

APPENDIX 1

**An Economic Analysis of Mandated Wholesale Access for MVNOs and
Competition in the Mobile Wireless Telecommunications Industry in Canada**

Prepared for
Canadian Network Operators Consortium Inc.
Independent Telecommunications Providers Association
Canadian Communication Systems Alliance, Inc.

by
Zhiqi Chen, PhD
Delta Economics Group, Inc.

May 10, 2019

Executive Summary

- ES1. The retail markets for mobile wireless services in Canada are characterized by a high level of concentration and a lack of vigorous price competition among the national wireless carriers. Statistics from multiple sources show that Canadians pay among the highest prices and have one of the lowest levels of adoption and usage of wireless services among the developed countries.
- ES2. Growth of MVNOs in Canada will likely put price pressure on existing mobile wireless carriers. However, it is unlikely to cause a net loss of subscriptions or reduce investments by the existing mobile wireless carriers.
- ES3. A predetermined date for the phase-out of mandated access will negatively affect the entry and expansion by MVNOs. Instead of a predetermined date, the test for the initiation of phase-out process should be based on market conditions. Specifically, two conditions should be met before the initiation of the phase-out process. First, the mobile wireless retail markets in all provinces of Canada are subject to competition sufficient to protect the interests of users. Second, MVNOs are firmly established as a meaningful competitive force in the mobile wireless retail markets in all provinces of Canada.
- ES4. The regulatory framework for wholesale mobile wireless services should be forward-looking and include mandated wholesale MVNO access to 5G networks and all future new technologies. Without timely access to the newest technologies, MVNOs will be perpetually kept at a competitive disadvantage *vis-à-vis* their facilities-based competitors. Unless access to 5G networks and future new technologies is included in the regulatory framework for wholesale mobile wireless services, any benefits from the mandated MVNO access will likely be temporary and we will likely be back facing the same problem in a few years.

I. Introduction

1. I have been retained by Canadian Network Operators Consortium Inc. (“CNOC”), Independent Telecommunications Providers Association, and Canadian Communication Systems Alliance, Inc. to provide an economic analysis on a number of issues related to mandated wholesale access for mobile virtual network operators (MVNOs) and competition in the mobile wireless telecommunications industry in Canada. Specifically, I will discuss the state of competition in the retail markets for mobile wireless telecommunications services (“mobile wireless services”) in Canada, the potential impact of mandated wholesale MVNO access on existing mobile wireless carriers (“wireless carriers”),¹ the appropriate phase-out process of the mandated access, and mandated wholesale MVNO access to 5G networks and future wireless technologies.
2. I am a professor of economics at Carleton University, where I have been a faculty member since 1991. My fields of specialization are industrial organization and international trade. Since receiving my PhD in economics from the University of Western Ontario in 1991, I have published more than 40 articles in refereed journals on topics in these and other fields of economics, including three articles on the telecommunications industry. Moreover, I have written numerous reports commissioned by the Government of Canada, specifically, by the Department of Industry (now renamed as Innovation, Science and Economic Development Canada) and the Department of Foreign Affairs and International Trade (now Global Affairs Canada). These reports examined issues related to Canadian industries and international trade policies.
3. I have extensive experience in the application of economics to competition and trade issues. I twice served as the T.D. MacDonald Chair in Industrial Economics at the Canadian Competition Bureau, from September 1998 to August 1999 and from September 2004 to August 2005. I spent another six

¹ A wireless carrier requires spectrum and a mobile wireless network to provide mobile wireless services. In Canada, there are three wireless carriers that offer services nationally: Bell Mobility Inc. (“Bell”), Rogers Communications Canada Inc. (“Rogers”), and TELUS Communications Company (“TELUS”). Collectively, they are referred to as the “national wireless carriers”.

months as a visiting economist at the Competition Bureau from September 2011 to February 2012. In those roles, I provided expert economic advice on many competition cases involving mergers, abuse of dominance and price-fixing. My curriculum vitae is attached as an appendix.

4. This report is organized as follows: Section II delineates the relevant markets that will be studied in this report. Section III analyzes the state of competition in the retail markets for mobile wireless services in Canada, and Section IV examines the potential impact of mandated wholesale MVNO access on existing wireless carriers. Sections V and VI consider two issues related to the design of mandated wholesale MVNO access, specifically, the appropriate phase-out process and MVNO access to 5G networks and future wireless technologies.

II. Market Definitions

5. This report examines issues related to two levels of markets involved in the provision of mobile wireless services: the retail mobile wireless service markets (“retail markets”), and the wholesale mobile wireless service markets (“wholesale markets”).
6. To be more specific, a retail product market involves the sales of mobile wireless services to consumers. They encompass telecommunications services of voice, text and data. In reality, there is a great degree of heterogeneity in the demands for these services, as reflected in the wide array of plans offered by mobile wireless service providers.² In this report, I will be cognizant of the demand heterogeneity and will consider the retail sales of mobile wireless services to different segments of consumers in various parts of the report.
7. The geographic market for the retail sales of mobile wireless services is, in my opinion, no broader than a province. For practical purpose, it is convenient to delineate the geographic market based on provincial boundaries. This approach is supported by the observation that significant price differences exist across

² Rogers, for example, offers five types of smartphone plans: No Tab, Smart, Premium, Premium+, and Ultra. Within each type, there are 10 different plans; Rogers’ website, <https://www.rogers.com/consumer/wireless/smartphone-plans?ipn=1>, accessed in Ottawa on May 1, 2019.

different provinces. For example, in 2018 a plan with 450 voice minutes and 300 SMS cost \$45.00 per month in Ontario, but only \$39.13 per month in Quebec. A plan with 1,200 voice minutes, 300 SMS and 1 GB Data cost \$89.17 in Ontario, but only \$44.46 in Quebec.³ These significant price differences imply that an application of the hypothetical monopolist test would lead to the conclusion that a provincial hypothetical monopolist can profitably impose a significant and non-transitory increase in the price of mobile wireless services. Indeed, this definition of geographic market for retail sales of mobile wireless services was adopted by the Competition Bureau in their analysis of a number of merger cases involving wireless service providers, for example, the acquisition of Microcell Telecommunications Inc. by Rogers Wireless Communications Inc.,⁴ and the acquisition of Manitoba Telecom Services (MTS) by BCE Inc.⁵

8. The wholesale mobile wireless markets involve the sales of services among different mobile wireless service providers. These services include, for example, domestic or international roaming, antenna tower and site sharing access, and MVNO access service. In this report, I will focus on the wholesale market for MVNO access service.
9. The geographic market for the wholesale MVNO access is, in my opinion, national. In order to be a viable and effective competitor, an MVNO has to be able to offer broad or national mobile wireless coverage to its retail customers. This is true even if all of their customers reside in a particular region; a wireless service plan would be of limited value to customers if they were not able to use the service outside their areas of residence. This definition of geographic market for wholesale MVNO access is consistent with the determination by the Canadian Radio-television and Telecommunications Commission (the “CRTC” or

³ Wall Communications Inc. “Price Comparisons of Wireline, Wireless and Internet Services in Canada and with Foreign Jurisdictions, 2018 Edition,” August 29, 2018 (“2018 Wall Communications Study”).

⁴ Competition Bureau “Acquisition of Microcell Telecommunications Inc. by Rogers Wireless Communications Inc.: Technical backgrounder,” April 2005.

⁵ Competition Bureau “Competition Bureau statement regarding Bell’s acquisition of MTS: Position statement”, February 15, 2017.

“Commission”) in TRP 2015-177 that the appropriate geographic market for wholesale access services is national.⁶

10. For ease of discussion, I will use the term “MVNO retail market” to refer to the segment of a retail market served by MVNOs. The use of this term is purely for convenience, and it does not mean that I consider MVNOs constitute a separate product market of its own.

III. State of Competition in the Retail Markets

11. The retail markets for mobile wireless services in Canada are characterized by a high level of concentration and a lack of vigorous price competition among the national wireless carriers. Statistics from multiple sources show that Canadians pay among the highest prices and have one of the lowest levels of adoption and usage of wireless services among the developed countries.

Highly Concentrated Markets

12. Recall that the geographic market for the retail sales of mobile wireless services is no broader than a province. Therefore, it is more appropriate to analyze the market structure at the provincial level than at the national level.
13. Table 1, constructed using data collected by CRTC, shows the wireless service subscriber shares of the three national wireless carriers and other wireless service providers (“WSPs”) in the ten provinces in 2017. As we can see from the last column of Table 1, the three national wireless carriers collectively held a dominant market share in all provinces except Saskatchewan. To be more specific, their combined market share was almost 100 percent in seven provinces and was not too far from 100 percent (98 percent) in Ontario. Quebec and Saskatchewan were the only two provinces where their combined market share was below 98 percent: 84 percent in Quebec and 38 percent in Saskatchewan.

⁶ Telecom Regulatory Policy CRTC 2015-177, *Regulatory framework for wholesale mobile wireless services*, May 5, 2015 (“TRP 2015-177”), para. 83.

Table 1: Provincial Wireless Service Subscriber Market Share (Excluding Freedom Mobile and Eastlink), 2017

Province	Bell	TELUS	Rogers	Other WSPs	Combined Share of National Carriers
British Columbia	20.9	41.2	37.6	0.3	99.7
Alberta	25.1	52.3	22.2	0.4	99.6
Saskatchewan	19.5	13.6	5.0	61.8	38.1
Manitoba	45.4	15.2	39.0	0.4	99.6
Ontario	30.2	21.2	46.8	1.7	98.3
Quebec	29.5	26.5	27.9	16.1	83.9
New Brunswick	55.1	25.7	19.0	0.3	99.7
Nova Scotia	53.0	34.3	12.4	0.3	99.7
Prince Edward Island	53.6	33.6	12.7	0.2	99.8
Newfoundland and Labrador	67.9	29.4	2.0	0.7	99.3

Source: CRTC, *Communications Monitoring Report 2018*, Figure 6.5 and the associated data downloaded from <https://open.canada.ca/data/en/dataset/f4233c69-f639-4cab-a234-80dbdd04eaa0>, Table 6.6.

14. However, the CRTC data used to construct Table 1 do not include two smaller carriers, Freedom Mobile and Eastlink. This likely overstates the market shares of the national wireless carriers in the provinces where Freedom Mobile and Eastlink offer wireless services. To rectify this problem, I estimated the number of subscribers of Freedom Mobile and Eastlink and used the estimates to adjust the subscriber market shares of the national wireless carriers. Specifically, I obtained Freedom Mobile's number of subscribers in 2017 from the quarterly report of its parent company (Shaw Communications Inc.) for the first quarter of fiscal 2018. This enabled me to calculate Freedom Mobile's average market share in the three provinces where it offered services, British Columbia, Alberta, and Ontario. I used this average market share (which is 5.9 percent) as the estimate for its subscriber share in each of these three provinces in 2017. Because I was not able to find data on Eastlink's number of subscribers, I assumed that Eastlink had the same market share (5.9 percent) in each of the

four provinces where it offered wireless services, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador.⁷

Table 2: Estimated Provincial Wireless Service Subscriber Market Share, 2017

	Bell	Telus	Rogers	Others WSPs	Combined Share of National Carriers	HHI
British Columbia	19.7	38.8	35.4	6.2	93.8	3177
Alberta	23.6	49.2	20.9	6.3	93.7	3453
Saskatchewan	19.5	13.6	5.0	61.8	38.1	4409
Manitoba	45.4	15.2	39.0	0.4	99.6	3813
Ontario	28.4	19.9	44.0	7.5	92.4	3199
Quebec	29.5	26.5	27.9	16.1	83.9	2610
New Brunswick	51.8	24.2	17.9	6.2	93.9	3628
Nova Scotia	49.8	32.3	11.7	6.2	93.8	3700
Prince Edward Island	50.4	31.6	11.9	6.1	94.0	3720
Newfoundland and Labrador	63.9	27.7	1.9	6.6	93.4	4890

Source: Author's calculations using data associated with *Communications Monitoring Report 2018*, Tables 6.6 and 6.15. The number of subscribers for each of the three national wireless carriers in each province was estimated by multiplying a carrier's market share given in Table 1 by the difference between the total number of wireless subscribers in the province and the estimated/assumed number of subscribers of Freedom Mobile or Eastlink.

15. Table 2 presents the subscriber market shares that I estimated based on the above assumptions. As expected, the (estimated) market shares of the national wireless carriers in Table 2 are lower than those in Table 1 in the provinces where Freedom Mobile and Eastlink offered wireless services. Despite this, Table 2 still shows that the three national wireless carriers collectively held a dominant market share in all provinces except Saskatchewan. To be more specific, their combined market share was above 92 percent in all provinces except Saskatchewan and Quebec. In Quebec, their combined market share was 84 percent.

⁷ This assumption likely overstates Eastlink's market share in these provinces because its wireless services had a much shorter history than Freedom Mobile (formerly WIND Mobile). In particular, Eastlink's wireless service in the greater St. John's area of Newfoundland was launched in June 2017; Eastlink News Release, "Eastlink launches wireless service in St. John's, NL," June 8, 2017, <https://www.eastlink.ca/about/mediacentre.aspx?NewsId=1167>, accessed on May 9, 2019.

16. Individually, Bell had a market share of 50 percent or higher in the four provinces in Atlantic Canada. TELUS held a market share of just below 50 percent in Alberta. SaskTel, a regional carrier, had a market share of over 60 percent in Saskatchewan.

17. When examining cases under the abuse of dominance provisions of the *Competition Act*, the Competition Bureau uses two market share thresholds as an initial screening tool to assess whether a firm (or a group of firms) holds a substantial degree of market power:

“A market share of 50 percent or more will generally prompt further examination; and in the case of a group of firms alleged to be jointly dominant, a combined market share equal to or exceeding 65 percent will generally prompt further examination.”⁸

From Tables 1 and 2 we can see that one or both of these market share thresholds were exceeded for the retail market of mobile wireless services in every province.

18. Another commonly used measure of market concentration is Herfindahl-Hirschman Index (HHI). In the United States, antitrust authorities use HHI in their screening mechanism, and they consider a market is highly concentrated if HHI is above 2500.⁹ From Table 2, we can see that HHI in every province in Canada exceeds the threshold for what the American antitrust authorities would consider as highly concentrated markets. Moreover, HHI is above 3100 for nine of the ten provinces.

19. Therefore, the statistics in Tables 1 and 2 show that the retail market for mobile wireless services is highly concentrated in every province. In particular, the national wireless carriers are jointly dominant in all provinces except Saskatchewan. Indeed, the Commission recently observed that retail market concentration for mobile wireless services remains high.¹⁰

⁸ Competition Bureau, *Abuse of Dominance Enforcement Guidelines*, March 7, 2019, para. 34.

⁹ U.S. Department of Justice and the Federal Trade Commission, *Horizontal Merger Guidelines*, August 19, 2010, <http://www.justice.gov/atr/public/guidelines/hmg-2010.pdf>, accessed on May 5, 2019.

¹⁰ Telecom Notice of Consultation CRTC 2019-57, *Review of mobile wireless services*, February 28, 2019 (“TNC 2019-57”), para. 26.

20. One observation of particular relevance to this report is the virtual absence of MVNOs in Canadian retail markets. Unlike many other OECD countries, there has been virtually no MVNO activity that would provide additional competitive retail options to Canadian consumers.¹¹ To be more specific, MVNOs can range from full MVNOs to branded resellers.¹² All existing MVNOs in Canada are branded resellers that have no control over any network elements. They operate under brands such as Petro-Canada Mobility and 7-Eleven SpeakOut Wireless.¹³

Very High Barriers to Entry

21. The barriers to entry into a retail market for mobile wireless services are very high. For a facilities-based entrant, a very significant barrier is the high cost of acquiring spectrum. For example, during the 700 megahertz spectrum auction in 2014, Rogers paid \$3.3 billion for 22 licenses, TELUS spent over \$1.1 billion for 30 licenses, and Bell spent \$565.7 million for 31 licenses.¹⁴ Another significant barrier to entry is the high cost of investment in facilities. Mobile wireless network deployment involves lengthy construction times and high sunk investment costs.¹⁵

22. By definition, an MVNO does not need to hold any spectrum license. But it needs access to the radio access network (RAN) of mobile network operators (MNOs) in order to offer wireless services. For an MVNO, a significant barrier to entry is the ability to obtain wholesale mobile wireless services from wireless carriers, in particular the national wireless carriers, at reasonable rates, terms, and conditions. So far, however, the national wireless carriers have showed little

¹¹ *Ibid*, para. 37.

¹² CNOC, "Intervention of CNOC in the matter of Review of Wholesale Mobile Wireless Services, Telecom Notice of Consultation CRTC 2014-76, 20 February 2014," p.64. A branded reseller does not own any facilities, while a full MVNO invests in, builds and operates its own backbone network in addition to securing interconnection agreements with other carriers to terminate traffic.

¹³ Both Petro-Canada Mobility and 7-Eleven SpeakOut Wireless operate on Rogers' network; <https://www.comparecellular.ca/petro-canada-mobility-coverage-maps/> and <https://www.comparecellular.com/7-eleven-speakout-wireless-coverage-maps/>.

¹⁴ Canadian Press, "700 MHz spectrum licences paid in full, James Moore says", April 3, 2014; <https://www.cbc.ca/news/business/700-mhz-spectrum-licences-paid-in-full-james-moore-says-1.2596727>, accessed on April 28, 2019.

¹⁵ TRP 2015-177, *supra* note 6 para. 72.

interest in providing potential MVNOs with wholesale access.¹⁶ This erects an insurmountable barrier to MVNO entry into the retail markets in Canada.

23. Moreover, both facilities-based and service-based entrants face a number of common barriers to entry and expansion. They include development of a retail distribution network, obtaining access to flagship smartphones, and the building of customer service systems. Furthermore, continuous technological change in the mobile wireless industry requires the employment of sophisticated personnel with specialized expertise.¹⁷

24. Consumer switching costs are another barrier faced by both facilities-based and service-based entrants. The Wireless Code has significantly reduced switching costs.¹⁸ However, certain practices by the national wireless carriers continue to make switching service providers costly for their customers. For example, the practice of two-year contracts with early cancellation fees makes it costly for a consumer to leave a service provider before the contract expires.¹⁹ Moreover, it was reported that call center employees for Bell and Rogers were penalized if they canceled or reduced a customer's service and as a result, some employees adopted all kinds of tactics to avoid doing that.²⁰ These practices raise consumer switching costs and make it more difficult for an entrant to attract customers from the incumbents.

25. Finally, the foreign ownership restrictions could be a barrier to large-scale entry. Under the current Canadian ownership rules, a carrier with a market share of more than 10 percent of total Canadian telecommunications revenue are subject to foreign ownership restrictions.²¹ For a large entrant with a business plan of

¹⁶ TRP 2015-177, *supra* note 6 para. 86, and TNC 2019-57, *supra* note 10 para. 37.

¹⁷ Competition Bureau, *supra* note 5.

¹⁸ For example, cellphones sold by a wireless service provider used to be locked to the service provider's network. In an update to the Wireless Code in 2017, the Commission put an end to the practice of locked phones. Moreover, the Commission also made it easier for consumers to cancel contracts. See CRTC News Release, "CRTC puts an end to locked cellphones and unlocking fees," June 15, 2017.

¹⁹ The wireless Code permits early cancellation fees and specifies rules governing the calculation of this type of fees. See CRTC, "The Wireless Code, simplified," December 1, 2017, section G.

²⁰ Johnson, E., "Rogers, Fido and Bell call centre workers penalized for reducing plans, offering credits," CBC News, October 14, 2018, <https://www.cbc.ca/news/business/telecom-call-centre-incentives-hurt-customers-say-insiders-1.4857890>, accessed on May 4, 2019.

²¹ *Telecommunications Act*, s.16.

capturing more than 10 percent market share, the foreign ownership restrictions reduce its ability to tap into foreign capital.

Lack of Vigorous Price Competition among the National Wireless Carriers

26. High concentration and high barriers to entry confer a significant amount of market power to the national wireless carriers and, in the case of Saskatchewan, to SaskTel. The unilateral and coordinated exercises of market power by these wireless carriers have led to high prices and low consumption level of wireless services in Canada. Statistics show that Canadians pay among the highest prices and have one of the lowest levels of adoption and usage of mobile wireless services among the developed countries.

High Prices

27. In Figure 1 is an international price comparison based on the data from a 2017 study by NGL Nordicity Group.²² It shows that Canada ranked among the highest in terms of the prices of mobile wireless telecommunications services across all levels of service baskets. Specifically, among the eight jurisdictions selected for comparison, Canadians paid the highest prices for service baskets Levels 3, 4 and 5, the second-highest prices for service baskets Levels 1 and 6, and the third-highest price for service basket Level 2.²³

28. This pattern of high prices is confirmed by the data from the 2018 Wall Communications Study.²⁴ As shown in Figure 2, in 2018 Canadians paid the highest prices for service baskets Levels 3 and 6, the second-highest prices for service baskets Levels 1, 2 and 4, and the third-highest price for service basket Level 5.²⁵

²² NGL Nordicity Group Ltd., “2017 Price Comparison Study of Telecommunications Services in Canada and Select Foreign Jurisdictions,” October 5, 2017 (“2017 Nordicity Study”).

²³ The services included in these six baskets are as follows: Level 1: 150 voice minutes; Level 2: 450 voice minutes and 300 SMS; Level 3: 1,200 voice minutes, 300 SMS and 1 GB Data; Level 4: unlimited voice minutes, SMS and 2 GB Data; Level 5: unlimited voice minutes, SMS and 5 GB Data; and Level 6 (Family Plan): unlimited voice minutes, SMS and 10 GB Data with 3 Lines. See NGL Nordicity Group, *ibid*, p.4.

²⁴ *Supra* note 3.

²⁵ There is a slight difference in the definition of Level 6 between the Nordicity Study and the Wall Communications Study. In the latter, Level 6 is a shared plan with 3 phones lines and unlimited

29. Studies conducted by international consulting firms also show that Canadians paid among the highest prices for mobile wireless services in the developed countries. Figure 3, constructed by Strategic Analytics, compares the average price per GB for post-paid mobile broadband in OECD countries. It shows that Canadians paid the third-highest price among the 37 OECD countries. Figure 4, constructed using data from Finnish telecommunications management consulting firm Rewheel, compares the maximum data allowance in 4G smartphone plans for 30 Euros in 41 countries that are member countries of OECD or European Union.²⁶ It shows that Canada had one of the lowest levels of data allowance. This implies that Canada had one of the highest prices per gigabyte of data allowance. Moreover, in a study of 4G pricing published this year, Rewheel found that the median gigabyte price in Canada was €7.3, this was more than three times the average price of OECD countries (€2.2) and was the fourth highest among the member countries of OECD and EU combined.²⁷
30. Figure 5 is from an industry analysis by Sweden-based research firm Tefficient.²⁸ It plots the total mobile service revenue per consumed gigabyte against the average mobile data usage per SIM and month for 37 countries around the world. Along the horizontal axis of this figure, we see that that Canada had the highest total mobile service revenue per GB. This corroborates the finding by Rewheel that Canada had one of the highest gigabyte prices.

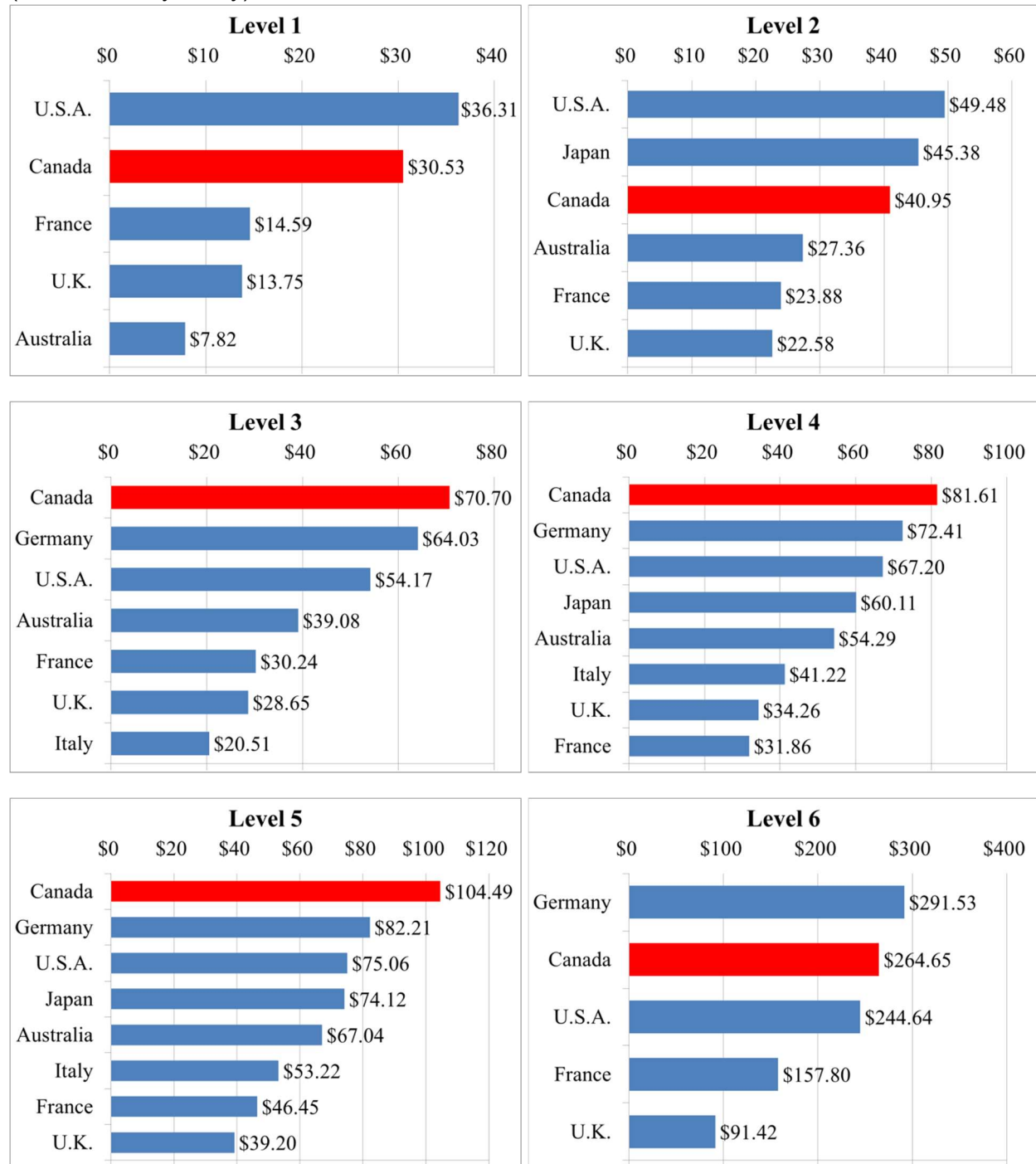
nationwide talk and text along with 10 to 49 GB of data. See Wall Communications Inc., *supra*, note 3, p.ii.

²⁶ To be more specific, these 41 countries include 36 OECD member countries, 23 of which are also members of the European Union, and the remaining five EU member countries that are not OECD members. Colombia, which joined OECD in 2018, is not in this diagram because it is not in the original Rewheel data.

²⁷ Rewheel, "The state of 4G pricing–1H2019," April 2019; http://research.rewheel.fi/downloads/The_state_of_4G_pricing_DFMonitor_11th_release_1H2019_PUBLI_C.pdf, accessed on April 29, 2019. The gigabyte price used in this report is the fully allocated price of 4G smartphone plans with at least 1,000 minutes and 3Mbit/s for HD video.

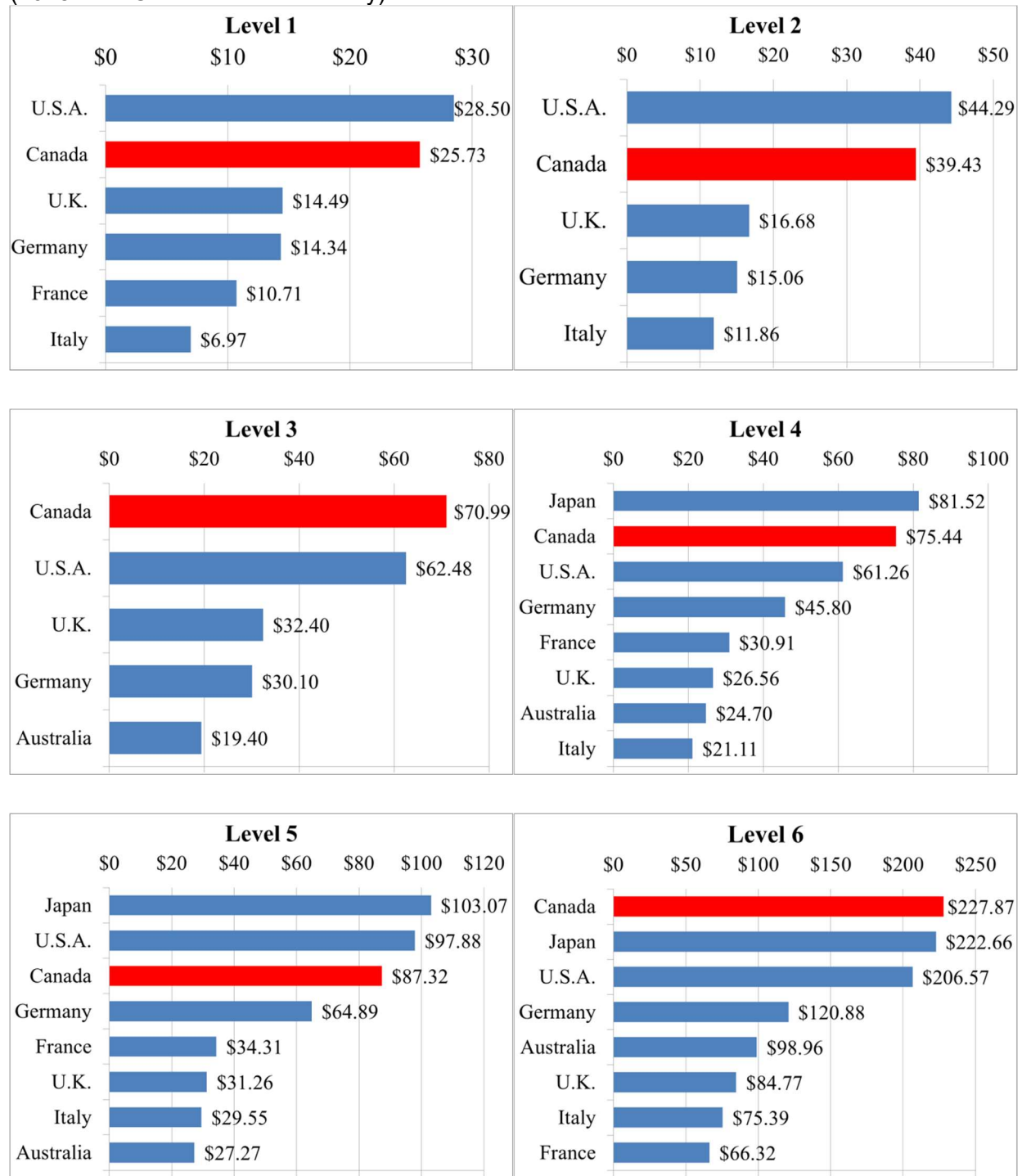
²⁸ Tefficient AB, "Mobile data – first half 2018 China and India shift to 4th gear – leave many mature markets in the dust," January 17, 2019; <https://tefficient.com/wp-content/uploads/2019/01/tefficient-industry-analysis-3-2018-mobile-data-usage-and-revenue-1H-2018-per-country-final-17-Jan-2019.pdf>, accessed on April 25, 2019.

Figure 1: International Price Comparison for Mobile Wireless Telecommunications Services (2017 Nordicity Study)



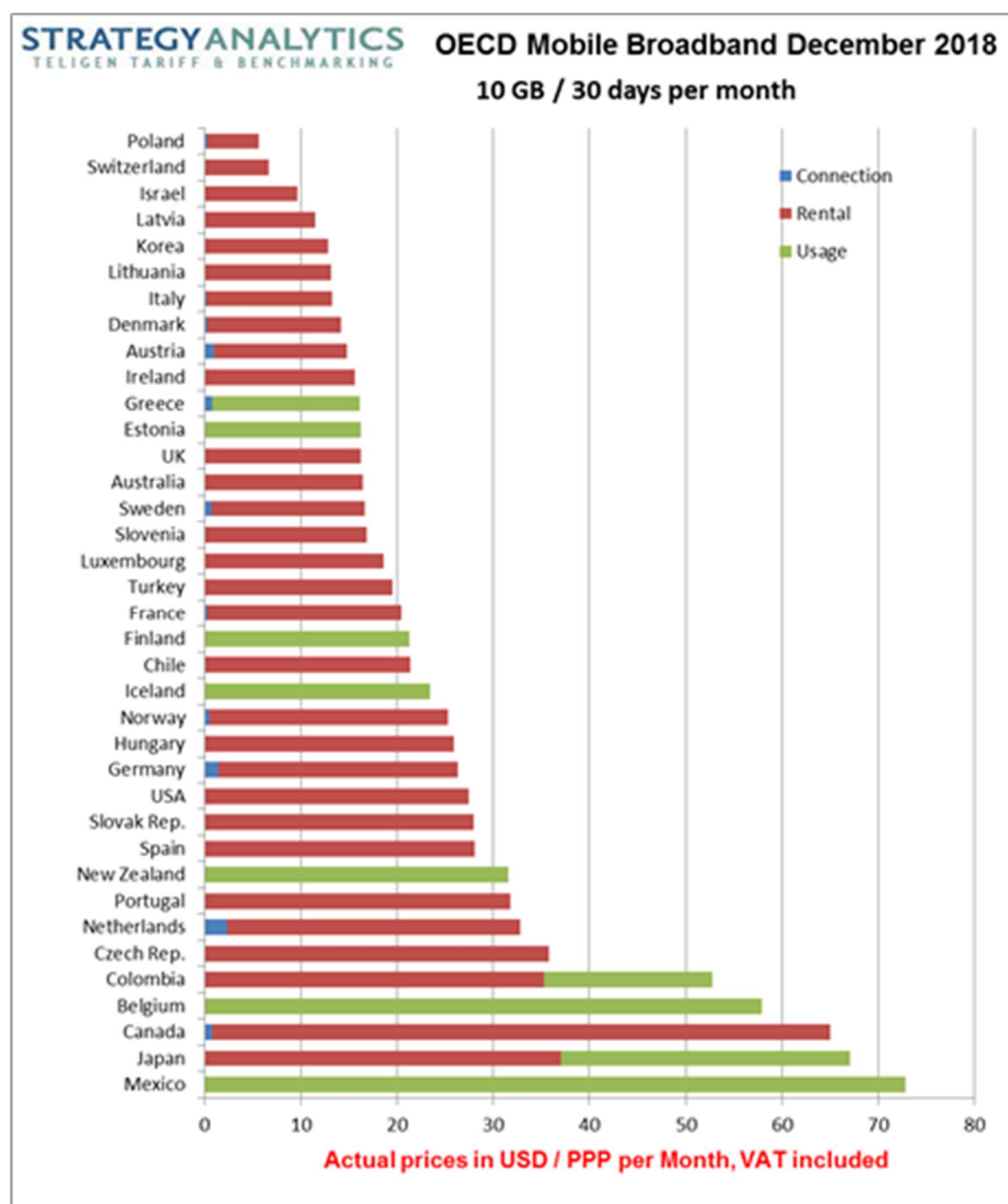
Source: The 2017 Nordicity Study, Figure 6 (pp.36-37).

Figure 2: International Price Comparison for Mobile Wireless Telecommunications Services (2018 Wall Communications Study)



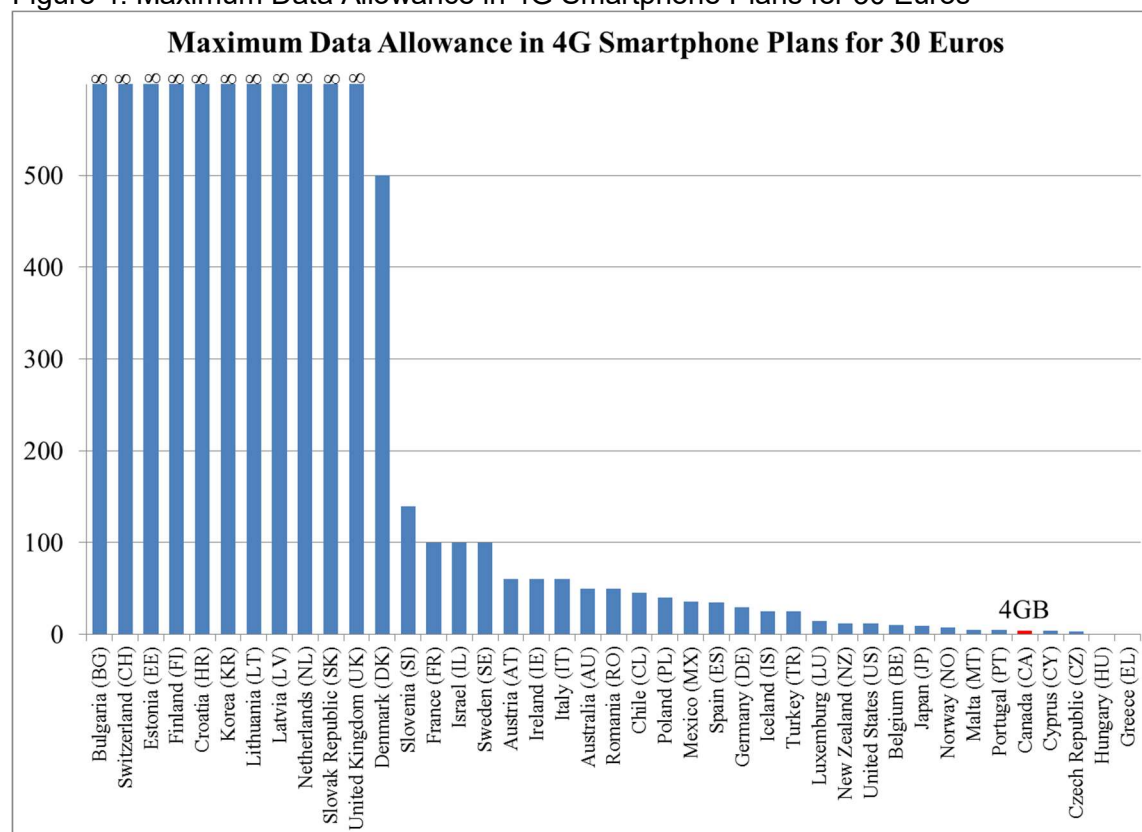
Source: The 2018 Wall Communications Study, Table A3.1 (pp.67-68).

Figure 3: Average Price per GB for Post-paid Mobile Broadband, 2018



Source: Strategy Analytics, "OECD Mobile Broadband Price Benchmarking Q4 2018."

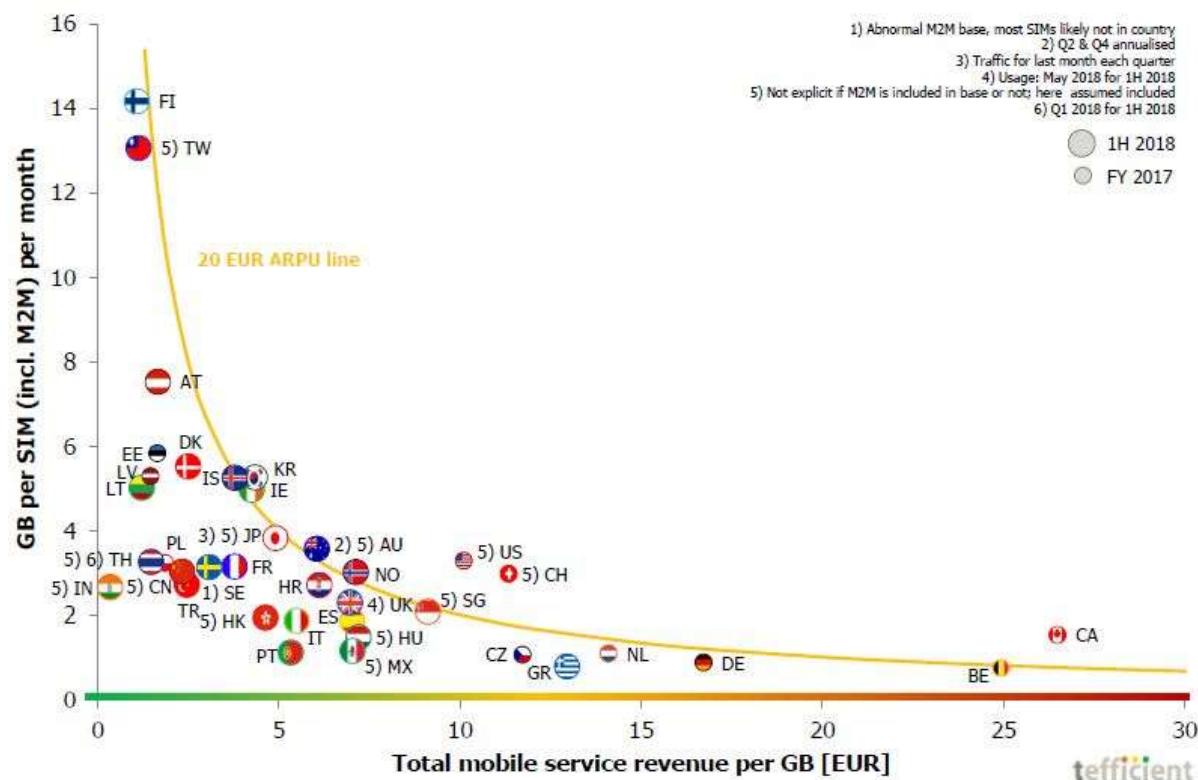
Figure 4: Maximum Data Allowance in 4G Smartphone Plans for 30 Euros



Note: The sign “∞” means unlimited data.

Source: Rewheel, “The state of 4G pricing—1H2019,” Digital Fuel Monitor 11th release, April 2019.

Figure 5: Total Mobile Service Revenue per GB and Mobile Data Usage (2017-2018)



Source: Tefficient AB, “Mobile data – first half 2018 China and India shift to 4th gear – leave many mature markets in the dust”, January 17, 2019, p.17.

Low Penetration Rates and Low Usage

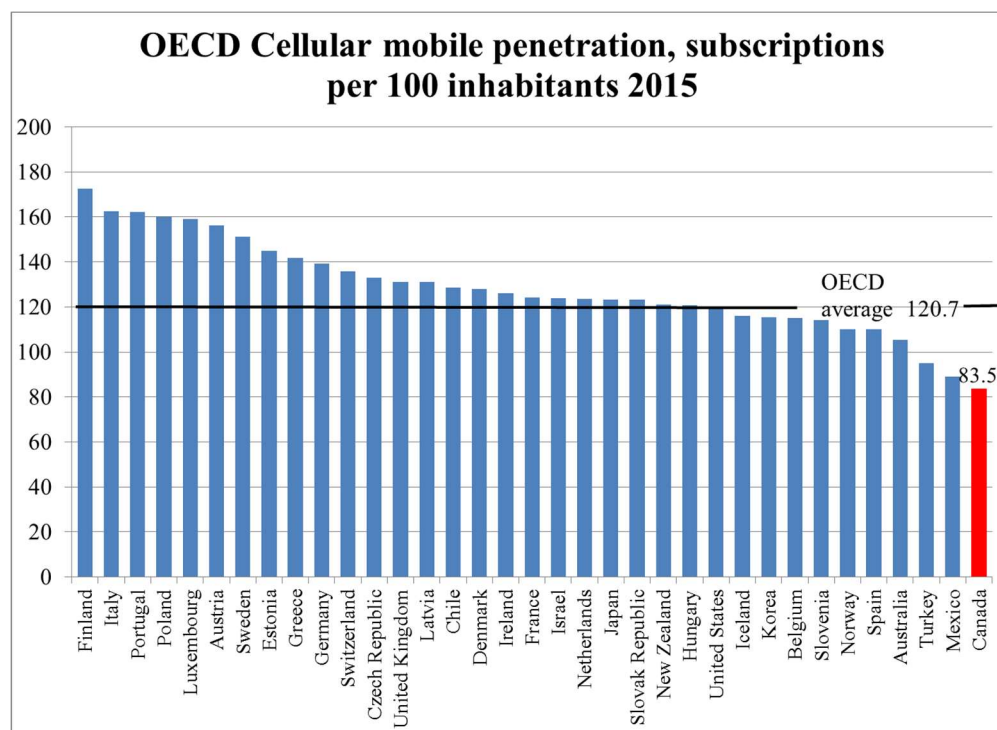
32. Canada lags substantially behind other OECD countries in terms of adoption and usage of mobile wireless services. In a report commissioned by then Industry Canada in 2003, I observed that Canada had the fourth-lowest cellular mobile penetration rate among OECD countries in 2000.²⁹ More than a decade later, unfortunately, Canada’s performance relative to other OECD countries fell further behind. As we can see from Figure 6, Canada had the lowest cellular mobile

²⁹ The report was subsequently published in a volume of the Industry Canada Research Series. See Chen, Z. “Liberalization of Trade and Investment in Telecommunication Services: A Canadian Perspective,” in R.G. Lipsey and A.O. Nakamura (eds.), *Services Industries and the Knowledge-Based Economy*, University of Calgary Press, 2006. Penetration rate is measured by the number of subscriptions per 100 inhabitants.

penetration rate among OECD countries in 2015. It is more disappointing that Canada's cellular mobile penetration rate was substantially below the average of all countries in the world, including developed and developing countries. In 2017, Canada had 85.9 cellular mobile subscriptions per 100 inhabitants. In comparison, the average penetration rate for the world was 104.5 per 100 inhabitants.³⁰

33. In terms of adoption of mobile broadband services, Canada also lags substantially behind the average of OECD countries. As we can see from Figure 7, Canada had the fifth-lowest penetration rate of mobile broadband services among OECD countries in 2018.

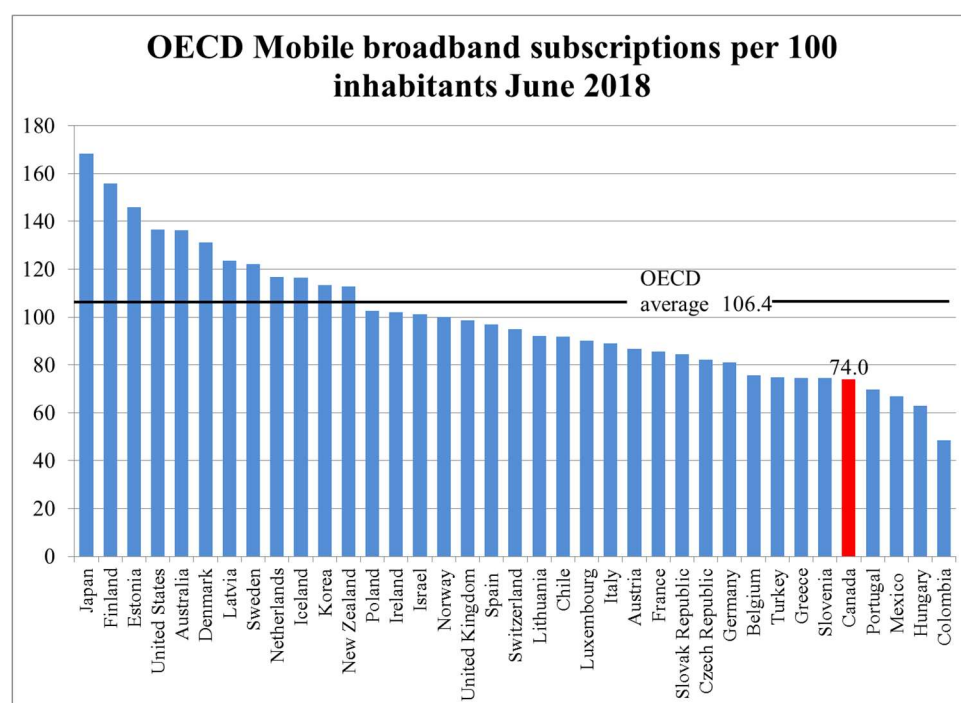
Figure 6: Cellular Mobile Penetration Rates among OECD Countries



Source: OECD and ITU World Telecommunication/ICT Indicators 2017 database
<http://www.oecd.org/internet/broadband/oecdkeyictindicators.htm>

³⁰ The World Bank, "World Development Indicators, Mobile cellular subscriptions (per 100 People)," updated March 21, 2019; data in Excel file downloaded from <https://data.worldbank.org/indicator/IT.CEL.SETS.P2> on April 23, 2019.

Figure 7: Mobile Broadband Penetration Rates among OECD Countries

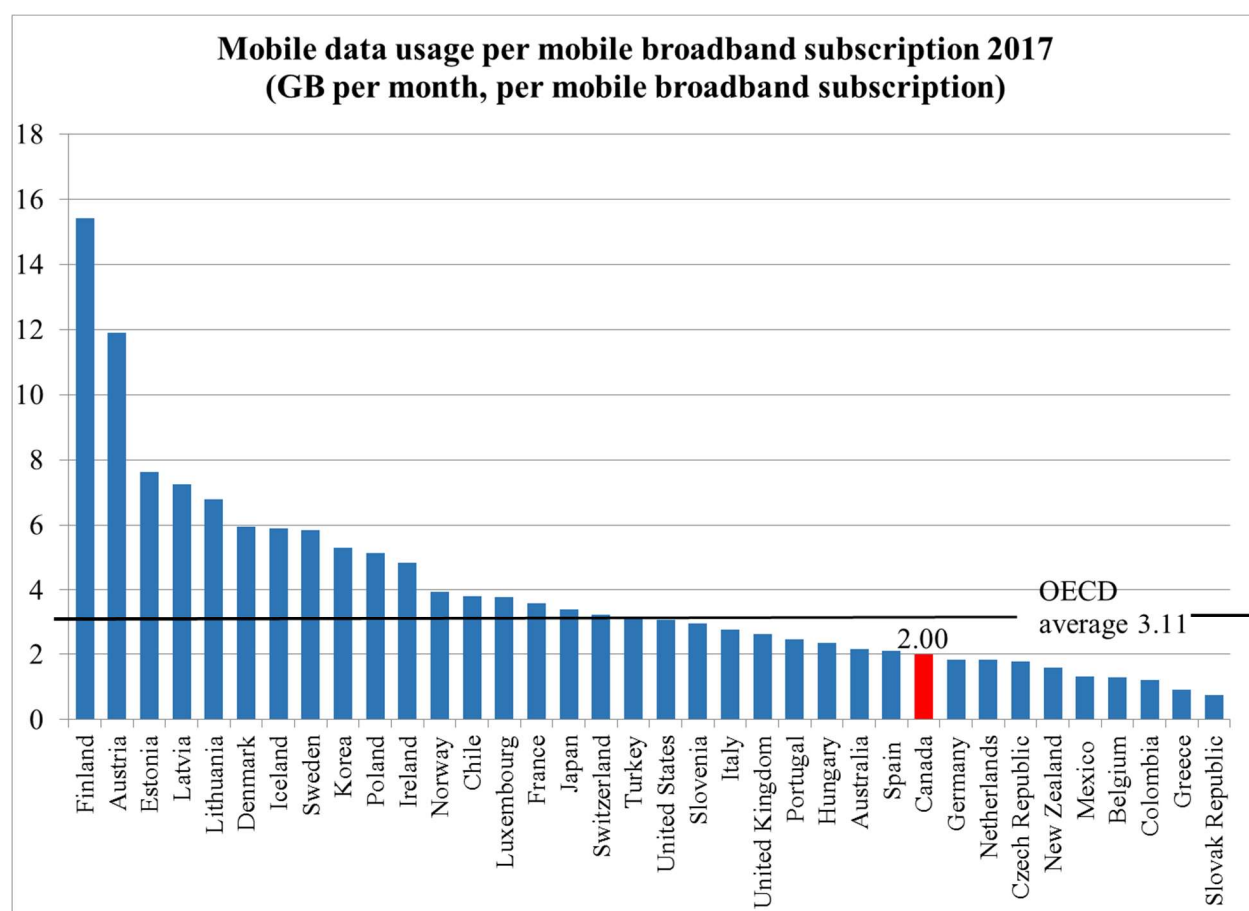


Source: OECD Broadband Portal, <http://www.oecd.org/internet/broadband/broadband-statistics/>

34. A basic economic principle is that higher price leads to smaller quantity of consumption. Given the evidence on Canada's high gigabyte prices, it is not surprising that Canadians lag significantly below the average of OECD countries in data usage. As Figure 8 shows, in 2017 Canadians on average used 2 GB of data per month per mobile broadband subscription, which was less than 2/3 of the OECD average.

35. The combination of high price and low usage is vividly illustrated in Figure 5. Canada lies at the bottom right corner of Figure 5, indicating that Canada had the highest price (measured by total mobile revenue per GB) and one of the lowest levels of usage.

Figure 8: Mobile Data Usage Per Mobile Broadband Subscription 2017



Source: OECD Broadband Portal <http://www.oecd.org/internet/broadband/broadband-statistics/>

Coordinated Behavior among the National Wireless Carriers

36. One of the reasons for the high prices of mobile wireless services in Canada is the coordinated behavior among the national wireless carriers. During its nine-month investigation of Bell's acquisition of Manitoba Telecom Services (MTS), the Competition Bureau conducted a pricing analysis and concluded that as a result of coordinated behavior among Bell, TELUS and Rogers, mobile wireless prices in Canada were higher in regions where these three carriers did not face competition from a strong regional competitor. Conversely, in markets where the three national wireless carriers faced competition from a strong regional competitor, the Competition Bureau found that prices were substantially

lower. The Bureau reached these conclusions based on a systematic and thorough analysis using confidential internal company data.³¹

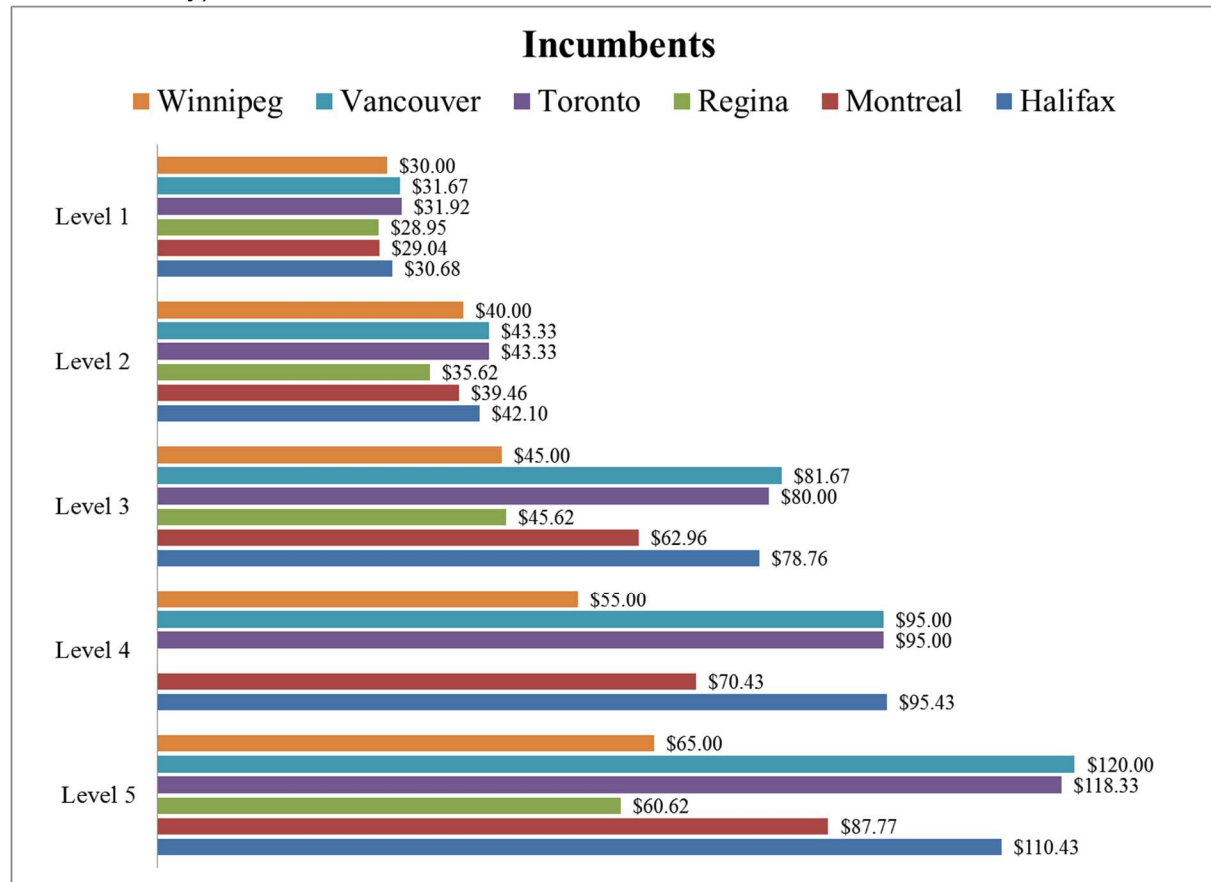
37. As I do not have access to the type of confidential data that the Competition Bureau used in its assessment, I am not able to replicate and update its analysis in this report. But an analysis of publicly available data corroborates the Competition Bureau's finding of coordinated behavior among the national wireless carriers.

38. Using the data from the 2017 Nordicity Study, the unweighted average of the price offerings of the national wireless carriers in six Canadian cities are plotted in Figure 9. Comparing the prices in different cities for each level of service baskets, we see a pattern: for all six levels of service baskets the prices in Regina, Winnipeg and Montreal were lower than those in Vancouver, Toronto and Halifax. Note that in each of the three cities with lower prices, there was a strong regional competitor: SaskTel in Regina, MTS in Winnipeg, and Videotron in Montreal.³² Therefore, this pattern of price differences across different cities is consistent with the Competition Bureau's finding of coordinated behavior among the national wireless carriers.

³¹ *Supra* note 5.

³² The data in the 2017 Nordicity Study and the 2018 Wall Communications Study were collected after Bell completed its acquisition of MTS. As we can see from Figures 9 and 10, prices in Winnipeg (Manitoba) were generally lower than Vancouver (B.C.), Toronto (Ontario) and Halifax (Nova Scotia) in 2017 and 2018 despite the acquisition. There are two possible reasons for this. First, it usually takes time for prices to adjust to the new market conditions. Second, in order to address the Competition Bureau's concerns over the likely substantial lessening of competition, Bell agreed to divest assets and provide various transitional services to Xplornet for three to five years. In addition, postpaid Bell Mobility customers in Manitoba who were under contract at the time of the consent agreement would be able to switch to Xplornet without penalty. It is possible that these measures have prevented prices from rising in Manitoba despite the acquisition of MTS by Bell. However, it remains to be seen what will happen to prices in this province after these measures expire.

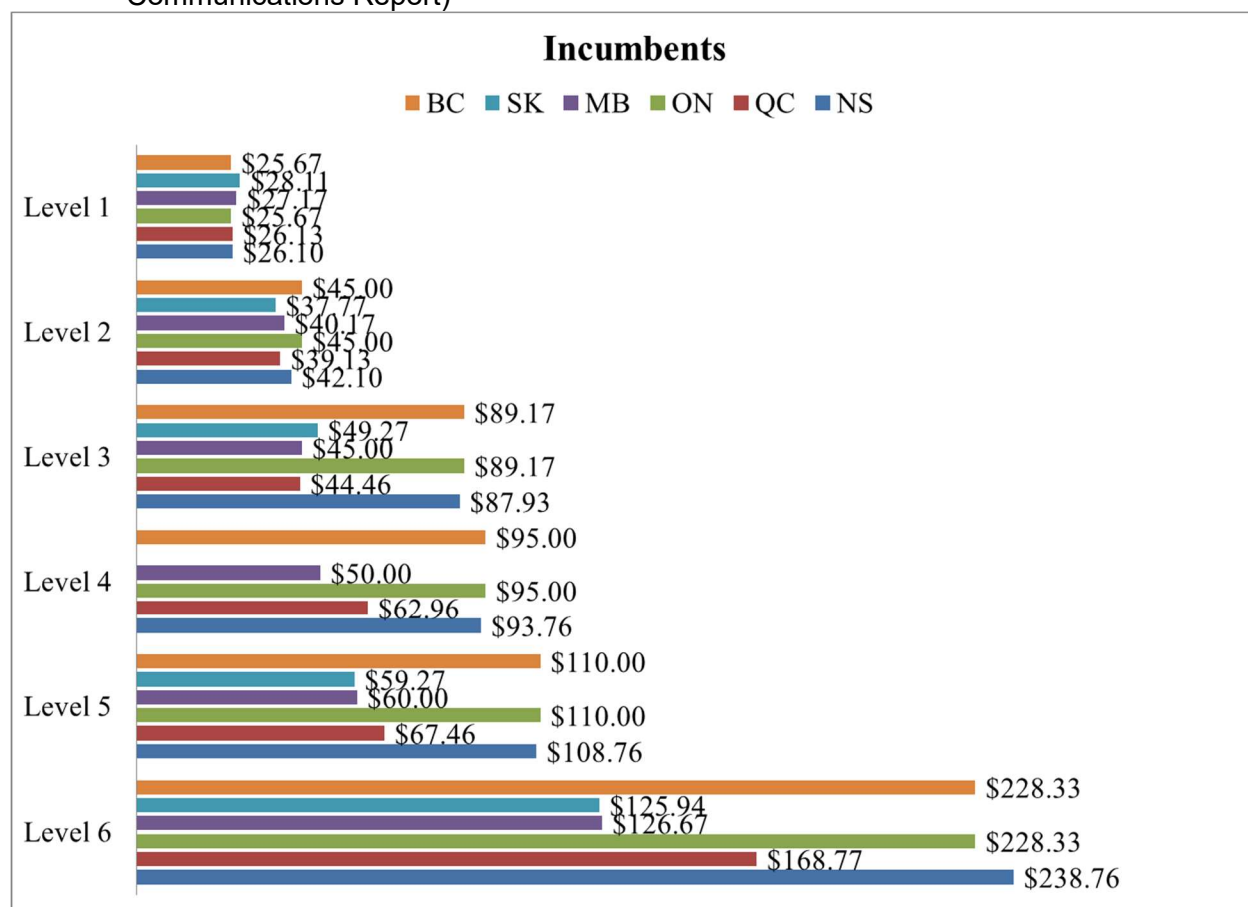
Figure 9: Within-Canada Comparison of Prices of National Wireless Carriers (2017 Nordicity Study)



Source: The 2017 Nordicity Study, Table 6 (p.32).

39. An analysis of the price data contained in the 2018 Wall Communications Study reveals the same pattern. Figure 10 plots the average prices of the national wireless carriers for the six levels of service baskets in six provinces: British Columbia, Saskatchewan, Manitoba, Ontario, Quebec and Nova Scotia. For all levels of service baskets except Level 1, the prices in Saskatchewan, Manitoba and Quebec were lower than those in British Columbia, Ontario and Nova Scotia. This further corroborates the Competition Bureau's finding of coordinated behavior among the national wireless carriers.

Figure 10: Within-Canada Comparison of Prices of National Wireless Carriers (2018 Wall Communications Report)



Source: The 2018 Wall Communications Study, Table 4 (pp.24-25).

40. An important implication of the preceding analysis is that lack of vigorous price competition is a contributing factor to the high prices of mobile wireless services in Canada. Some analysts have argued that the high prices in Canada are due to higher cost and/or higher quality of service in Canada than in other countries.³³ But what Figures 9 and 10 show is that significant price differences exist within Canada for the same service basket. For example, Figure 10 shows that in 2018 the lowest average price among British Columbia, Ontario and Nova Scotia for Level 3 service basket was \$87.93, which was 78.5 percent higher than the highest average price among Saskatchewan, Manitoba and Quebec (\$49.27) for the same service basket. While some inter-provincial differences in costs may

³³ See, for example, Martin, M., "The state of competition in Canada's telecommunications industry – 2018," Montreal Economic Institute, May 2018.

exist, it seems unlikely that the cost of providing Level 3 services in British Columbia, Ontario and Nova Scotia were more than 78 percent higher than the costs in Saskatchewan and Quebec (where they faced competition from strong regional carriers). In my opinion, this pattern of inter-provincial price differences indicates that lack of vigorous price competition is a contributing factor to the high prices of mobile wireless services in Canada.

Limited Impact of New Entrants on the State of Competition

41. After the 2008 AWS spectrum auction, three new entrants entered the retail markets for mobile wireless services in various provinces. They were WIND Mobile, Mobilicity, and Public Mobile.³⁴ Two of them were later acquired by the national wireless carriers. Specifically, Public Mobile was acquired by TELUS in 2013 and Mobilicity was acquired by Rogers in 2015. WIND Mobile, on the other hand, was acquired by Shaw Communications and was rebranded Freedom Mobile in 2016.³⁵
42. Among the three new entrants, only WIND/Freedom Mobile remains a competitor of the national wireless carriers. Public Mobile is not a competitor because of its ownership by one of the three national wireless carriers (TELUS). The Mobilicity brand was retired and its subscribers were migrated to Rogers' Chatr brand in 2016.³⁶
43. To ascertain the impact of Freedom Mobile on the state of competition in the retail markets, I have examined the prices of the national wireless carriers in provinces where Freedom Mobile operates, which are British Columbia, Alberta and Ontario. If Freedom Mobile is an effective competitor that constrains the exercise of market power by the national wireless carriers, we expect to see a difference in the prices of the three wireless carriers in these provinces relative to those in other provinces. To be more specific, we expect to see that the retail

³⁴ Martin, M. and P. Beaudry "The state of competition in Canada's telecommunications industry – 2016," Montreal Economic Institute, May 2016.

³⁵ *Ibid.*

³⁶ Dobby, C., "Rogers to move Mobilicity customers to discount brand Chatr," *The Globe and Mail*, May 10, 2016.

prices of the national wireless carriers would be lower in provinces where Freedom Mobile operates than in provinces where it does not operate.

44. To ascertain whether Freedom Mobile had a discernible impact on prices, I have examined the retail price data in the 2017 Nordicity Study and the 2018 Wall Communications Study. The Nordicity Study contains price data for six cities: Vancouver, Regina, Winnipeg, Toronto, Montreal, and Halifax, while the Wall Communications Study presents price data for six provinces: British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, and Nova Scotia. Among these six cities (provinces), Freedom Mobile offers mobile wireless services in Vancouver (B.C.) and Toronto (Ontario). In each of the remaining four cities (provinces), there was one regional wireless carrier. These regional carriers were: SaskTel, MTS (now partially replaced by Xplornet), Videotron, and Eastlink.
45. Recall that the average retail prices of the national wireless carriers in these six cities (provinces) are plotted in Figures 9 and 10. I already observed, in the discussion of coordinated behavior among the national wireless carriers, that retail prices were generally lower in Regina (Saskatchewan), Winnipeg (Manitoba) and Montreal (Quebec) than those in Vancouver (B.C.), Toronto (Ontario), and Halifax (Nova Scotia). This observation suggests that Freedom Mobile, which operated in Vancouver (B.C.) and Toronto (Ontario), was less effective at constraining the prices of the national wireless carriers than SaskTel, MTS and Videotron.
46. Next, I consider whether Freedom Mobile was as effective as Eastlink at constraining the prices of the national wireless carriers. From Figure 9, we see that the retail prices of the national wireless carriers in Vancouver and Toronto were higher than in Halifax for all levels of service baskets except Level 4. In the case of Level 4, the prices in these three cities were not materially different (\$95.00 vs. \$95.43). Figure 10 shows that the retail prices of the national wireless carriers in B.C. and Ontario were higher than in Nova Scotia for four out of the six service baskets, namely Levels 2 to 5. These observations indicate that while Eastlink was not a very effective competitor (in comparison with, for

example, Videotron), Freedom Mobile appears to be even less effective at constraining the exercise of market power by the national wireless carriers.

47. In conclusion, the three new entrants that entered the retail markets for mobile wireless services after 2008 were not effective competitors. Two of them were acquired by the national wireless carriers. The third one, WIND/Freedom Mobile does not appear to be effective at constraining the prices of the national wireless carriers. My examination of price data does not indicate that Freedom Mobile had a discernible impact on the prices of the national wireless carriers.³⁷

IV. Potential Impact of Mandated Wholesale MVNO Access on Existing Mobile Wireless Carriers

48. As the Commission noted in TNC 2019-57, so far there has been virtually no MVNO activity that would provide additional competitive retail options to Canadian consumers, and a sustainable retail MVNO market has failed to develop on its own.³⁸

49. If designed and implemented properly, mandated wholesale MVNO access will facilitate the entry of MVNOs into the retail markets across Canada. This, in turn, could have a positive impact on competition, which could provide consumers with more affordable and innovative choices of mobile wireless services.

50. The magnitude of MVNOs' impact in the retail markets will depend on a number of factors, including the terms, conditions, and rates for wholesale access. A range of scenarios are possible. At one extreme, MVNOs might fail to grow into a meaningful competitive force and consequently might consist of only small wireless carriers with negligible market shares in the retail markets. At the other extreme, MVNOs might become as successful as in some of the European

³⁷ Ideally, I would like to conduct an econometric analysis to properly control for other factors that may affect the prices. But I was not able to conduct this analysis because of limited data availability and the limited amount of time I had to prepare this report.

³⁸ *Supra* note 10 paras 37 and 38.

countries such as Denmark and the Netherlands, taking up over 30 percent of the subscriber share.³⁹

51. It is beyond the scope of this report to forecast the market shares of MVNOs in the retail markets in Canada. However, an assumption about the market shares of MVNOs is needed in order to assess their potential impact on the existing mobile wireless carriers. Taking into consideration the current market shares of MVNOs in the United States, Europe and Australia,⁴⁰ I shall assume that the wholesale pricing regime and other conditions in Canada will be such that MVNOs will capture market shares of between 5 and 15 percent.

52. Another assumption in my assessment is that the rates for MVNO wholesale access will be set by the Commission using a cost-based approach qualitatively similar to the one for wholesale roaming service. In particular, I assume that the rates will include a markup that will confer a sufficient rate of return on capital. Indeed, in the case of wholesale roaming services, the Commission was cognizant of the need for wholesale rates to enable the national wireless carriers to recover their costs and obtain a fair return on capital. It stated, “The Commission considers that using a cost-based approach to establish wholesale rates will confer price certainty within the wireless industry and enable the national wireless carriers to recover their costs and obtain a fair return on their investments.”⁴¹

53. In addition to the regulatory framework of wholesale MVNO access, the business strategies of prospective MVNO entrants will also be an important factor in

³⁹ A study by management consulting firm McKinsey reported that MVNOs captured between approximately 10 and 40 percent of the business in developed markets in 2014; see Lehtikainen, J., P. Pont, and Y. Sent, “Virtually mobile: What drives MVNO success,” McKinsey & Company, Inc., June 2014, Figure 1. According to a study by Alan Rasmussen of One Development (a mobile virtual network aggregator and enabler based in Thailand), the MVNO market shares in Denmark and the Netherlands in 2018 were 34.6 percent and 33.5 percent, respectively; see Rasmussen, A. “The state of MVNO in 2018 – More than 1,300 active MVNOs in 79 countries,” December 12, 2018, Table 1, www.weconnectthailand.com/news/the-state-of-mvno-in-2018-more-than-1300-active-mvnos-in-79-countries/, accessed on April 22, 2019.

⁴⁰ In 2018, the market share of MVNOs was 4.7 percent in the United States, and 13.1 percent in Australia, respectively. In top MVNO countries in the European Union, the market share was between 11.2 percent (France) and 34.6 percent (Denmark). See Rasmussen, *ibid*. Estimates of MVNO market shares in earlier years can be found in the McKinsey report, *ibid*, Exhibit 1.

⁴¹ *Supra* note 6 para. 135. In the case of wholesale roaming services, a 40% markup was added to the regulated rates; Telecom Order CRTC 2018-99, *Wholesale mobile wireless roaming service tariffs – Final rates*, March 22, 2018, para. 189.

determining the impact of MVNOs on the retail markets. It is reasonable to predict that not all of these strategies will work and some MVNO entrants will fail. Any impact that these failed entrants will have will likely be transitory. The non-transitory impact of MVNO growth on the retail markets, then, will be exerted by successful entrants that will be able to firmly establish themselves and operate for a sustained period.

54. Based on extensive market research and its experience working on a variety of MVNO launches and MNO wholesale strategies, global management consulting firm McKinsey has identified five key success factors for MVNOs. Chief among them is to exploit brands and market segmentation:

“This typically means identifying emerging niche markets that lie beyond the reach of traditional marketing approaches or are too costly to serve or address using a conventional business model. To attract these niches, companies should set aggressive segment-targeted pricing strategies and develop specific distribution tactics.”⁴²

The other four success factors identified by McKinsey are: forging a win-win agreement with an MNO, striving for marketing excellence, focusing on sales and customer excellence, and pursuing operational excellence.

55. The importance of serving previously unfulfilled demand segments to the success of MVNOs is confirmed in an analysis of the entry process and competitive strategies of MVNOs in Italy and France.⁴³ The analysis showed that the most successful MVNOs were those characterized by the ability to find a perfect match between their core competencies and the needs of specific segments of demand that had not been previously fulfilled.
56. These key success factors for MVNOs suggest that the growth of MNVOs in Canada will likely be driven by highly efficient entrants that target niche or underserved segments of the retail markets with affordable prices and innovative services. Accordingly, entry by MVNOs will likely expand the size of the retail

⁴² Lehtikoinen, *et al.*, *supra* note 39 p.2.

⁴³ Corrocher, N. and L. Lasio, “Diversification strategies in network-based services: The case of mobile virtual network operators,” *Telecommunications Policy*, 37(2013), pp.1110–1123.

markets by attracting additional consumers who are previously unserved or underserved.

57. Indeed, in the United States where major wireless carriers such as T-Mobile and Sprint have voluntarily formed MVNO partnerships, the wireless carriers see MVNOs as a way to expand market share and reach into market segments where it might not have visibility.⁴⁴ According to Matt Carter, President of Sprint's Wholesale and Emerging Solutions unit, MVNOs offer a good economic return for the company. "It's a good strategic play for us," Carter said in an interview with FierceWireless. "It's another army to help us garner more subscribers on the network."⁴⁵

Growth of MVNOs in Canada will likely put price pressure on existing mobile wireless carriers

58. As MVNO entrants target their chosen market niches with aggressive marketing strategies, existing wireless carriers that serve these or adjacent market segments will likely feel the pressure to respond in order to retain some of their customers. This will likely lead to lower retail prices in these market segments. Therefore, consumers will likely benefit from lower prices in addition to more choices of affordable and innovative services offered by MVNOs.

59. In this regard, full MVNOs, and to varying degrees partial MVNOs, will likely be a stronger competitive force than branded resellers because the more facilities that an MVNO owns, the greater its ability to control more aspects of its service offering. Thus, for example, full MVNOs will be able to offer new services completely independently of MNOs.⁴⁶ The combined competitive force of full and partial MVNOs, the regional carriers and Freedom Mobile will act to restrain the exercise of market power by the national wireless carriers.

60. Note, however, the intensity of price of competition between MVNOs and the existing mobile wireless carriers will be constrained by the wholesale rates that

⁴⁴ Marek, S., "Sprint, T-Mobile execs explain the MVNO explosion," FierceWireless, <https://www.fiercewireless.com/special-report/sprint-t-mobile-execs-explain-mvno-explosion>, accessed on April 25, 2019.

⁴⁵ *Ibid.*

⁴⁶ *Supra* note 12, p.66.

MVNOs will pay for wholesale access. The mark-up built into the regulated wholesale rates will mean that it is unlikely that the retail prices will fall to a level at which the existing mobile wireless carriers are unable to earn a fair return on their investments.

61. On the other hand, the preceding discussion also implies that the level of wholesale rates will have a direct impact on MVNOs' ability to compete. Higher wholesale rates will push up their costs and weaken their ability to offer lower prices.

Growth of MVNOs is unlikely to cause a net loss of subscriptions for the existing mobile wireless carriers

62. The entry of MVNOs will likely lead to a substantial increase in the number of mobile wireless subscriptions in Canada. As noted earlier, the growth of MNVOs will likely be driven by entrants that target niche or underserved segments of the retail markets with affordable prices and innovative services. The combination of lower prices and innovative services will likely attract a substantial number of new subscriptions.
63. Compared with other countries, Canada has significant room to increase the number of mobile wireless subscribers. In 2017, Canada had 85.9 mobile wireless subscriptions per 100 inhabitants. In comparison, the average penetration rate for the world (which includes both developed and developing countries) was 104.5 per 100 inhabitants, and the average penetration rate of the OECD countries was 117.9 per 100 inhabitants.⁴⁷
64. Mandated wholesale access and the ensuing growth of MVNOs in Canada holds the promise of significantly improving Canada's mobile wireless penetration rate. If, in the next few years, Canada should reach the 2017 world average penetration rate, the number of mobile wireless subscriptions would increase by 6.8 million. At this penetration rate, even if the MVNO entrants were to capture a market share of 15% (the upper limit of my assumed range) across Canada, it

⁴⁷ *Supra* note 30.

would still leave 1.1 million additional subscriptions for the existing wireless carriers.⁴⁸

65. In reality, it is unlikely that MVNOs will capture such a large share of the increased subscriptions. As the MVNOs enter the markets, the existing wireless carriers are unlikely to sit idle; they will likely respond with lower prices and improved services. As a result, the increase in the number of subscriptions will likely be more evenly distributed between new MVNOs and the existing wireless carriers. Therefore, it is unlikely that the growth of MVNOs will cause a net loss of subscriptions by the existing wireless carriers.

Growth of MVNOs is unlikely to reduce investments by existing wireless carriers

66. When the Commission established the current regulatory framework for wholesale mobile wireless services in 2015, it did not mandate wholesale MVNO access due to its concerns that doing so would undermine network investments, particularly investments in spectrum and network facilities by regional competitors.⁴⁹

67. Analytically, the crux of the concerns over investments is the question, how will increased competition intensity brought about by MVNOs affect the investments by existing wireless carriers? To answer this question, it is necessary to consider the incentives for investments by existing wireless carriers and analyze how these incentives will be affected by mandated wholesale MVNO access.

68. Below I will first examine the potential impact of mandated wholesale MVNO access on the incentives to invest by the national wireless carriers. Then I will consider the same issue for the smaller wireless carriers, such as Freedom Mobile and regional carriers such as SaskTel, Videotron, and Eastlink. It is useful to consider these two groups of carriers separately because of the differences in their competitive positions in the retail markets and in their

⁴⁸ Here is how I calculated these numbers. The difference in mobile wireless penetration rate between Canada and the world average is $104.5 - 85.9 = 18.6$ per 100 inhabitants. Multiplying this difference by Canada's population in 2017 (36.7 million), I obtained the increase in the number of subscriptions: 6.8 million. Adding this increment to the number of subscriptions in Canada in 2017 (31.5 million), I obtained the total number of subscriptions if Canada should reach the world average penetration rate: 38.3 million. Deducting 15 percent of this number from 6.8 million yields 1.1 million.

⁴⁹ TRP 2015-177, *supra* note 6 para. 122, and TNC 2019-57, *supra* note 10 para. 35.

expected obligations under mandated wholesale MVNO access. In TNC 2019-57, the Commission stated its preliminary view that it would be appropriate to mandate that the national wireless carriers provide wholesale MVNO access, but made no mention of other wireless carriers.⁵⁰ In the ensuing analysis, I assume that mandated wholesale MVNO access will not be applied to the smaller wireless carriers.

69. To determine the potential impact of mandated wholesale MVNO access, I will compare a wireless carrier's incentives to invest under the following two scenarios. In one scenario, mandated wholesale access enables MVNOs to capture a significant share (5% or more) of the retail markets in Canada. This scenario will be compared with the benchmark scenario where there is no mandated access and as a result, MVNOs have virtually zero market shares. The benchmark scenario reflects the current state of wireless mobile retail markets in Canada, where there has been virtually no MVNO activity.⁵¹

Investments by the national wireless carriers

70. To analyze how mandated wholesale MVNO access will affect the investment incentives of the national wireless carriers, we need first to understand why they have not provided wholesale MVNO access service voluntarily. Generally speaking, entry by MVNOs into the mobile wireless markets will affect the profits of the national wireless carriers through two channels. First, the emergence of a wholesale market for MVNO access services offers the national wireless carriers an additional source of revenue. This will generate additional profits for the national wireless carriers.⁵² Second, increased competition intensity resulting from the entry of MVNOs may reduce the profits of the national wireless carriers. Whether it will be profitable for the national wireless carriers (as a group) to offer

⁵⁰ *Supra* note 10 para. 39.

⁵¹ TNC 2019-57, *supra* note 10 para. 37.

⁵² According to Matt Carter of Sprint USA, MVNOs offered a good economic return for his company because it was "another army to help us garner more subscribers on the network." See Marek, *supra* note 44.

wholesale MVNO access will depend on which of these two effects is expected to be larger.⁵³

71. In reality, the national wireless carriers have shown little interest in providing potential MVNOs with wholesale access.⁵⁴ This suggests that, in the estimation of the national wireless carriers, the second effect is likely to dominate the first. By not providing wholesale access to MVNOs, the national wireless carriers forego the profit opportunity in the wholesale market to protect their profits in the retail markets.

72. Note that it may be rational for a national wireless carrier to refrain from providing wholesale MVNO access as long as it expects the other national wireless carriers to do the same so that MVNOs will be kept out of the retail markets. If one of the national carriers breaks rank and starts to provide wholesale access to MVNOs, this will allow the latter into the retail markets and thus will significantly diminish or even eliminate the benefit that a national carrier expects to receive from denying MVNOs wholesale access (which is to prevent competition in the retail markets). This may tip the scale in favor of selling wholesale access services to MVNOs, in which case each of them will be compelled to sell wholesale access to MVNOs because it will not be in its interest to cede the wholesale market to its rivals.⁵⁵ Therefore, coordinated behavior among the national wireless carriers may have played a role in sustaining the current state of the retail markets where MVNOs have negligible market shares.

73. Mandated wholesale MVNO access will remove the ability of the national wireless carriers to coordinate on wholesale access; they will no longer have the option of blocking the entry of MVNOs through the denial of wholesale access.

⁵³ This trade-off facing mobile network operators (MNOs) is captured in the theoretical models by Ordover and Shaffer (2007) and Kalmus and Wiethaus (2010). In both models, two MNOs decide on whether to provide wholesale supply to one or multiple MVNOs. These analyses show that one of the factors that affects this decision is the degree of substitutability between the services offered by MNOs and the services offered by MVNOs. The MNOs may refuse to supply MVNOs if the degree of substitutability is too high (*i.e.*, if their services are very close substitutes). See Ordover, J. and G. Shaffer, "Wholesale access in multi-firm markets: When is it profitable to supply a competitor?" *International Journal of Industrial Organization*, 25 (2007), pp.1026–1045; Kalmus, P. and L. Wiethaus, "On the competitive effects of mobile virtual network operators," *Telecommunications Policy*, 34(2010), pp.262–269.

⁵⁴ TRP 2015-177, *supra* note 6 para. 86.

⁵⁵ Matt Carter of Sprint USA described the competition to form partnerships with MVNOs in this way: "If we didn't do this, someone else would." See Marek, *supra* note 44.

This raises the question of what impact, if any, mandated MVNO access would have on the national carriers' incentives to invest in network infrastructure.

74. In my opinion, mandated wholesale MVNO access at regulated rates is unlikely to reduce investments by the national wireless carriers. To the contrary, it could very possibly stimulate their investments because the entry of MVNOs into the retail markets will likely increase the number of mobile wireless subscriptions. Compared with the benchmark scenario, there will likely be a larger demand for network capacity. In the benchmark scenario, the national wireless carriers choose not to meet MVNOs' demand for capacity because they want to protect their profits in the retail markets. Under the mandated wholesale access, on the other hand, they will no longer have the option of denying MVNO access to their facilities. This will change the decision question faced by the national wireless carriers. Instead of "do we want to meet MVNO's demand for capacity?" the question they face will become, "how do we meet MVNOs' demand for capacity?" Given the assumption that the markup in the regulated wholesale rates will be sufficient to offer a fair return on their investments, the national wireless carriers could very possibly find it profitable to increase their investments in network capacity to meet the larger demand brought by the entry of MVNOs. Therefore, mandated wholesale MVNO access could very possibly stimulate investments by the national wireless carriers.

Investments by the smaller wireless carriers

75. When the Commission established the current regulatory framework for wholesale mobile wireless services in 2015, it expressed a concern over the possibility that mandated wholesale MVNO access would discourage continued investment by the smaller wireless carriers, because they could rely on this access rather than investing in their own mobile wireless network infrastructure.⁵⁶ In my opinion, this will be unlikely because of the significant markup a wireless carrier could earn from its investments in network infrastructure. As long as a

⁵⁶ TRP 2015-177, *supra* note 6 para. 122.

carrier has the necessary resources to do so, building its own mobile wireless network infrastructure will generate a higher return than purchasing wholesale access from other wireless carriers at rates that include a significant markup. It will also help the smaller carriers improve their competitive positions *vis-à-vis* the national wireless carriers. Moreover, the emergence of a wholesale market for MVNO access services offers the carriers another way to earn profits from their investments. This reduces the level of risk associated with their investments in network infrastructure, which will likely have a positive impact on their incentives to invest.

76. Over the past few years, the smaller wireless carriers have made significant investments in spectrum and network infrastructure.⁵⁷ Mandated wholesale MVNO access is unlikely to cause these investments to become stranded. For the investments to be stranded, the retail prices will have to fall to such a low level that these wireless carriers could no longer recover the costs of their investments. However, the markup built into the wholesale rates will limit the intensity of price competition between MVNOs and the facilities-based competitors because an MVNO will incur a loss if its price falls below the wholesale rate it pays. This means that the retail prices of mobile wireless services are unlikely to fall to a level at which the smaller wireless carriers will not be able to earn a fair return on their past investments. Moreover, they will have opportunities to sell access services to MVNOs. This will provide an additional avenue to earn profits from the investments they made in the past few years. Therefore, the markup built into the wholesale rates will likely ensure that the investments made by the smaller wireless carriers will not become stranded.

Empirical evidence supports the opinion that mandated wholesale MVNO access is unlikely to reduce investments

77. In the academic literature, there are only a small number of empirical studies that have investigated the relationship between competition intensity and investment

⁵⁷ TRP 2015-177, *supra* note 6 para. 121, and TNC 2019-57, *supra* note 10 para. 36.

in the mobile wireless industry. Among those, Kim *et al.* (2011)⁵⁸ and Hounghonon and Jeanjean (2016)⁵⁹ are of particular relevance to the present report.⁶⁰

78. Using firm-level data of 58 mobile network operators (MNOs) from 21 developed countries (including Canada), Kim *et al.* (2011) examined the effects of MVNO entry and access regulation on the investment behavior of MNOs. Their econometric analysis suggests that mandated MVNO access was associated with decreased investment incentives of MNOs.

79. However, as detailed in a previous report filed in proceeding TNC CRTC 2017-259, the study by Kim *et al.* (2011) suffers from a number of shortcomings.⁶¹ Among those, the most problematic shortcoming, in my opinion, is the assumption of linear relationship between investment and competition. This assumption artificially rules out the possibility that the relationship may be nonlinear. Yet one of the recurring themes in the voluminous theoretical and empirical literature on the effects of competition is that, under many circumstances, the relationship between competition intensity and investment is non-linear and may, in fact, have an inverted-U shape.⁶²

80. An inverted-U relationship is indeed what Hounghonon and Jeanjean (2016) found regarding the impact of competition intensity on investment in the mobile wireless industry. Using more sophisticated econometric techniques that

⁵⁸ Kim, J., Y. Kim, N. Gaston, R. Lestage, Y. Kim, and D. Flacher, "Access regulation and infrastructure investment in the mobile telecommunications industry," *Telecommunications Policy*, 35(2011), pp. 907-919.

⁵⁹ Hounghonon, G.V. and F. Jeanjean, "What level of competition intensity maximises investment in the wireless industry," *Telecommunications Policy*, 40(2016), pp.774-790,

⁶⁰ Both studies are specifically about the wireless telecommunications industry and include Canada in their samples. Among other studies, Kang *et al.* (2012) examines the relationship between market concentration and investment in China's wireless industry; Kang, F., J.A. Hauge, T. Lu, "Competition and mobile network investment in China's telecommunications industry," *Telecommunications Policy*, 36(2012), pp.901-913.

⁶¹ Appendix A of submission by Ice Wireless Inc. in the matter of Reconsideration of Telecom Decision 2017-56 Regarding Final Terms and Conditions for Wholesale Mobile Wireless Roaming Service, TNC CRTC 2017-259, "Economic Review of Mandated Wholesale Access for Wi-Fi First Service Providers, Investment and Competition in the Mobile Wireless Telecommunications Industry in Canada," by Markus von Wartburg, paras 77-79. The shortcomings identified in this report are the small sample size of the study, the assumption of a linear relationship between investment and competition, and the endogeneity of competition.

⁶² See, for example, Aghion, P. and R. Griffith, *Competition and Growth: Reconciling Theory and Evidence*, Cambridge, MIT Press, 2005.

overcome the main shortcomings of Kim *et al.* (2011), Hounghbonon and Jeanjean (2016) found an inverted-U shaped relationship between competition intensity and investment in wireless networks. Specifically, a wireless carrier's investment decreases with the intensity of competition if its profits, measured by EBITDA, are below the thresholds of 37-40 per cent of its revenue, but it increases with the intensity of competition if its EBITDA ratio is above the thresholds of 37-40 per cent of its total revenue.

81. For Canada, this finding by Hounghbonon and Jeanjean implies that increased competition brought about by MVNOs will not reduce investments by the national wireless carriers. In Table 3 are the EBITDA ratios of the three national wireless carriers from 2016 to 2018. It shows that the average EBITDA ratio over the last three years was 42.3 percent for Bell, 43.2 percent for Rogers, and 42.8 percent for TELUS. These ratios exceed the threshold above which more intense competition is estimated to increase investment.

Table 3: EBITDA Margins of the National Wireless Carriers

	Bell	Rogers	TELUS
2016	41.9%	41.5%	42.2%
2017	42.6%	43.5%	42.9%
2018	42.3%	44.5%	43.3%
Average	42.3%	43.2%	42.8%

Note: (a) EBITDA margins in this table are those of the wireless segment of the respective company.

(b) Rogers' EBITDA margin in 2016 is from the author's calculation in order to be consistent with other numbers in this table. The 2016 EBITDA margin presented in Rogers' annual reports is as a percentage of wireless service revenue rather than total revenue of its wireless segment.

Source: Annual reports of BCE Inc., Rogers Communications Inc., and TELUS Corporation.

82. Moreover, the estimates by Hounghbonon and Jeanjean (2016) show that wireless carriers which host an MVNO invest more than their rivals. This lends support to the opinion that the national wireless carriers could very possibly invest more in order to meet the increased demand for capacity brought about by MVNOs.

83. Therefore, the available empirical evidence supports the opinion that mandated wholesale MVNO access is unlikely to reduce investments.

V. Appropriate Phase-Out Process for Mandated Wholesale MVNO Access

84. While I have assumed in the preceding analysis that mandated wholesale MVNO access will enable MVNOs to establish a significant presence in the retail markets, the regulatory framework for wholesale MVNO access will play an important role in ensuring the establishment of a viable MVNO retail market. An appropriate phase-out process is one aspect of the regulatory framework that will be critical to the success of MVNOs.

85. In TNC 2019-57, the Commission expressed its preliminary view that the national wireless carriers' mandated wholesale MVNO access should be in place for a limited amount of time and be subject to a phase-out period as market forces take hold.⁶³

86. I agree with the principle that as the MVNO market matures and MVNOs establish themselves in the retail markets across Canada, regulatory intervention should eventually give way to a market-based approach. However, it is important to recognize that the design of the phase-out process itself can have a significant impact on the success or failure of mandated wholesale MVNO access in promoting competition in the retail markets.

87. I am of the opinion that a predetermined date for the phase-out of mandated access is not appropriate because it will have a negative impact on the entry and expansion by MVNOs. In the worst-case scenario, the presence of a predetermined date could prevent MVNOs from becoming a meaningful competitive force in the retail markets. Instead of a predetermined date, the test for the initiation of the phase-out process should be based on market conditions, in accordance with the criteria for forbearance set out in s.34 of the *Telecommunications Act*.

A predetermined date for the phase-out of mandated access will negatively affect the entry and expansion by MVNOs in a number of ways

⁶³ *Supra* note 10, para. 40.

88. One problem with a predetermined date for the phase-out process is the practical difficulty of predicting, with a reasonable degree of precision, when MVNOs will be firmly established. Therefore, it carries the risk of phasing out mandated access prematurely.
89. A MVNO market is firmly established when services provided MVNOs take up a sufficiently large share of network capacity that it would not be profitable for the national wireless carriers, acting independently or cooperatively, to deny access to their facilities by MVNOs. Given MVNOs' reliance on the wholesale access services provided by the national carriers, loss of access to latter's facilities would severely damage their ability to operate and could even force them to shut down their operations completely. Therefore, premature phase-out of mandated access could threaten the survival of MVNOs. This is a risk associated with a predetermined date for the phase-out of mandated access.
90. The risk of premature phase-out associated with a predetermined date will make it more costly for MVNOs to raise capital. Investors will demand a larger risk premium to compensate for this additional risk. Higher costs of capital will inhibit the entry and expansion by MVNOs.
91. The risk of premature phase-out associated with a predetermined date will also have a negative impact on investments in facilities by the national wireless carriers. To meet the expected increase in demand brought about by MVNOs, the national carriers may need to invest more in capacity. If there is a significant risk that MVNOs will not be sustainable beyond a predetermined date, they may delay or scale down their investments as a way to manage the risk.
92. More importantly, a predetermined date for the phase-out process will create incentives for the national wireless carriers to adopt measures that will have the effects of obstructing the entry and expansion of MVNOs. If the national wireless carriers manage to restrain the expansion of MVNOs during the predetermined period of mandated access, they will face less competition after the mandated access ends. The reluctance of the national wireless carriers to open up their networks to MVNO access in the past suggests that, if wholesale MVNO access is mandated, they will likely have incentives to prevent MVNOs from becoming a

meaningful competitive force that will restrain their retail profitability. From the perspective of competition, it would not be a good outcome if the mandated wholesale access fails to enable MVNOs to develop into a meaningful competitive force in the retail markets across Canada.

The test for the initiation of phase-out process should be based on market conditions

93. In my opinion, the test for initiating the phase-out process should be based on market conditions rather than a predetermined time line. Moreover, the design of the test should be guided by the requirements in s.34 of the *Telecommunications Act* to assess whether the appropriate market conditions exist to justify regulatory forbearance:

“(2) Where the Commission finds as a question of fact that a telecommunications service or class of services provided by a Canadian carrier is or will be subject to competition sufficient to protect the interests of users, the Commission shall make a determination to refrain, to the extent that it considers appropriate, conditionally or unconditionally, from the exercise of any power or the performance of any duty.”

“(3) The Commission shall not make a determination to refrain under this section in relation to a telecommunications service or class of services if the Commission finds as a question of fact that to refrain would be likely to impair unduly the establishment or continuance of a competitive market for that service or class of services.”

94. My reading of s.34(2) and s.34(3) of the *Telecommunications Act* suggests that two conditions should be met before the initiation of the phase-out process. First, the mobile wireless retail markets in all provinces of Canada are subject to competition sufficient to protect the interests of users. Second, MVNOs are firmly established as a meaningful competitive force in the mobile wireless retail markets in all provinces of Canada.

95. To operationalize these two conditions, I would propose a two-step procedure for the initiation of the phase-out process. The first step involves two market share thresholds (discussed below). The meeting of these two market share thresholds will trigger the second step, which is a comprehensive review of market conditions to determine whether a mobile wireless retail market is sufficiently competitive and whether MVNOs are firmly established. This review will examine, among other things, prices and trends in prices, adoption and usage of services, qualities of services, investment, innovation, and barriers to entry.
96. Regarding the first step, I would propose that two market share thresholds be used, one for the combined market share of the three national wireless carriers and the other for the combined market share of MVNOs. A retail market may be considered sufficiently competitive if the combined market share of the national wireless carriers falls below the first threshold, and MVNOs may be considered firmly established in a retail market if their combined market share exceeds the second threshold. These market share thresholds will serve as a screening mechanism that will help the Commission to determine the timing of a full review.
97. Since the geographic market for the wholesale MVNO access is national, the phase-out process – when initiated – should apply to the whole country rather than to individual provinces. However, given the uneven market shares of the competitors in different provinces (as can be seen from Tables 1 and 2), it is quite possible that some provinces will reach the market share thresholds before others. One design issue with the proposed screening mechanism is the minimum number of provinces that should reach the market share thresholds before a full review of market conditions (*i.e.*, step 2) is launched. In principle, the full review can be launched when preliminary indications based on market shares suggest that a sufficient number of Canadians in a sufficient number of provinces have access to competitive retail markets for mobile wireless services (including MVNO services). In this regard, one possibility is to use a formula similar to the one for amending the Constitution: a full review of market conditions will be launched if the market share thresholds are reached in seven out of ten provinces representing at least 50 percent of the population of Canada.

98. The specific values of the two market share thresholds should be chosen to reflect the Commission's view on what a properly functioning competitive mobile wireless market in Canada should look like and what role MVNOs should play in the competitive market. In my opinion, 80 percent could be an appropriate threshold for the combined market share (based on the number of subscriptions) for the national wireless carriers. This condition would imply that the competitors of the national wireless carriers should have a share of at least 20 percent in a retail market. Given the high barriers to entry and evidence of coordinated behavior, it is unlikely that competitors would be able to effectively restrain the unilateral and coordinated exercise of market power by the national wireless carriers if their combined market share is below 20 percent.
99. To put this market share threshold in perspective, note that 65 percent is the threshold for combined market share in the initial screening mechanism used by the Competition Bureau to determine joint market dominance.⁶⁴ In the United States, antitrust authorities use HHI in their screening mechanism, and they consider a market is moderately concentrated if HHI is between 1500 and 2500.⁶⁵ In the present context, if we assume that the three national wireless carriers collectively hold a market share of 80 percent and three other competitors split the remaining 20 percent evenly, this would give rise to an HHI value of at least 2267, which is at the high end of the range for moderately concentrated markets.⁶⁶
100. Because of the near absence of MVNOs in Canada's retail markets, it is more challenging to ascertain what would be an appropriate threshold for the combined market share of MVNOs. Statistics for other OECD countries show a wide range of MVNO market share, from 5 percent to over 30 percent.⁶⁷ I will need more information before I could propose a specific value as the threshold for the market share of MVNOs in Canada.

⁶⁴ *Supra* note 8.

⁶⁵ *Supra* note 9.

⁶⁶ An HHI value of 2267 is obtained if the three national wireless carriers split the 80-percent market share evenly. The HHI value will be higher if they have unequal shares. Changing the assumption about the number of other competitors will not have a qualitative impact on the conclusion.

⁶⁷ *Supra* notes 39 and 40.

101. Unlike a predetermined date for the phase-out process, this market-share based test will not create incentives for the national wireless carriers to obstruct the entry and expansion of MVNOs. To the contrary, it may provide an incentive for them to facilitate the expansion of both service-based and facilities-based competitors. The sooner the retail markets reach these thresholds, the sooner the national wireless carriers will be freed from the constraints imposed by mandated access.
102. Another advantage of the market-share based test is that it conveys a commitment for competitive retail markets and for a significant presence of MVNOs in these markets. This commitment will provide regulatory certainty and help anchor the expectation of all market participants, which will facilitate investments by the national wireless carriers and other wireless service providers including MVNOs.

VI. Wholesale Access to 5G Networks and Future Technologies

103. The deployment of 5G wireless technology by wireless carriers in Canada will make their wireless networks exponentially faster, more pervasive, and more versatile.⁶⁸ In addition to the promise of enabling countless new applications, the faster data rates and lower latencies of 5G networks will significantly enhance consumers' experience from activities they already perform on their smartphones, such as video streaming and virtual reality games.⁶⁹ This will mean that wireless service providers that have access to 5G networks will be able to offer their customers more choices and better quality of services, giving them a significant competitive advantage over those that do not.
104. In my opinion, the regulatory framework for wholesale mobile wireless services should be forward-looking and include mandated wholesale MVNO access to 5G networks. This will make an important difference to the viability and success of MVNO services and to the achievement of competitive retail

⁶⁸ TNC 2019-57, *supra* note 10, para. 18.

⁶⁹ Clark, D. "What is 5G? Here's what you need to know about the new cellular network," *The New York Times*, December 31, 2018.

markets across Canada. Compared with U.S., Australia and many countries in Europe, Canada is many years behind in the introduction of MVNO services.⁷⁰ Being latecomers to the retail markets in Canada, MVNO entrants will have to overcome the entrenched dominance of the national wireless carriers in order to establish a significant presence. If 5G networks are not included in the mandated wholesale access in a timely fashion, MVNOs will be confined to offering services based only on older generations of wireless technology. This will further weaken their competitive positions *vis-à-vis* their facilities-based competitors and make it extremely difficult for them to go beyond the role of small niche players. Therefore, exclusion of 5G networks from mandated wholesale access will significantly diminish the likelihood of MVNOs becoming a significant competitive force in the retail markets across Canada.

105. Mandated MVNO access to 5G networks is unlikely to have a negative impact on the investments in 5G network infrastructure in Canada. The innovative services offered by MVNOs will likely bring more consumers onto the 5G networks. This will likely create a larger demand for 5G network infrastructure. Since the regulated wholesale rates are expected to include a markup that will offer a fair return on their investments, the wireless carriers will likely find it profitable to boost their investments in network capacity to meet the larger demand. Therefore, mandated wholesale MVNO access to 5G networks could very possibly have a positive rather than negative impact on investments in 5G network infrastructure.

106. The preceding analysis is also applicable to other new wireless technologies that will emerge in the future. Without timely access to the newest technologies, MVNOs will be perpetually kept at a competitive disadvantage *vis-à-vis* their facilities-based competitors. Unless access to future new technologies is included in the regulatory framework for wholesale mobile wireless services, any benefits from the mandated MVNO access will likely be temporary and we will likely be back facing the same problem in a few years. A forward-looking

⁷⁰ In these other countries, MVNOs have been operating for more than 15 years and have captured significant market shares; Rasmussen, *supra* note 39, Table 1.

regulatory framework, therefore, should include mandated wholesale MVNO access to 5G networks and all future new technologies.

Appendix

Curriculum Vitae

ZHIQI CHEN

OFFICE ADDRESS

Department of Economics
Carleton University
Ottawa, Ontario
CANADA K1S 5B6
Voice: (613)520-2600 ext. 7456; Fax: (613)520-3906
E-mail: zhiqi.chen@carleton.ca

PRESENT POSITION

Full Professor, Department of Economics, Carleton University, Ottawa, Ontario, since 2002

CAREER HIGHLIGHTS

- Published 49 articles in refereed journals, including top journals in economics such as *American Economic Review*, *Economic Journal*, *International Economic Review*, and *RAND Journal of Economics*
- Co-edited one book on Canadian industrial policy
- Received more than 2100 citations (Google Scholar data)
- RePEc world rankings (as of January 2019): Top 8% overall; Top 5% in terms of Number of Journal Pages (Weighted by Number of Authors), Top 6% in terms of Number of Distinct Works (Weighted by Number of Authors), Top 7% in terms of Number of Citations (Weighted by Number of Authors and Impact Factors)
- Received 14 external research grants, including six SSHRC grants
- Served as a Co-Editor of *Journal of Economics and Management Strategy* since 2004
- Served as the Executive Editor of *Frontiers of Economics in China* since 2013
- Supervised 11 completed PhD theses (including one co-supervision)
- Twice served as the T.D. MacDonald Chair in Industrial Economics at the Canadian Competition Bureau
- Worked for public and private clients as an economics expert on more than 30 cases related to competition policy and other issues
- Listed in *Canadian Who's Who*, since 2001
- Listed in *Who's Who Legal: Competition*, since 2016

EDUCATION

Ph.D. (Economics), University of Western Ontario, 1991

Title of Dissertation: *Economic Growth: Dynamic Interactions with International Trade and Global Environment*

M.A. (Economics), Carleton University, 1987

B.A. Honours (Economics), Nanjing University, China, 1985

PREVIOUS POSITIONS

Visiting Economist, Competition Bureau, Government of Canada, September 2011 - February 2012

Director, Ottawa-Carleton Joint Doctoral Program in Economics, 2001 - 2004

T.D. MacDonald Chair in Industrial Economics, Competition Bureau, Government of Canada, September 1998 - August 1999, and September 2004 - August 2005

Associate Professor (1996 - 2002) and Assistant Professor (1991-1996), Department of Economics, Carleton University

Director, Carleton Industrial Organization Research Unit, 1996 - 1998

Senior Fellow, Department of Economics, National University of Singapore, 1997 - 1998

AWARDS AND PROFESSIONAL HONOURS

Department of Economics Research Excellence Award, Carleton University, 2018

Listed in *Who's Who Legal: Competition*, since 2016

Listed in *Who's Who Legal: Consulting Experts*, since 2016

Listed in *Who's Who Legal: Canada*, since 2016

CES-Chow Teaching Fellowship, 2010

Listed in *Canadian Who's Who*, since 2001

Research Achievement Award, Carleton University, 2000 - 2001

PUBLICATIONS

Articles in Refereed Journals

“Supplier Innovation in the Presence of Buyer Power,” *International Economic Review*, volume 60, issue 1 (February 2019), 329-353

“Horizontal Mergers in the Presence of Capacity Constraints,” joint with Gang Li, *Economic Inquiry*, volume 56, issue 2 (April 2018), 1346–1356

“Short-Term and Long-Term Margins of International Trade: Evidence from the Canada-Chile Free Trade Agreement,” joint with Marcel Voia, *Frontiers of Economics in China*, volume 13, issue 1 (March 2018), 93–115

“Do Merger Efficiencies Always Mitigate Price Increases?” joint with Gang Li, *Journal of Industrial Economics*, volume 66, issue 1 (March 2018), 95-125

“Product Market Competition and Innovation: What Can We Learn from Economic Theory?” *Frontiers of Economics in China*, volume 12, issue 3 (September 2017), 341-355

“Specific Investment and Supplier Vulnerability,” joint with Xiaoqiao Wang, *Economics Letters*, volume 151 (February 2017), 16-18

“Border Effects Before and After 9/11: Panel Data Evidence across Industries,” joint with Horatiu Rus and Anindya Sen, *World Economy*, volume 39, issue 10 (October 2016), 1456 - 1481 (lead article)

“Downstream Competition and the Effects of Buyer Power,” joint with Hong Ding and Zhiyang Liu, *Review of Industrial Organization*, volume 49, issue 1 (August 2016), 1 - 23 (lead article)

“Denying Leniency to Cartel Instigators: Costs and Benefits,” joint with Subhadip Ghosh and Thomas W. Ross, *International Journal of Industrial Organization*, Volume 41 (July 2015) 19 - 29

“Product Line Rivalry and Firm Asymmetry,” joint with Zhihong Chen, *Journal of Industrial Economics*, Volume 62, Issue 3 (September 2014), 417 - 435

“Venture Capital Networks and Investment Performance in China,” joint with Zhiyang Liu, *Australian Economic Papers*, Volume 53, Issue 1-2 (June 2014), 97 - 111

“Unemployment and Welfare Consequences of International Outsourcing under Monopolistic Competition,” joint with Richard Brecher, *Canadian Journal of Economics*, volume 47, Issue 2 (May 2014), 540 - 554

“Unemployment and Product Market Competition in a Cournot Model with Efficiency Wage,” joint with Bo Zhao, *Canadian Journal of Economics*, volume 47, Issue 2 (May 2014), 555-579

“The Trouble with Offshoring: Static and Dynamic Losses in the Presence of Unemployment,” joint with Richard Brecher and Zhihao Yu, *World Economy*, volume 36, Issue 1 (January 2013), 1 - 11 (lead article)

“Telephone Penetration and Economic Growth in the APEC Region: A Simultaneous Non-Linear GMM Approach,” joint with Eng Kooi Lim, *Frontiers of Economics in China*, volume 7, Issue 3 (September 2012), 339 - 362

“The Impact of Trade Liberalization in Telecommunications Services: The Case of APEC Countries,” joint with Eng Kooi Lim, *Telecommunications Policy*, volume 36 (May 2012), 274 -

“The Quiet Life of a Monopolist: The Efficiency Losses of Monopoly Reconsidered,” joint with Jun Chen, *Frontiers of Economics in China*, volume 6, Issue 3 (September 2011), 389 - 412

“Unemployment of Skilled and Unskilled Labor in an Open Economy: International Trade, Migration and Outsourcing,” joint with Richard Brecher, *Review of International Economics*, volume 18, Issue 5 (November 2010), 990 - 1000

“A Dynamic Model of Shirking and Unemployment: Private Saving, Public Debt and Optimal Taxation,” joint with Richard Brecher and Ehsan Choudhri, *Journal of Economic Dynamics and Control*, volume 34, Issue 8 (August 2010), 1392 - 1402

“Credible Retaliatory Entry and Strategic Toe-Holds,” joint with Thomas Ross, *Journal of Industrial Economics*, volume 57, Issue 2 (June 2009), 244 - 253

“Defining Buyer Power,” *Antitrust Bulletin*, volume 53, No. 2 (Summer 2008), 241 - 250

“Markets Linked by Rising Marginal Costs: Implications for Multimarket Contact, Recoupment and Retaliatory Entry,” joint with Thomas Ross, *Review of Industrial Organization*, volume 31 (2007): 1 - 21

“Buyer Power: Economic Theory and Antitrust Policy,” *Research in Law and Economics: A Journal of Policy*, volume 22 (2007): 17 - 40

“Nuisance Suits and Contingent Attorney Fees,” *Review of Law and Economics*, volume 2, issue 3 (October 2006), 363 - 370

“Dynamic Stability in a Two-Country Model of Optimal Growth and International Trade,” joint with Richard A. Brecher, and Ehsan U. Choudhri, *Journal of Economic Dynamics and Control*, volume 29 (2005): 583 - 594

“An International Trade Model of Currency Crisis,” *The Chinese Journal of Economic Theory*, volume 1 (2004): 36 - 44

“Price Dispersion in a Model of Identical Agents with Perfect Information,” joint with Ying Kong, *Pacific Economic Review*, volume 9, No. 1 (February 2004), 29 - 44

“Dominant Retailers and the Countervailing Power Hypothesis,” *RAND Journal of Economics*, volume 34, No. 4 (Winter 2003), 612 - 625

“A Theory of International Strategic Alliance,” *Review of International Economics*, volume 11, November 2003, 758 - 769

“Cooperating Upstream while Competing Downstream: A Theory of Input Joint Ventures,” joint with Thomas Ross, *International Journal of Industrial Organization*, volume 21 (2003), 381 - 397

“Absolute and Comparative Advantage, Reconsidered: The Pattern of International Trade with Optimal Saving,” joint with Richard Brecher and Ehsan Choudhri, *Review of International Economics*, volume 10, November 2002, 645 - 656

“Unemployment and Growth in the Long-Run: An Efficiency-Wage Model with Optimal Savings,” joint with Richard Brecher and Ehsan Choudhri, *International Economic Review*, volume 43, August 2002, 875 - 894

“A Cournot-Nash Model of Family Decision Making,” joint with Frances Woolley, *Economic Journal*, volume 111, October 2001, 722 - 748

“Selective versus Universal Vouchers: Modelling Median Voter Preferences in Education,” joint with Edwin West, *American Economic Review*, volume 90, December 2000, 1520 - 1534. Reprinted in L. Zhou, Z. Tao, D. Xie and M. Song eds., *Essays in Modern Economics Research in Honour of Professor Gregory Chow*, Gelin Press, 2008

“Strategic Alliances, Shared Facilities and Entry Deterrence,” joint with Thomas Ross, *RAND Journal of Economics*, volume 31, Summer 2000, 326 - 344

“Adoption of New Technology by a Lagging Country: Leapfrogging or No Leapfrogging?” *Pacific Economic Review*, volume 4, February 1999, 43 - 57

“A Theory of Tenure for the Teaching University,” joint with Steve Ferris, *Australian Economic Papers*, volume 38, March 1999, 9 - 25

“Refusals to Deal and Orders to Supply in Competitive Markets,” joint with Thomas Ross, *International Journal of Industrial Organization*, volume 17 (1999), 399 - 417

“International Comparisons of Biotechnology Policies,” joint with Alison McDermott, *Journal of Consumer Policy*, volume 21, December 1998, 527 - 550. Reprinted in A. Mathias and B.M. Knoppers eds., *Biotechnology and the Consumer*, Kluwer Academic, 1999

“Orders to Supply as Substitutes for Commitments to Aftermarkets,” joint with Thomas Ross, *Canadian Journal of Economics*, volume 31, November 1998, 1204 - 24

“Refusals to Deal and Aftermarkets,” joint with Thomas Ross and William Stanbury, *Review of Industrial Organization*, volume 13, No. 1-2, April 1998, 131-51

“Can Economic Activities Lead to Climatic Chaos? An Economic Analysis on Global Warming,” *Canadian Journal of Economics*, volume 30, No.2, May 1997, 349-66. Reprinted in J.B. Rosser, Jr and K. L. Kramer, Jr. eds., *Complexity in Economics*, volume 174 in the International Library of Critical Writings in Economics series, Edward Elgar Publishing, 2004

“Negotiating an Agreement on Global Warming: A Theoretical Analysis,” *Journal of Environmental Economics and Management*, Volume 32, No.2, February 1997, 170-88. Reprinted in *The Economics of International Environmental Agreements*, edited by A.A. Batabyal, Ashgate Publishers, 1999

“New Technology, Subsidies, and Competitive Advantage,” *Southern Economic Journal*, Volume 63, No. 1, July 1996, 124-39

“The Heckscher-Ohlin Theorem with Endogenous Labour Supply,” *Bulletin of Economic Research*, volume 47, No.4, October 1995, 275-83

“How Low is a Guaranteed-Lowest-Price?” *Canadian Journal of Economics*, volume 28, No.3, August 1995, 683-701

“Why Are Extended Warranties So Expensive?” joint with Thomas Ross, *Economics Letters*, volume 45, No.2, June 1994, 253-257

“Refusal to Deal, Price Discrimination and Independent Service Organizations,” joint with Thomas Ross, *Journal of Economics and Management Strategy*, volume 2, No.4, Winter 1993, 593-614

“Long-run Equilibria in a Dynamic Heckscher-Ohlin Model,” *Canadian Journal of Economics*, Volume 25, No.4, November 1992, 923-43

Chapters in Books

“Recent Developments in Industrial Organization Theory,” joint with Guofu Tan, in S. Song and Z. Pan (eds.), *The Frontier of Western Social Sciences and Humanities Research: Economics*, Chinese Renmin University Press, 2008

“Liberalization of Trade and Investment in Telecommunication Services: A Canadian Perspective,” in R.G. Lipsey and A.O. Nakamura eds, *Services Industries and the Knowledge-Based Economy*, University of Calgary Press, 2006

“Measuring the Barriers to Trade in Services: Literature and Methodologies,” joint with Lawrence Schembri, *Trade Policy Research* (published by Department of Foreign Affairs and International Trade, Government of Canada), 2002

Books

Industrial Organization in Canada: Empirical Evidence and Policy Challenges, Co-editor (with Marc Duhamel), McGill-Queen’s University Press, 2011

OTHER SCHOLARLY OR PROFESSIONAL ACTIVITIES

Research Grants and Contracts

“Consumer Protection in the Age of Internet Commerce and Big Data,” Social Sciences and Humanities Research Council of Canada (SSHRC) Insight Grant, 2019 - 2024.

“Price Impact of Merger Efficiencies,” FPA Research Productivity Bursary, Carleton University, 2016

“Measurement of Non-Tariff Barriers,” for Department of Foreign Affairs and International Trade, Government of Canada, 2011 - 2012

“Barriers to Competition in Canada,” for Industry Canada, Government of Canada, 2010 - 2012

“Capital Investment, Cooperative R&D, and Product Market Rivalry,” Social Sciences and Humanities Research Council of Canada (SSHRC) strategic research grant, 2008 - 2011

“Product Market Competition in Chinese Industries,” Social Sciences and Humanities Research Council of Canada (SSHRC) strategic development grant, 2009 - 2010

“Productive Inefficiency and Unemployment: The Efficiency Consequences of Monopoly Reconsidered,” Social Sciences and Humanities Research Council of Canada (SSHRC) standard research grant, 2006 - 2009

“Rivalry, Market Structure, and Industrial Competitiveness: Issues and Evidence,” for Industry Canada, Government of Canada, 2006

“The Consideration of Buyer Power and Cooperation among Competitors in Antitrust Analysis,” for the Competition Bureau, Government of Canada, 2004 - 2005

“Slotting Allowances, Private Label Products, and Buyer Power,” Social Sciences and Humanities Research Council of Canada (SSHRC) standard research grant, April 2002 - March 2005

“E-Commerce and Canada’s Competition Policy,” Social Sciences and Humanities Research Council of Canada (SSHRC) Initiative on the New Economy (INE) Development Grant, 2002 - 2003

“Competition among Firms: Prices and Qualities,” Social Sciences and Humanities Research Council of Canada (SSHRC) standard research grant, April 1999 - March 2002

Director of Ottawa-Carleton Joint Program Research Grant, from the Office of Research Services, Carleton University, 2001 - 2004

“Price Guarantees and Tacit Collusion,” research grant from the Vice President (Academic) and Dean of Faculty of Public Affairs and Management, Carleton University, 2001

“International Trade in Services,” joint with Lawrence Schembri, for Department of Foreign Affairs and International Trade, Government of Canada, December 2000 - June 2001

“Impact of the North America Free Trade Agreement on Canada-Taiwan Trade,” joint with Lawrence Schembri, for Council of Economic Development and Planning, Taiwan, October 1999 - August 2000

“Issues in Anti-Trust Economics,” research grant from the Competition Bureau, Industry Canada, Government of Canada, 1998 - 1999

“Consumers and Biotechnology,” for the Office of Consumer Affairs, Industry Canada, Government of Canada, 1997

“Carleton Industrial Organization Conference,” a conference grant from the Office of Research Services, Carleton University, 1996

Research on a variety of topics, funded by Carleton University GR6 grants, 1991 -1992, 1992 - 1993, 1993 - 1994

Scholarly Work in Progress

“Trade and Labour Standards: Will There Be a Race to the Bottom?” joint with Afshan Dar-Brodeur, revised and resubmitted to *Canadian Journal of Economics*

“Specific Investment, Supplier Vulnerability and Profit Risks,” joint with Xiaoqiao Wang, revise and resubmit, *Journal of Business Finance and Accounting*

“Strategic Corporate Social Responsibility under Demand Uncertainty,” joint with Zhihong Chen and Heng Xu

“Buffer Strategic Alliances,” joint with Thomas Ross

“Colluding on Surcharges”

“Private Label and Product Quality under Asymmetric information,” joint with Heng Xu

Papers Presented (Since 2003)

“Retailer Buyer Power and Pricing Mechanisms of Generic Drugs in Canada,” presented at Health Economics & Simulation Modelling Methods Cluster, University of British Columbia, November 2018

“Colluding on Surcharges,” presented at University of California, Santa Barbara (October 2016), Hong Kong University of Science and Technology (March 2017), The 2017 Workshop on Anti-Monopoly Law and Competition Economics, Shanghai (May 2017), Peking University (June

2017), Renming University (May 2018), Canadian Economics Association Meetings, Montreal (June 2018), Hohai University (June 2018)

“Buyer Power: Economic Theory and Competition Policy,” presented at Tianjin University of Finance and Economics (April 2015), ICN-OECD KPC Competition Economics Workshop for Chief and Senior Economists, Seoul (May 2018), and Dongbei University of Finance and Economics (June 2018)

“Short-Term and Long-Term Margins of International Trade: Evidence from the Canada-Chile Free Trade Agreement,” presented at Forum on Free Trade Zone and New Openness in China, Shanghai (May 2015), International Forum on Silk Road Economy, Xi’an (May 2017), and Chinese Economists Society annual conference, Nanjing (June 2017)

“Role of Economists and Economic Analysis in Antitrust Enforcement,” presented at Hong Kong University of Science and Technology (March 2017)

“Horizontal Cooperation Agreements: Economic Theory and Competition Policy,” presented at Tianjin University of Finance and Economics (June 2016)

“Canada’s Enforcement Approach to Collaboration among Competitors,” presented at the 2016 Workshop on Antitrust and Industrial Organization, Shanghai (May 2016), and the 2016 Conference on Frontier Issues in Industrial Organization, Dalian (June 2016)

“Do Merger Efficiencies Always Mitigate Price Increases?” presented at Shanghai University of Finance and Economics (May 2015), and at University of Manitoba (March 2016)

“Supplier Innovation in the Presence of Buyer Power,” presented at Queen’s University (March 2014), Nanjing University (June 2016)

“Denying Leniency to Cartel Instigators: Costs and Benefits,” presented at Shanghai University of Finance and Economics (June 2013) and the Canadian Economic Association Meetings, Toronto (May 2015)

“Supplier Incentives in the Presence of Buyer Power: A General Theory with Applications”, at Nanjing University (June 2012), the 8th Conference on Industrial Economics and Economic Theory (Jinan, June 2013), University of Victoria (October 2012)

“Horizontal Mergers in the Presence of Capacity Constraints,” presented at Shanghai Jiaotong University (June 2012), at the International Conference on Game Theory and Economic Behaviour (Qindao, June 2012), and at the Shanghai Workshop on Industrial Organization and Competition Policy (Shanghai, June 2011)

“Unemployment and Welfare Consequences of International Outsourcing under Monopolistic Competition,” presented at Shanxi University of Finance and Economics (May 2012), and at the 2012 Microeconomics Workshop (Shanghai, June 2012)

“Downstream Competition and the Effects of Buyer Power,” presented (jointly with Hong Ding) at the Annual Meetings of the Canadian Economics Association (Ottawa, June 2011), and at the International Conference on Frontier Issues in Industrial Organization (Dalian, June 2011)

“Product Line Rivalry and Firm Asymmetry,” presented at the 2011 International Conference on Industrial Economics (Hangzhou, June 2011), and at Dongbei University of Finance and Economics (June 2011)

“The Trouble with Offshoring: Static and Dynamic Losses in the Presence of Unemployment,” presented at Shanghai University of Finance and Economics (April 2011)

“The Quiet Life of a Monopolist: The Efficiency Losses of Monopoly Reconsidered,” presented at Shanghai University of Finance and Economics (December 2010), and at Nanjing University (December 2010)

“Unemployment and Product Market Competition in a Cournot Model with Efficiency Wage,” presented at the 6th Conference on Industrial Economics and Economic Theory (Jinan, June 2011), at the 71st International Atlantic Economic Conference (Athens, March 2011), at Shanghai University of Finance and Economics (June 2010), at the 2010 International Conference on Economic Theory (Hangzhou, June 2010), at Dongbei University of Finance and Economics (June 2010), Nanjing University (July 2010), and McGill University (September 2010)

“Strategic Alliances and Other Forms of Horizontal Cooperation Agreements: Theory and Competition Policy,” presented at the International Conference for Academic Disciplines, (Orlando, February 2009)

“Unemployment of Skilled and Unskilled Labor in an Open Economy: International Trade, Migration and Outsourcing,” presented at University of Waterloo (September 2008), Xiamen University (December 2008), University of Manitoba (March 2009), Shanghai University of Economics and Finance (May 2009), Zhejiang University (June 2009), University of International Business and Economics (June 2009)

“Strategic Alliances and Other Forms of Horizontal Cooperation,” presented at the conference on China's Competition Policy and Anti-Monopoly Law (Beijing, October 2007)

“Defining Buyer Power,” presented at the American Antitrust Institute (AAI) Invitational Symposium on Buyer Power (Washington DC, June 2007)

“Monopoly and Unemployment: Perspective from an Efficiency Wage Model,” joint with Bo Zhao, presented at Summer Workshop on Industrial Organization and Business Strategy (Shanghai, May 2007)

“Rivalry, Market Structure and Industrial Competitiveness: Issues and Evidence,” presented at the Research Workshop on Rivalry, Market Structure, Entrepreneurship and Competitiveness (Montreal, November 2006) and Xiamen University (April 2007)

“Strategic Alliances and Competition,” presented at Xiamen University (May 2006) and University of International Business and Economics (July 2006)

“Markets Linked by Rising Marginal Costs: Implications for Multimarket Contact, Recoupment and Retaliatory Entry,” presented at the 2005 Singapore Economic Review Conference (August 2005), and Xiamen University (June 2007)

“Monopoly and Product Diversity: The Role of Retailer Countervailing Power,” presented at the Canadian Competition Bureau (September 2004), University of British Columbia (October 2004), University of Montreal (March 2006), International Industrial Organization Conference (Boston, April 2006), Xiamen University (April 2006), Summer Workshop on Industrial Organization and Business Strategy (Beijing, July 2006)

“Countervailing Power and Product Diversity,” presented at the North American Econometric Society meetings, San Diego, January 2004

“Liberalization of Trade and Investment in Telecommunication Services: A Canadian Perspective,” presented at the conference on Service Industries and Knowledge-Based Economy (Winnipeg, October 2003)

Prior to 2003, I presented papers at the following venues:

- The American Economic Association meetings
- The Canadian Economics Association meetings
- The Canadian Resource and Environmental Economics Study Group Conference
- The Competition Bureau, Government of Canada
- The Far Eastern Meeting of Econometrics Society
- The GREEN Conference
- Hitotsubashi University
- The Midwest Conference on International Trade Theory
- McGill University
- National Central University, Taiwan
- National Chengchi University, Taiwan
- National Chengkung University, Taiwan
- National University of Singapore
- Queen’s University
- Simon Fraser University
- University of Alberta
- University of British Columbia
- University of Calgary
- University of Laval
- University of Victoria
- University of Windsor

Consultancy

Senior consultant, Delta Economics Group, since 2002

Affiliate, Law & Economics Consulting Group (LECG), 1999 - 2002

Worked for public and private clients as an economics expert on more than 30 cases related to competition policy and other issues

Other Professional Activities

Member of Program Selection Committee, annual meetings of the Canadian Economics Association, 2017, 2018 and 2019

Advisor, Specialized Committee on Competition Policy, Chinese Association of Industrial Economics (since 2017)

Executive Editor, *Frontiers of Economics in China*, since 2013, (Co-Editor from 2011 to 2013)

Co-Editor, *Journal of Economics and Management Strategy*, since 2004

Guest editor, *China Economic Review*, CES 2010 Special Issue, Volume 23, Issue 3, September 2012

Adjunct Research Professor, Nanjing University, since 2011

Adjunct Professor, Shanghai University of Finance and Economics, since 2007

Organizer, Carleton Library Series Workshop on Industrial Organization and Market Structure in Canada, March 2010

Vice President, Chinese Economists Society, 2009 - 2010. In this capacity, I acted as the program chair of the 2010 Annual Conference of the Society, held in Xiamen in June 2010

Member of Working Group on Making and Marketing Costs for the Patented Medicine Prices Review Board, 2008

Changjiang Scholar, Xiamen University, 2007 - 2010

External reviewer of *Global Competitive Advantage*, by Daniel F. Spulber, Cambridge University Press, 2007

Editorial advisor, *Canadian Journal of Economics*, 2002 - 2005

Member of Grant Application Adjudication Committee, Social Sciences and Humanities Research Council (SSHRC), 2003 - 2005

Director, Ottawa Economics Association, 2003 - 2010

Invited speaker, Shanghai International Forum on Human Capital, October 2000

Organizer, Carleton Industrial Organization Conference, June 1996

External referee for the following journals: *American Economic Journal: Microeconomics*, *American Economic Review*, *Australian Economic Papers*, *B.E. Journal of Economic Analysis & Policy*, *Canadian Journal of Economics*, *Contemporary Economic Policy*, *Economic Inquiry*, *Economics Letters*, *Economic Modelling*, *Economics of Education Review*, *European Economics Review*, *International Economic Review*, *International Journal of Industrial Organization*, *International Review of Law and Economics*, *Journal of Economic Integration*, *Journal of Economics and Business*, *Journal of Economics and Management Strategy*, *Journal of Environmental Economics and Management*, *Journal of Environmental Management*, *Journal of Industrial Economics*, *Journal of Industry, Competition and Trade*, *Journal of International Economics*, *Journal of Population Economics*, *Pacific Economic Review*, *Public Finance and Management*, *Quarterly Journal of Economics*, *RAND Journal of Economics*, *Resource and Energy Economics*, *Review of Industrial Organization*, *Review of International Economics*

External assessor for Social Sciences and Humanities Research Council (SSHRC), numerous applications

External referee for the University Grants Committee in Hong Kong, numerous applications

External examiner of PhD theses for
University of British Columbia (two PhD theses)
Concordia University (one PhD thesis)
Queen's University (two PhD theses)

TEACHING

Undergraduate Courses

“Introduction to International Trade”
“Industrial Organization I, Theory and Evidence” (fourth year level)
“Intermediate Microeconomics”
“Intermediate Macroeconomics”
“Advanced Microeconomic Theory” (fourth year level)
“Honours Seminar: Microeconomics”
“Honours Capstone Seminar”

Graduate Courses

“Topics in Industrial Organization” (MA and PhD level)
“Microeconomic Theory” (PhD level)

“Industrial Organization I” (formerly “Firms and Markets”, MA and PhD level)
“Microeconomic Theory” (MA level)
“Mathematical Methods for Economists”

Taught graduate courses at University of Havana in 1994, 1995, and 1996, at Xiamen University in 2006 - 2010, and at Shanghai University of Finance and Economics in 2007 - 2009

Supervised numerous MA and PhD students Directed Readings courses

Member of numerous examination boards of PhD comprehensive exams, since 1992

Thesis Supervision

Supervisor of two ongoing PhD theses (Matthew Strathearn, Yufan Hu)

Supervisor of 10 completed PhD theses:

Xiguang Liu (1997), Ying Kong (2000), Angela Zeiler (2003), Liping Zhang (2005), Jun Chen (2008), Eng Kooi Lim (2008), Bo Zhao (2009), Hong Ding (2013), Gang Li (2013), Heng Xu (2016)

Co-supervisor of one completed PhD thesis: Afshan Dar-Brodeur (2013)

Committee member of 17 completed PhD theses since 2009:

Guohan Zhu (2009), Reza Ghazal (2009), Rashid Nikzad (2009), Sui Sui (2009), Ahmed Nasim Sydee (2010), Jeffrey Peter (2011), Hong Thi-Dieu To (2011), Chahreddine Abbes (2011), Elias Collette (2012), Derek Olmstead (2012), Olayinka Williams (2015), Armaghan Rahimi (2015), Bao Anh Nguyen (2016), Steve Martin (2017), Alexander Maslov (2018), Parisa Pourkarimi (2018), Chenyu Wang (2019)

Supervisor of one completed MA thesis: Laura Sonley (2015)

ADMINISTRATIVE RESPONSIBILITIES

Supervisor of PhD Studies, Department of Economics, July 2000 - 2004

Member of:

Carleton University Board of Governor Committee on Student Affordability, 2014 - 2015
Carleton University Research Achievement Award Selection Committee, 2005, 2006, 2010
Carleton University Senate, 2003 - 2004
Carleton University Graduate Faculty Board, 2000 - 2004
Departmental Tenure and Promotion Committee, 1996 - 1997, 2008 - 2011, 2015 - 2018

Departmental Graduate Committee, 1992 - 1996, 1999 - 2004, 2005 - 2010, 2012 - 2016
Departmental Appointment Committee, 1993 - 1995, 2005 - 2007, 2009 - 2011, 2012 - 2013

BGInS (Bachelor of Global and International Studies) Appointment Committee, 2015-16
Departmental Undergraduate Committee, 1992 - 1993, 2016 - 2017
Program Committee of the OCGSE Conference, March 2017
Departmental Ad Hoc Hiring Committee, 2017 - 2018
Departmental Planning Committee, 2017 - 2018