate its own radio access network (RAN). Instead it relies on the spectrum and RAN of a wireless carrier and in some cases it may also rely on other facilities and services in order to provide mobile wireless services to consumers.

⁵ CRTC 2015-177, at paragraph 121: “Investment in wireless network infrastructure by wireless carriers is important to ensure that Canadians have access to mobile wireless networks and services of high quality in all regions of Canada. The new entrants have made and are planning to make significant investments in spectrum and their wireless networks. The Commission considers that mandating wholesale MVNO access at this time would significantly undermine these investments, particularly outside urban core areas.”

⁶ CRTC 2015-177, paragraph 167.

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in the North, re-sold regulated roaming that it had on Rogers' network to the MVNO Sugar Mobile, which Sugar Mobile used to offer wireless services to Canadians anywhere served by Rogers' network by first providing its wireless customers with access to public Wi-Fi with access to Rogers' network through roaming provided where public Wi-Fi was not available. An important consequence of this type of offering is Sugar Mobile could sell wireless service to end users who live (or have their businesses) anywhere in Canada, such that Sugar Mobile's customer base would not be restricted to customers who reside (or have a business in) Ice Wireless' home territory.⁷

In Telecom Decision CRTC 2017-56 *Wholesale mobile wireless roaming service tariffs – Final terms and conditions*, the Commission clarified that the definition of “home” network that applies in its roaming decision does not include public Wi-Fi networks,⁸ but instead is defined to be investments in RAN. In reaching this conclusion, the Commission maintained that regional carriers, and the MVNOs that purchase roaming on the networks of national carriers from regional carriers, can provide wireless service only to customers located in the regional carriers' operating areas. Had the Commission decided otherwise, MVNOs would avoid the regulatory requirements faced by regional carriers, and MVNOs would circumvent the Commission's decision not to mandate wholesale access to national networks to MVNOs directly, which is what Sugar Mobile ultimately did. As the Commission determined in its original decision, MVNOs that fail to make investments in either RAN (or the public Wi-Fi networks which they utilize) are evading the established regulatory requirements that are designed to encourage greater investment in wireless infrastructure in Canada.

The Governor in Council has required the Commission to reconsider its decision in CRTC 2017-56. In so doing, the Commission has called for comments to address a number of questions in Telecom Notice of Consultation CRTC 2017-259, two of which I discuss in this report, namely:

- How would an expanded definition of “home network” impact competition in the market for retail mobile wireless services?

⁷ Ice Wireless had a network in the territories and Northern Quebec, and Sugar Mobile sold wireless service primarily to customers who were located elsewhere in Canada.

⁸ The Commission issued CRTC 2017-57 on the same date as its publication of CRTC 2017-56. CRTC 2017-57 was concerned specifically with whether the business models of Sugar Mobile and Ice Wireless were consistent with the Commission's ruling in CRTC 2015-177. The Commission ruled that they were not, and ordered the companies to cease making unauthorized use of Rogers' network.

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- How would an expanded definition of “home network” impact investment in mobile wireless network infrastructure?

When considering the effect an expanded definition of “home network” would have on “competition”, I focus on the outcomes from the competitive process, as opposed to the count of suppliers or count of product offerings in the marketplace. Economists and policymakers are advocates for competition not as an end in itself, but because competitive rivalry between suppliers is typically the most effective means by which consumers are provided with a wide selection of well-priced goods and services. In turn, the competitive process drives suppliers to adopt cost-efficient processes and to invest in developing new and innovative products and services in order to win customers from rival firms.

In the case of Sugar Mobile, its offering was targeted to consumers with relatively limited voice and data requirements on wireless networks, while requiring consumers to have a smartphone to be able to use public Wi-Fi networks. If other MVNOs were to position themselves similarly, the predominant effect on competition – if any – is likely to be a “business stealing” effect where share losses would most likely come from other carriers that target consumers requiring lower usage of cellular networks. An expanded definition of home network that includes public Wi-Fi is highly unlikely to expand overall demand for wireless services in Canada generally or result in materially lower average prices throughout the industry. As a result, competitive outcomes are unlikely to be materially improved even though there would be some turnover of customers attracted to public Wi-Fi oriented MVNOs.

Demand for wireless services in Canada – as measured by smartphone penetration – is unlikely to be expanded by public Wi-Fi oriented MVNOs beyond what it would be without these carriers. Penetration has grown in Canada at relatively faster rates than in other countries prior to the entry of Sugar Mobile. Changing the definition of “home network” to include public Wi-Fi oriented MVNO offerings is unlikely to expedite penetration rates beyond what they would be without the change. At this stage, Canada already ranks among the top six countries in the world for smartphone penetration. More generally, there is no indication that countries which mandated MVNO access have increased penetration rates beyond what they would have been without mandated MVNO access. Thus, it is unlikely that a public Wi-Fi-oriented MVNO gaining the equivalent of mandated MVNO access would expand demand for wireless services in Canada.

Average industry prices to consumers are unlikely to be reduced with the entry of public Wi-Fi oriented MVNOs. The restrictions on the use provided by public Wi-Fi oriented MVNOs like Sugar Mobile mean that these services likely appeal only to a small subset of wireless subscribers in Canada. For customers with low demand for voice minutes and wireless data,

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low-cost alternatives already exist in the market. For the majority of wireless subscribers in Canada that purchase larger plans, a public Wi-Fi oriented carrier is likely to be an unattractive alternative that is unlikely to greatly influence pricing. In other countries where MVNO access has been mandated by regulators, industry concentration was far greater than exists in Canada today, which is further evidence that providing for mandated MVNO access in Canada through a change in the definition of home network, is unlikely to materially lower average wireless prices in Canada. In particular, the wireless markets in 14 out of 17 countries with mandated MVNO access, were more highly concentrated (based on the Herfindahl-Hirshman Index commonly used by antitrust enforcement agencies to measure market concentration) at the time of mandating MVNO access compared to the current Herfindahl-Hirshman Index in Canada.⁹

Finally, the MVNO offer provided by public Wi-Fi oriented MVNOs is not unique in offering Wi-Fi enabled calling. There are many applications (“apps”) that are widely available that allow Canadians to make calls over Wi-Fi and do not require access to wireless networks. Wi-Fi calling apps, such as Fongo, Skype, and others, allow customers to make calls over Wi-Fi including to landlines and mobile numbers at a small cost. As a result, the Sugar Mobile offer is not particularly innovative in the marketplace.

While there is little to suggest there would be meaningful improvements in competitive outcomes from redefining “home network” in a way that allows public Wi-Fi oriented MVNOs to circumvent the Commission’s and government’s investment requirements related to mandated roaming, the impact on investment is clearly negative. Whether MVNOs, regional carriers or national carriers are considered, all have a reduced incentive to invest when competing against MVNOs using public Wi-Fi networks.

- Consider MVNOs first. MVNOs will not invest more with a redefined home network because the networks being used are not owned or operated by MVNOs, but instead are public Wi-Fi and national carrier networks to which MVNOs gain access through roaming rights. Even with respect to the public Wi-Fi network which carriers like Sugar Mobile require to provide service, they make no investments in the network that their customers are using, because that network is “public.” In fact, the investments made in public Wi-Fi networks have been made by private and government organizations as opposed to the MVNO. In essence, the MVNO free rides on investments made by others in Wi-Fi networks and makes no investments in RAN that national and regional carriers invest in to provide services to wireless subscribers.

⁹ See the discussion below in Table 2 and section 3.2.

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- Next consider regional carriers. For the regional carrier like Ice Wireless through which Sugar Mobile acquires roaming rights, redefining “home network” is not likely to increase or alter its investment strategy with respect to building out its network. To the extent that Ice Wireless benefits more from selling roaming rights than selling services to subscribers within its home territory, its focus may shift away from investments needed to enhance its wireless services to its home territory subscribers.
- For other regional carriers like Freedom Mobile, Eastlink and Videotron that may lose share to public Wi-Fi oriented MVNOs, their incentive to invest is reduced, all else being equal, as their subscriber bases are reduced. A smaller subscriber base means fewer subscribers over which a given regional carrier can amortize capital expenditures, while also reducing the total financial returns available to undertake network infrastructure investments. Regional carriers will have less incentive to invest in their existing wireless networks since MVNOs may gain subscribers at the regional carrier’s expense without the MVNO undertaking comparable investments to provide wireless services. Regional carriers may also opt to make greater use of public Wi-Fi networks rather than building out their own networks into smaller centres.
- Finally consider national carriers. The likely effect on national networks’ investment incentives is also negative. Mandated roaming access rates are based on Phase II costing. Phase II costing – like many other regulatory costing methods – generally undercompensates national carriers for their costs of investment as is well documented in the economics literature. Reduced incentives to invest may result in meaningful reductions in actual investments. In a comprehensive study of investment intensity involving 21 countries (including Canada), countries with mandated MVNO access were found to have had lower investment intensity by mobile network operators (which are the equivalent of the national carriers in Canada) of 17.1% after controlling for other factors that explain firm investment.¹⁰

In summary, all parties have reduced incentives to invest with an altered definition of home network. On balance, there is no clear benefit to consumers from expanding the definition of home network to include public Wi-Fi. Competitive outcomes are not significantly improved, and all market participants’ investment incentives are reduced. Overall, there is little to no

¹⁰ Kim, Jihwan, Yunhee Kim, Noel Gaston, Romain Lestage, Yeobnae Kim, and David Flacher, “Access regulation and infrastructure investment in the mobile telecommunications industry,” *Telecommunications Policy*, 35 (2011), 907-919. For a detailed discussion, see section 4.1.

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consumer benefit from the Commission reversing its prior decisions and a significant risk of harm from sub-optimal investment in wireless networks.

I expand on these summary conclusions in the following sections. Section 2 describes MVNOs and provides greater detail on the public Wi-Fi oriented MVNOs offering. Section 3 discusses whether competitive outcomes would be improved by redefining home network. Section 4 discusses the economics literature on investment incentives when mandated access is required by regulators. Section 5 provides a brief conclusion.

2. MVNO Overview

MVNOs are described by the Commission as relying “on some or all components of a wireless carrier’s network, including the RAN, to provide retail services.”¹¹ An MVNO that supplies most of the components of a network apart from the RAN is referred to as a full MVNO.¹² Branded resellers provide marketing services, distribution channels, and billing services, but rely on wireless carriers for the rest of their business, including the operation of the network. While MVNO models vary, they all require access to the RAN of a wireless carrier.”¹³

MVNOs in Canada do not use public Wi-Fi as their home network in order to gain access to a broader host network through roaming agreements. Instead, the MVNO acts as a reseller of a national carrier’s network, often serving a niche set of consumers. For example, PhoneBox targets foreign students and travelers,¹⁴ and good2GO Mobile targets consumers interested in low-cost, no-contract wireless services.¹⁵ PhoneBox and good2GO Mobile both contract with Rogers for wireless network access. Additional MVNOs in Canada include 7-Eleven Wireless and PetroCanada Mobility. All MVNOs in Canada (with the exception of Sugar Mobile) access the networks of national carriers under commercial agreements.

¹¹ CRTC 2015-177, paragraph 43.

¹² Ibid.

¹³ Ibid.

¹⁴ See <https://qophonebox.com/>.

¹⁵ See <http://canada.good2gomobile.com/pick-your-plan>.

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2.1 Public Wi-Fi service targets subscribers with low use of mobile wireless networks

Public Wi-Fi oriented MVNOs like Sugar Mobile are likely to target subscribers with relatively low wireless usage requirements. In the case of Sugar Mobile,¹⁶ it has one plan for which the user requires her own unlocked iPhone or Android device. An app needs to be installed on the device before using Sugar Mobile services. The monthly plan includes unlimited talk and text in Canada and the United States using public Wi-Fi, but only 400 MB of non-Wi-Fi data in Canada and the U.S., which the end user can use for voice, text, email, or internet use.¹⁷ The geographic scope available to a user will depend on access to public Wi-Fi. Where public Wi-Fi is not available the Sugar Mobile plan is equivalent to one that has a total of 400 MB of usage. The basic plan includes caller ID and call waiting. Call forwarding and voicemail can be purchased for additional fees. Additional non-Wi-Fi data of 500 MB can also be purchased.

Whether the Sugar Mobile offer is attractive depends on the subscriber's location and usage. With relatively low cellular network access, the subscriber is highly dependent on being located in an area with extensive access to public Wi-Fi. There are other plans available from regional carriers and the national carriers' shared and flanker plans that provide low-cost, low-usage options for subscribers. Details of these options are discussed in the report filed by Wall Communications Inc., *A Research Report Examining Affordability in the Canadian Mobile Wireless Market*.¹⁸ Other plan prices are higher but with fewer usage restrictions.

2.2 Other Wi-Fi calling options

Canadians have access to a wide variety of Wi-Fi calling apps that do not rely on wireless networks. These apps include Skype, Fongo, Viber, WhatsApp, Facebook Messenger, and Apple's built-in iMessage and FaceTime. Mobile users with access to public Wi-Fi can use these apps to make voice calls to other users who have installed the app. For example, Fongo is a Waterloo Ontario-based startup that provides VoIP services to which users can port their mobile numbers. The service comes with unlimited Canada-wide calling and texting for free over Wi-Fi.¹⁹ Like Sugar Mobile, this service also includes voicemail, caller ID, call waiting

¹⁶ Sugar Mobile's service was introduced in late 2015. For an early media coverage of Sugar Mobile services, see <https://mobilesyrup.com/2015/12/24/sugar-mobile-uses-old-tricks-to-challenge-the-canadian-telco-status-quo/>.

¹⁷ Sugar Mobile's website indicates that 400 MB of data is equivalent to calling for up to 1,200 minutes, or sending 40,000 text messages, or sending or receiving up to 8,000 Snap Chats, or talking for up to 160 minutes on Facetime, or sending or receiving up to 4,000 emails without attachments, or sending or receiving up to 800 emails with attachments, or making up to 1,600 posts on Facebook, Twitter or Instagram, or viewing up to 2,000 webpages. See www.sugarmobile.ca.

¹⁸ Wall Communication Inc., "A Research Report Examining Affordability in the Canadian Mobile Wireless Market", 2017.

¹⁹ See <https://www.fongo.com/>.

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and call forwarding. In addition, Viber and Skype users can make calls to landline and mobile numbers for relatively low fees (in addition to any cost that the user may have to pay for Wi-Fi or wireless data): Viber charges 1.9 US cents/minute for voice calls, and Skype offers a monthly subscription of CAN\$4.00 for unlimited minutes or 3.1 cents/minute for pay-as-you-go.²⁰⁻²¹ These apps are used by consumers worldwide, and are growing in popularity. As of January 2017, Viber, Skype, WhatsApp, and Facebook Messenger were reported to have worldwide 249 million, 300 million, 1 billion, and 1 billion monthly active users respectively.²²

3. Limited Benefits to Competitive Outcomes from Expanding Definition of “Home Network” to Include Public Wi-Fi

In this section I discuss how competitive outcomes might be affected by expanding the definition of “home network” to include public Wi-Fi. International comparisons are made to situate Canada with and without mandated MVNO access for MVNOs using public Wi-Fi as a home network.

3.1 Public Wi-Fi MVNOs are unlikely to significantly expand demand for wireless services in Canada

There is limited scope for public Wi-Fi oriented MVNOs to increase total demand for wireless services in Canada. Canada already has one of the highest smartphone penetration rates in the world.

- For example, a study by Catalyst found that 76% of Canadians owned smartphones, based on a survey conducted in April 2016.²³ This represents a 21 percentage point increase from 55% smartphone ownership in 2014.
- A study by Newzoo found the smartphone penetration rate in Canada in April 2017 was 69.8%, behind only five other countries (United Arab Emirates, Sweden,

²⁰ See Viber's calling rate at <https://account.viber.com/en/call-canada>.

For Skype calling rate, see <https://secure.skype.com/en/calling-rates?expo365=empty>

²¹ Unlike Fongo or Sugar Mobile, currently Skype users in Canada cannot obtain a phone number at which they can be reached. However this service is available for Skype users in other jurisdiction. For more detail, see <https://secure.skype.com/skypein/start>.

²² For statistics on monthly active users for mobile messaging apps, see <https://www.statista.com/statistics/258749/most-popular-global-mobile-messenger-apps/>.

²³ See <http://catalyst.ca/2016-canadian-smartphone-behaviour/>.

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Switzerland, South Korea, and Taiwan).²⁴ In the Newzoo 2017 study, a smartphone user is anyone using a smartphone at least once a month.

- Cisco reports that in Canada in 2016, smartphones account for 59.2% of all device connections, lagging only China in the G20.²⁵

As shown in Table 1 below, Canada's smartphone adoption rate, is currently ranked 6th in the G20 country groups.²⁶

²⁴ See <https://newzoo.com/insights/rankings/top-50-countries-by-smartphone-penetration-and-users/>. See also https://en.wikipedia.org/wiki/List_of_countries_by_smartphone_penetration#cite_note-1.

²⁵ See https://www.cisco.com/assets/sol/sp/vni/forecast_highlights_mobile/#~Country. Note that Cisco uses a broad definition of devices connection, which include smartphones, non-smartphones, tablets, laptops, gaming consoles, entertainment systems, and other smart devices.

²⁶ Smartphone adoption rate is smartphone connections expressed as a percentage share of total connections (excluding machine-to-machine).

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Table 1: G20 countries ranking by smartphone adoption rate, as of Q2 2017

Country	Smartphone adoption	Ranking
South Korea	81.26%	1
Australia	80.87%	2
France	80.44%	3
United States of America	79.73%	4
United Kingdom	76.88%	5
Canada	76.10%	6
Turkey	72.26%	7
Brazil	71.63%	8
China	71.20%	9
Saudi Arabia	67.32%	10
Germany	65.04%	11
Italy	64.30%	12
Mexico	60.99%	13
Indonesia	58.29%	14
Russian Federation	57.39%	15
Japan	56.86%	16
Argentina	52.58%	17
South Africa	45.64%	18
India	30.42%	19

Note: The G20 group also include the European Union. Due to the divergence in smartphone adoption across EU countries, we do not report an average number for the EU here.

Calculations made by Charles River Associates using information obtained from GSMA Intelligence.

Outside Canada, in countries where wholesale access for MVNOs to incumbent wireless networks has been mandated by regulators, there is no indication that mandated access for MVNOs increased penetration rates above and beyond what penetration rates would have been without mandated MVNO access.

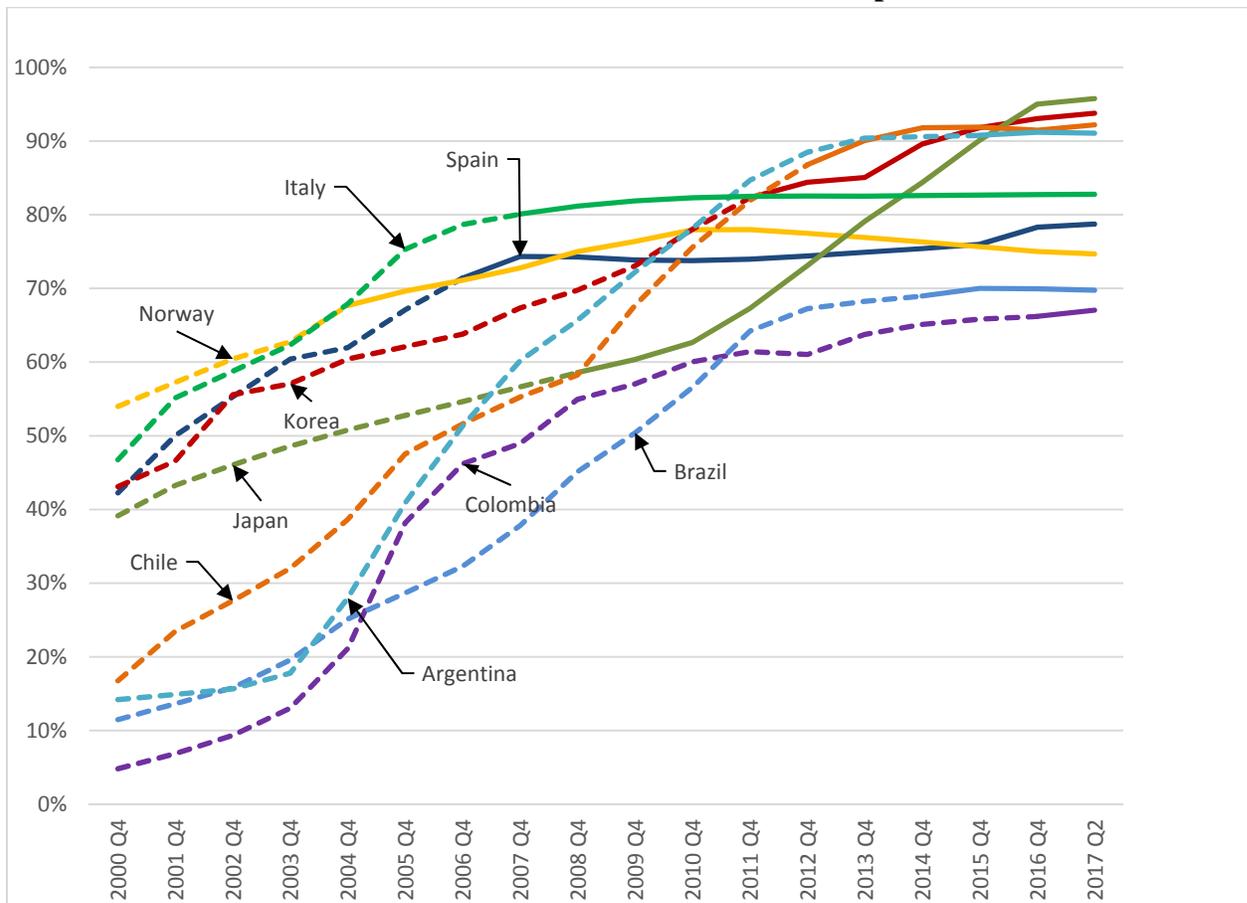
Mandated MVNO access can be categorized into three groups depending on the type of regulations that gives rise to access, namely access through market power analysis, through merger review, and as a condition of spectrum licensing. The following figures compare penetration rates from Quarter 2, 2007 to Quarter 2, 2017 for each of these three groups of countries with mandated MVNO access. For each country, we distinguish the time period before MVNO access was mandated by using a dotted line and the time period after access was mandated is represented by a solid line.

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Figure 1: Penetration rate by unique subscribers
Countries with mandated MVNO access due to market power concerns



Note: The dotted line represents the time period before MVNO access was mandated.

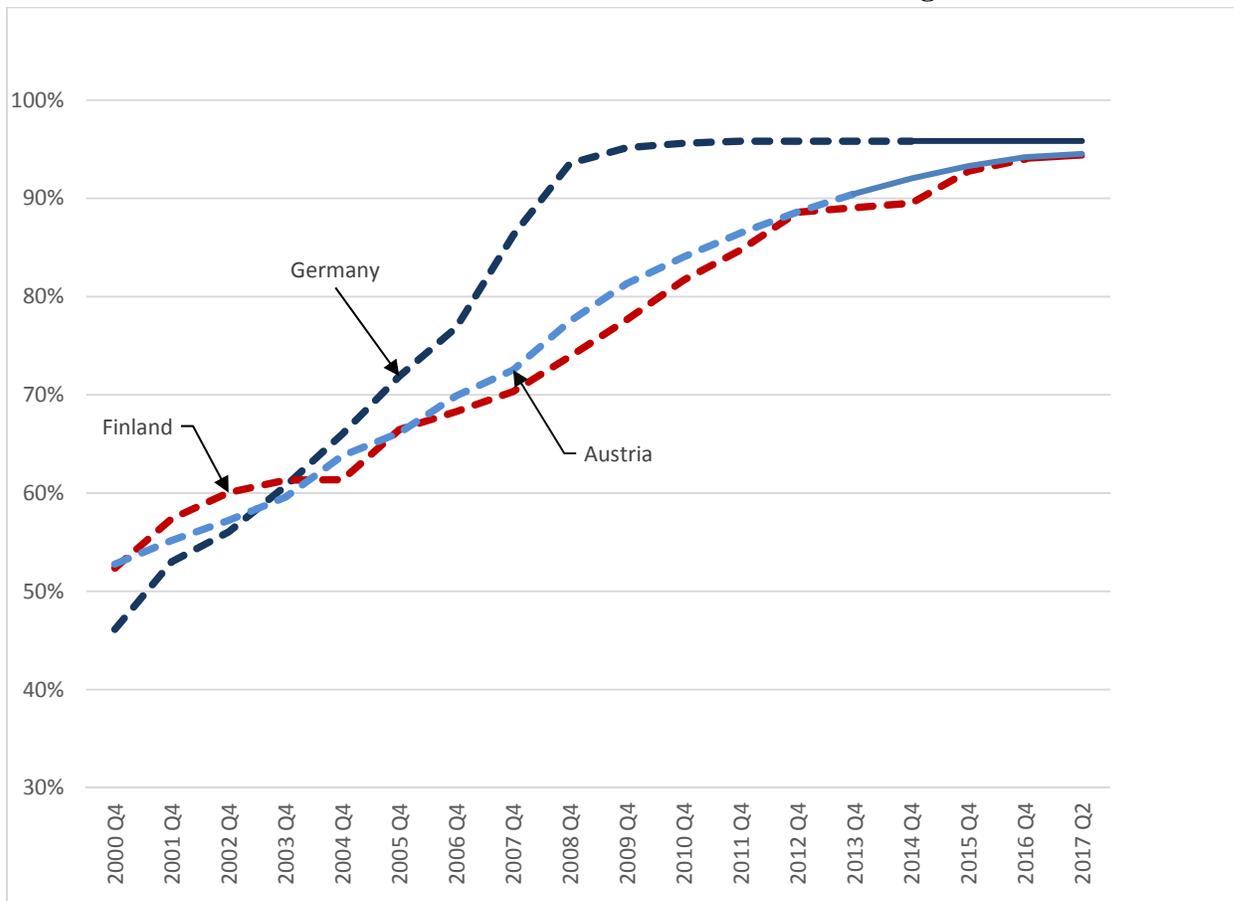
Source: Penetration rate from GSMA Intelligence. Date of mandated access is compiled from various sources.

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Figure 2: Penetration rate by unique subscribers
Countries with mandated MVNO access further to a merger review



Note: The dotted line represents the time period before MVNO access was mandated.

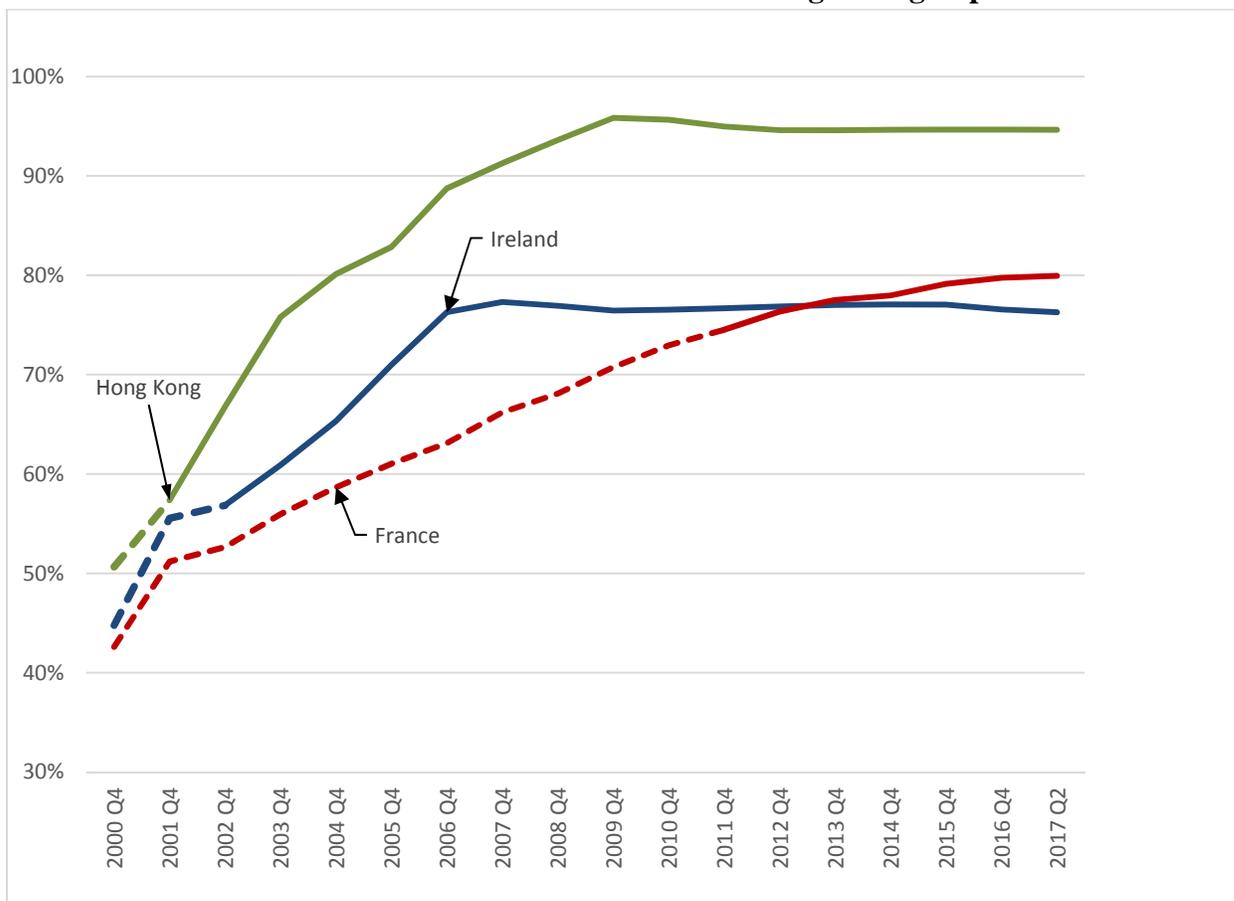
Source: Penetration rate from GSMA Intelligence. Date of mandated access is compiled from various sources.

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Figure 3: Penetration rate by unique subscribers
Countries with mandated MVNO access as a condition of granting a spectrum licence



Note: The dotted line represents the time period before MVNO access was mandated.

Source: Penetration rate from GSMA Intelligence. Date of mandated access is compiled from various sources.

These figures show that mandating MVNO access did not cause a material increase in the growth rate of mobile penetration in any country where such access was mandated. Instead, the slope of the line showing penetration rate growth over time is not steeper after mandated access was provided to MVNOs. Instead, the rate of growth in penetration continued on its earlier path even after mandating MVNO access.

Given the lack of evidence that penetration grew with mandated MVNO access, to the extent that MVNOs that benefitted from mandated access increased their market share, this would have occurred at the expense of existing carriers. The international experience suggests that, if the Commission were to broaden the definition of “home network” in Canada and thereby enable public Wi-Fi oriented MVNOs, this would not have a material impact on mobile uptake in Canada.

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3.2 MVNOs access regulations in other countries

In several countries, wireless carriers were required to provide MVNO access as a condition of approval of a merger or acquisition. This has occurred in Austria, Denmark, Finland, Germany, Ireland, Italy, and Norway. In other countries, MVNO access is mandated *ex ante* as the result of a market review or as a condition for obtaining spectrum licences. Comparing Canada to countries that have regulated mandated access for MVNOs, in nearly every instance, market concentration was higher than industry concentration in Canada is today.

As many of these countries mandated MVNO access owing to market power or merger concerns, it is useful to compare their levels of market concentration to Canada's today. Below, I report a commonly used measure of market concentration known as the Herfindahl-Hirshman Index ("HHI")²⁷ for various countries where MVNO access was mandated. The HHI measure is calculated just prior to the time that regulators imposed mandated access. Market shares used in the HHI calculation are shares of connections.²⁸ Countries in this table are ranked by industry concentration at the time that MVNO access was mandated. I have included Canada in this table, with Canada's HHI evaluated using data for Q2 2017. Out of 17 countries with mandated MVNO access, the HHI was higher at the time of mandating MVNO access compared to the current HHI in Canada in 14 countries. If the Commission were to change the definition of "home network", it would be mandating MVNO access in a market that is less concentrated compared to the concentration levels that existed in most any other country where mandated MVNO access has been imposed by regulators.

²⁷ The HHI is calculated by first squaring each individual firm's share within the market, and second taking the sum of the squared individual firm shares. Third, this sum of squared shares is multiplied by 10,000. The HHI is a measure of concentration that is commonly used by antitrust enforcement agencies to assess market power in mergers and other competition matters. A monopolist in a market would generate an HHI equal to 10,000.

²⁸ According to GSMA Intelligence, HHI is calculated as "the sum of the squares of market share by connections for all MNOs in a market."

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Table 2: Market concentration at the time of mandating MVNO access in countries where MVNO access is mandated v. concentration in Canada in Q2 2017

Country	Herfindahl-Hirschman Index (HHI)	Ranking by HHI
Ireland	4,870	1
Norway	4,319	2
Colombia	4,106	3
Peru	3,973	4
Korea	3,792	5
France	3,773	6
Japan	3,649	7
Spain	3,589	8
Chile	3,465	9
Finland*	3,229	10
Argentina	3,139	11
Italy	3,085	12
Austria*	2,966	13
Germany*	2,625	14
Canada	2,590	15
Malaysia	2,517	16
Brazil	2,462	17
Hong Kong	1,944	18

* MVNO access mandated as a condition of merger approval.

Note: The HHI as of the last quarter before MVNO access was mandated is reported.

Source: Herfindahl-Hirschman Index is reported by GSMA Intelligence. Mandated access date is compiled from various sources.

Moreover, currently the HHI in Canada is one of the lowest among countries that do not mandate MVNO access. Table 3 below shows the HHIs at the time MVNO access was mandated just prior to imposition of the mandate for mandate countries, and also shows HHIs as of Q2 2017 for countries where MVNO access is not mandated. As can be seen from Table 3, MVNO access tends to be mandated when HHIs are relatively high. Among the 13 countries in the sample where MVNO access is not mandated, there are only three countries (Poland, Sweden, and Denmark) that have an HHI lower than Canada. Furthermore, there are three countries where MVNO access was mandated as a condition of merger approval (Finland, Austria, and Germany—these countries are denoted by an asterisk in Tables 2 and 3), which is not the situation that the Commission is considering here.

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Table 3: Market concentration in MVNO mandated and non-mandated countries

Country	Mandated MVNO access?	Herfindahl-Hirschman Index (HHI)
Ireland [Q1 2002]	Yes	4,870
Norway [Q3 2003]	Yes	4,319
Colombia [Q3 2015]	Yes	4,106
Peru [Q4 2015]	Yes	3,973
Australia [Q2 2017]	No	3,884
Greece [Q2 2017]	No	3,812
Korea [Q3 2010]	Yes	3,792
France [Q2 2011]	Yes	3,773
Japan [Q3 2007]	Yes	3,649
Spain [Q4 2005]	Yes	3,589
New Zealand [Q2 2017]	No	3,488
Belgium [Q2 2017]	No	3,483
Chile [Q3 2011]	Yes	3,465
Czech [Q2 2017]	No	3,419
Portugal [Q2 2017]	No	3,371
Finland [Q3 2015]*	Yes	3,229
Argentina [Q3 2014]	Yes	3,139
Italy [Q1 2007]	Yes	3,085
Slovakia [Q2 2017]	No	2,980
Austria [Q3 2012]*	Yes	2,966
UK [Q2 2017]	No	2,741
US [Q2 2017]	No	2,658
Germany [Q2 2014]*	Yes	2,625
Canada [Q2 2017]	No	2,590
Poland [Q2 2017]	No	2,562
Malaysia [Q1 2016]	Yes	2,517
Sweden [Q2 2017]	No	2,506
Brazil [Q2 2014]	Yes	2,462
Denmark [Q2 2017]	No	2,331
Hong Kong [Q4 2000]	Yes	1,944

* MVNO access mandated as a condition of merger approval.

Note: For countries with mandated MVNO access, the HHI as of the last quarter before MVNO access was mandated is reported. For countries with non-mandated MVNO access, the HHI as of Q2 2017 is reported. See reporting date in bracket.

Source: Herfindahl-Hirschman Index is reported by GSMA Intelligence. Mandated MVNO access dates are compiled from various sources.

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To summarize, when MVNO access has been mandated elsewhere, this has occurred in markets that were far more concentrated than Canada is today. Further, among countries without mandated MVNO access, Canada is one of the least concentrated. Even so, the international experience shows that mandating MVNO access did not accelerate penetration trends.

For Canada, redefining a “home network” to allow public Wi-Fi oriented MVNOs to have roaming without meeting the investment requirements that other carriers need to meet to have roaming will not likely meet the needs of a majority of Canadian wireless subscribers, who have usage patterns that make the plans of national and regional carriers more attractive. Public Wi-Fi oriented MVNOs target a niche segment of the market, and many similar options already exist in the Canadian market for this segment.²⁹ Enabling public Wi-Fi oriented MVNOs will simply fragment this niche segment and will thereby reduce the incentives of existing carriers to invest in improving service quality for consumers in this segment. I discuss these altered investment incentives in the next section.

4. Mandated MVNO Access and Investment

There is a substantial literature that studies the investment effects of mandating access to incumbent carrier networks for entrants and other carriers like MVNOs. These studies consider the effects of mandated access on the investments being made by entrants and incumbents. An important consideration for regulators when determining whether to mandate network access is how wireless carriers will resolve the “build versus buy” decision. Carriers – like MVNOs or regional carriers – that are granted mandated access to national carrier networks may choose to rely on mandated access to those networks (“buy”) rather than building their own networks (“build”), or delay building out their own networks. Reliance on access to national networks or delays in build-outs runs contrary to the policy adopted by most regulators, including the Commission, of promoting facilities-based competition.³⁰ Regulators generally seek to discourage excessive “buying” by managing access rates and placing time limits on access to encourage “building”.

²⁹ See Section 3 of the 2017 report filed by Wall Communications Inc.

³⁰ One of the primary policy objectives of the 1996 Telecommunications Act in the US was to promote facilities-based competition in the provision of local telecommunications services.

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The Commission's recent decisions in wholesale wireless proceedings reflect the concern that providing mandated access to MVNOs would reduce existing carriers' investment incentives. For example, in CRTC 2015-177, the Commission wrote:

Investment in wireless network infrastructure by wireless carriers is important to ensure that Canadians have access to mobile wireless networks and services of high quality in all regions of Canada. The new entrants have made and are planning to make significant investments in spectrum and their wireless networks. The Commission considers that mandating wholesale MVNO access at this time would significantly undermine these investments, particularly outside urban core areas.³¹

Similarly, the Commission indicated in CRTC 2017-56 that "including public Wi-Fi in the definition of 'home network' would undermine the policy objectives of mandated wholesale roaming, since it would discourage wholesale roaming customers from investing in their facilities."³² In CRTC 2017-57, the Commission indicated that "[I]n the wholesale wireless framework, the Commission concluded that it would not be appropriate to mandate wholesale MVNO access because doing so would, among other things, likely discourage investment by wireless carriers in their own network infrastructure."³³

MVNOs, by definition, do not build network infrastructure, and so as long as they have mandated access their investment will be zero. Furthermore, a public Wi-Fi oriented MVNO like Sugar Mobile does not even invest in the Wi-Fi networks that its subscribers use because these are "public". The reality is other organizations, be they private businesses or governments, have invested in the infrastructure to provide Wi-Fi connections and these organizations also pay national carriers for internet connectivity. Neither Sugar Mobile nor its subscribers pay for any of these investments made by other entities.

Mandated MVNO access may also reduce other carriers' investment by reducing the returns to such investment, which would occur if mandated MVNO access results in more highly fragmented markets. We expect carriers will make a particular investment if the net present value of the cost of the investment is less than the net present value of the cash flows that it expects to earn from the investment, allowing for a normal return on the carrier's capital. The carrier's cash flow in a given year is equal to the average margin that it earns from subscribers multiplied by the number of subscribers.

³¹ CRTC 2015-177, at paragraph 121.

³² CRTC 2017-56, at paragraph 29.

³³ CRTC 2017-57, at paragraph 35.

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Mandated MVNO access may have some effect on the cost of the investment, but its primary impact is to potentially affect the average margin earned and the subscriber base of the carrier that would otherwise make certain investments. For a regional carrier like Ice Wireless that resells its roaming to an MVNO with subscribers largely outside the regional carrier's territory, there is likely to be little effect from the MVNO on Ice Wireless' subscriber margins or subscriber base. Indeed the very purpose of the roaming resale is to have a means of supplying subscribers outside the regional carrier's territory without acquiring or building RAN that would otherwise be required of the regional carrier. However, for other regional carriers – like Freedom Mobile – whose subscribers may be targeted by the MVNO, shifting subscribers from Freedom Mobile to a public Wi-Fi oriented MVNO would reduce Freedom Mobile's investment incentives at the margin. The magnitude of the effect depends on the number of subscribers that would be taken from regional carriers. It also may lead the regional carrier to make greater use of public Wi-Fi itself rather than expanding its network footprint.

Similarly, at the margin, national carriers' investment incentives will also be reduced. National carriers that are not providing roaming services would be affected in the same way as regional carriers. For the national carrier that provides roaming, under Phase II costing the carrier providing roaming earns a margin on the MVNO's roaming that, in theory, compensates the national carrier for its investment cost. However, as is well documented in the economics literature, Phase II costing, like other forms of costing based on forward-looking long-run incremental costing, generally undercompensates carriers for their full costs of investment.

To the extent that enabling public Wi-Fi oriented MVNOs shifts market share to these MVNOs from national and regional carriers, this reduces the returns to investment for existing carriers. This may reduce the quality of wireless service for Canadian carriers. Anecdotally, we observe that lower quality of service is associated with lower wireless plan prices. For example, carriers like Freedom Mobile that until very recently offered plans with limited LTE coverage that used older technology set their wireless plan prices at lower levels than carriers offering higher network quality services. Canadian consumers have predominantly preferred higher quality wireless services at higher plan prices when both higher quality/higher priced and lower quality/lower priced options are available, given the relatively low share that carriers like Freedom Mobile have achieved.

4.1 Mandated MVNO access and investment by mobile network operators

An academic study by Kim *et al.*³⁴ empirically tests the effects of voluntary and mandated MVNO access on mobile network operator (“MNO”) investment levels. The Kim *et al.* study

³⁴ Kim *et al.*, *supra* footnote 10.

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is based on annual firm-level data for the period January 2000 to March 2008 from 58 MNOs in 21 countries.³⁵ The study compares MNO “investment intensity” which is calculated as capital expenditure on wireless cellular networks divided by wireless revenue,³⁶ for those MNOs in jurisdictions with mandated MVNO access compared to those jurisdictions with voluntary or no MVNO access,³⁷ controlling for other factors that would explain differences in carrier investment intensity across countries and over time. Non-mandatory MVNO access includes any form of voluntary provision of MVNO access by MNOs and threats of regulatory intervention. The countries with mandatory MVNO access are Australia, Denmark, Norway, Spain and Sweden. Canada is one of the countries included in the Kim *et al.* study that has MVNO presence but which is not mandated by regulation.³⁸

Across the sample, MVNOs generally have small market shares.³⁹ Nevertheless, the authors directly test whether mandated MVNO access reduces investment levels by MNOs, controlling for other influences on MNO investment intensity. The authors find that mandated MVNO access has a large negative and statistically significant (at the 10% level) effect on MNO investment. Mandated MVNO access is associated with 17.1% less investment intensity. The negative and statistically significant (at the 10% level) effect on MNO investment intensity from mandated MVNO access is robust to alternative model estimations.

The authors do not find that the mere presence of MVNOs has any statistically significant effect on MNO investment intensity. As well, they do not find that voluntary MVNO access has any statistically significant negative effect on MNO investment intensity. It is therefore the mandated nature of MVNO access that has a negative effect on carrier investment.

³⁵ The data is drawn from the Wireless Intelligence database, which provides data on firm-level capital expenditures on wireless cellular networks as well as data on average revenue per user (“ARPU”), revenue (reported in USD), market share, and the number of connections by type of mobile technology standard.

³⁶ Capital expenditure in the source data includes only Capex specifically for wireless cellular services, but does not distinguish between wholesale and retail-related Capex.

³⁷ There are six countries in the study without any MVNO presence during the sample period (Austria, Czech Republic, Greece, Japan, Korea and Slovakia).

³⁸ In order to control for other factors that would explain investment intensity, the authors include variables for MNO market concentration, an overall market regulation index, the sum of MNO penetration in the market and the rate of growth in total penetration by country. Variables that control for differences across countries are real GDP annual growth rate and population density. As well, the authors include variables to control for firm-level characteristics such as the number of connections for the MNO, the annual growth rate of connections and the firm’s age in years. A time trend is also included in the regression model. The authors also include a variable identifying the timing for the introduction of new mobile technologies in order to control for any increase in investment to adopt new mobile technologies. In their base model, the authors use a two-step estimation process to account for the fact that current period capital intensity is related to prior period capital intensity. For this model, any quarterly data is aggregated to the annual level. Alternative model estimations are used to test the robustness of the results from the base model.

³⁹ Kim *et al.*, *supra* footnote 10, at p. 915.

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While the results of the Kim *et al.* study rely on data from 2000-2008, their findings remain informative because they indicate how mandating MVNO access generally affects MNO investment activity at the time that mandated MVNO access is granted. Their empirical results indicate a short- and long-run effect of mandated MVNO access on MNO investment intensity of -17.1% and -32.6%, respectively. The measured effect on investment incentives for national carriers providing MVNO access is clearly negative and the size of the effect can be large.

4.2 The effects of mandated access on investment by entrants and incumbents

There is a substantial empirical literature that estimates the effects of mandated entrant access on the investment incentives of incumbents. Many of these papers find that mandated access for entrants reduces (or delays) investment by entrants because it makes it cheaper for the entrant to purchase network inputs than to build them. While these papers are in respect of wireline networks, they are nonetheless informative for the current issue because they demonstrate the sensitivity of carrier investment levels to the costs of investment relative to returns.

For example, in an early paper on this issue, Crandall, Ingraham, and Singer (2004) find that “artificially low UNE [unbundled network element] prices induce CLECs [i.e., entrants] to defer facilities-based investments because the NPV calculations of UNE leasing are higher than the NPV calculations of sinking capital into on-net assets.”⁴⁰ As well, they found that mandatory unbundling allows the CLEC to wait to see whether incumbent investment choices have been successful, which provides the CLEC with a real option value, and the authors argue that this value tips the balance of the CLECs’ investment decision in favour of waiting.

In another economic paper on investment incentives, Grajeck and Röller (2012)⁴¹ study the effects of wireline access regulation and investment by incumbents and entrants using a database with more than 70 fixed-line operators in 20 countries throughout Europe over a ten year period. They find that access regulation reduces total industry and individual carrier investment, and conclude that “promoting market entry by means of regulated access undermines incentives to invest in facilities-based competition.” They estimate that the effect of access regulation has been to reduce total industry investment by about €16.4 billion over a ten year period.

⁴⁰ Crandall, Robert W., Allan T. Ingraham, and Hal J. Singer, “Do Unbundling Policies Discourage CLEC Facilities-Based Investment,” *The B.E. Journals in Economic Analysis & Policy*, 2004, at p. 5.

⁴¹ Grajeck, Michal, and Lars-Hendrik Röller, “Regulation and Investment in Network Industries: Evidence from European Telecoms,” *Journal of Law and Economics*, 55 (February 2012), 189-216.

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Hausman and Sidak (2005)⁴² conduct case studies of the effects of mandatory unbundling of voice and broadband services in five countries, including Canada. They evaluate the effects of unbundling against regulators' rationales for mandated access. They find that the hypothesis that unbundling will reduce retail prices and encourage investment and innovation by incumbents and entrants is not supported by the evidence in the five countries included in the study. They also find no evidence in support of the hypothesis that mandatory unbundling enables future facilities-based investment.

In a 2014 analysis related to the Commission's decision to forbear from regulating rates for competitor digital network ("CDN") access and transport,⁴³ I found that following the establishment of regulated CDN rates that were priced at substantial discounts to the digital network access ("DNA") equivalent service sold at retail, a number of telecom service providers ("TSPs") determined it would be more economical to make greater use of CDN circuits rather than investing in additional fibre networks since it was cheaper to make use of the regulated inputs rather than build their own infrastructure.⁴⁴

While these studies relate to investments in wireline infrastructure, they clearly show that investment incentives are reduced for carriers acquiring mandated access components and for carriers providing mandated access components even when the carriers providing access receive some compensation for mandated access.

5. Conclusion

Broadening the definition of "home network" for the purposes of determining eligibility for *wholesale roaming* to include public Wi-Fi would enable MVNOs such as Sugar Mobile and potentially other public Wi-Fi oriented MVNOs to compete for subscribers against regional and incumbent carriers without materially improving competitive market outcomes. Instead, a niche part of the wireless services market would become more fragmented. Benefits to consumers would be minimal, in part because the services provided by public Wi-Fi oriented

⁴² Hausman, Jerry A., and J. Gregory Sidak, "Did Mandatory Unbundling Achieve its Purpose? Empirical Evidence from Five Countries," *Journal of Competition Law and Economics*, 1 (2005), 173–245.

⁴³ Sanderson, Margaret, "Forbearance and the Competitiveness of Business Telecom Services," 2014. Prepared for Bell Canada as part of its submissions to the Commission related to the Commission's review of its classification of wholesale services made in Telecom Decision 2008-17 to determine if changes should be made.

⁴⁴ See, for example, responses filed during the 2008-17 proceeding by Telus(MTS Allstream)12Apr07-106, Bell Canada(Bureau)12Apr07-25 – factors Bell considers when deciding to lease vs build, and Atria(Companies)12Apr07-20, as well as Vidéotron's initial evidence at paragraph 57.

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MVNOs are neither particularly innovative nor low-cost relative to existing options available under the current regulatory regime. A number of smartphone applications already provide calling from Wi-Fi networks at low cost and they can be ported to landline and wireless numbers. A user can combine Wi-Fi calling using these apps with a low-cost wireless plan for a service very similar to the Sugar Mobile plan, even at a lower cost (depending on usage). Sugar Mobile, and other public Wi-Fi oriented MVNOs that would be enabled by a broadening of the definition of “home network”, are therefore not innovative service providers. Rather, these MVNOs are simply evading the established regulatory requirements that are designed to encourage greater investment in wireless infrastructure in Canada.

Furthermore, international experience demonstrates that mandated MVNO access does not increase wireless penetration. In addition, in almost all countries where MVNO access has been mandated, the wireless market was more concentrated at the time of the mandate than the Canadian wireless market is today. While there may have been a “competition” problem that mandated MVNO access was designed to address in these other countries, Canada does not have the same issues to be resolved.

Although there are likely to be few, if any, benefits from enabling public Wi-Fi oriented MVNOs, there is a risk of undermining the investment incentives of regional and national carriers. First, enabling MVNOs would reduce the returns to investment by taking away some customers of existing regional and national carriers. Empirical studies have demonstrated that mandated access reduces wireless investment by existing carriers. In addition, regional carriers may decide to forego investments in wireless infrastructure in favour of encouraging their end users to access voice and text through public Wi-Fi networks. In such circumstances the Commission’s policy of encouraging facilities-based competition would be undermined without any demonstrable benefits.