Understanding the likely impacts of MVNOs in Canada

Part 1: Impacts on the Canadian telecom industry and economy

July 2020
Canada is engaged in a heated national debate about the affordability of consumer wireless services. According to the recent *Telephone Survey on Mobile Wireless Services* commissioned by the Canadian Radio-television and Telecommunications Commission (CRTC) in January 2020, 83% of Canadians are satisfied with their wireless service provider and twice as many believe they get good value for money than those that believe they do not. Yet, 66% of Canadians perceive wireless prices in Canada as more expensive than other countries. This is despite a recent PwC report that found that Canadian household expenditure on wireless and wireless substitutes as a share of household disposable income declined at 2.2% annually since 2010.

In response, the Federal Government has demanded that incumbent mobile network operators (MNOs) lower their prices by 25% within two years. Meanwhile, the CRTC has initiated a regulatory review to examine the state of the wireless market and determine whether further action is needed to improve choice and affordability for Canadians. In particular, the review aims to explore the possibility of mandating that MNOs provide wholesale access to mobile virtual network operators (MVNOs) in order to increase competition and reduce wireless prices.

This paper is the latest installment in a series of papers by PwC, which contribute to the broader conversations around wireless affordability in Canada and explore the potential consequences of regulatory intervention on the health of the Canadian telecom industry.

The paper is split into two parts, which together assess the implications of mandating wholesale MVNO access in Canada. In Part 1 (this report), we explore how MVNOs could impact the Canadian telecom industry and economy. In Part 2, we explore how Canada’s transition to the next generation of wireless communications technology, 5G, could be affected.

Our approach in Part 1 comprises four steps:

1. We assess the health of the Canadian telecom industry today
2. We evaluate the possible outcomes that could unfold in Canada should wholesale MVNO access be mandated. We then determine a scenario for analysis, based on the position of the Competition Bureau and analysis of other markets with varying MVNO regulations
3. We evaluate the impact of the chosen scenario on the existing MNOs and the resulting impact on the Canadian economy, notably on employment, gross domestic product (GDP), and government tax revenues
4. We integrate our findings to assess the future health of the Canadian telecom industry should MNOs be mandated to provide MVNOs with regulated access to their networks
We are of the view that the Canadian telecom industry today is healthy, with high-quality services offered at affordable prices via world-class networks that drives Canadian competitiveness and contributes to Canadian GDP, employment, government tax revenue and shareholder returns. Based on our analysis, we conclude that if the CRTC were to adopt the regulatory intervention some have proposed, it would lead to significant negative consequences. Ultimately, it could lead to a deterioration in the health of the telecom industry and negative outcomes for Canadians.

In the scenario we analyze, Canadian wireless average revenue per user (ARPU) could potentially decrease by 30-35% over the five years to 2025, while new MVNOs may gain 6-8% market share. For existing network operators, this would result in revenue declines of 16% across all lines of business, wiping out more than one third of consolidated EBITDA, and two thirds of simple free cash flow. Since the average return on invested capital (ROIC) generated by Canadian MNOs is already low (below the US and Australia, similar to Europe), we expect Canadian MNOs would be unable to absorb such an impact. As a result, in the short term (to 2025), MNOs would be forced by financial and capital-markets constraints to mitigate the impact. We assume that the industry’s EBITDA margin would drop from 42% in 2019 to 38% by 2025, while the industry’s capital intensity would drop from 19% to 17%.

In the longer term (past 2025), if a below-average ROIC was unsustainable in global capital markets, then consequences could include consolidation, increased prices or further outflows of capital from the Canadian market and a corresponding decline in investment and service levels. However, our analysis is limited to a possible short-term impact and does not incorporate these possible medium to long term consequences.

The analysis concludes that the short-term impact would be annual cuts of $5B and $3B in operating and capital expenditures respectively, resulting in the following aggregated impacts to network operators by 2025:

- 24,000 fewer jobs
- $9,400 less in total compensation per employee from cuts to bonus / benefits
- 850 retail stores closed
- $135M less in charitable donations
- Significant cuts to investments in wireless and wireline networks

The cumulative impacts on the network operators would subsequently impact Canada’s economy in 2025 as follows:

- $10B reduction in Canada’s GDP
- $2.5B reduction in tax revenue
- Approximately 94,000 jobs lost throughout the supply chain
- Widened digital divide between rural and urban Canada

We also highlight the Canadian telecom industry’s critical role in the national response to the COVID-19 crisis in early 2020. Despite facing economic challenges as a result of COVID-19 themselves, network operators maintained network stability while adding capacity to support Canadians. An April 2020 report by OpenSignal showed that Canada maintained some of the fastest wireless speeds worldwide and saw little to no decline in speeds, when compared to pre-crisis data. The curtailing of network investments that could result from mandating wholesale MVNO access would hamper the ability of network operators to support crisis response efforts in the future.

Our analysis shows that mandating wholesale MVNO access in order to reduce consumer wireless prices would lead to an unhealthy Canadian telecom industry and result in negative economic consequences.
The wireless industry is a key part of Canada’s infrastructure and economy. Canadian wireless customers experience the fastest 4G download speeds among the G7 countries,¹ and the wireless industry contributed more than $48B in gross domestic product (GDP) to Canada’s economy in 2018. In addition, facilities-based operators have invested more than $70 billion in building Canada’s wireless networks.²

However, Canada is approaching a critical juncture in how citizens build, use, and prosper from the communications infrastructure. This is important in three main respects. First, Canada is poised to make the leap from 4G to 5G technology, a milestone that promises enormous opportunities for the economy, and that could fundamentally change the ways that Canadians live, work, and communicate. The transition requires a nationwide civil engineering effort funded by substantial investment from MNOs in the order of tens of billions of dollars over the next decade.

Second, despite price reductions already seen since 2016, there are concerns that wireless prices in Canada remain too high. In response, the Federal Government has proposed a policy that would require certain wireless prices to be reduced by an additional 25% within two years. In an era of ubiquitous wireless connectivity, such a significant policy move requires close consideration of the potential consequences on the future investment in Canada’s networks.

Third, the wireless regulator—the Canadian Radio-television and Telecommunications Commission (CRTC)—has recently held public hearings aimed at exploring the possibility of mandating that incumbent network operators provide regulated wholesale access to mobile virtual network operators (MVNOs). The primary objective of such regulatory intervention would be to add new competitors to the market.

Typically, MVNOs are companies that purchase wireless network access at wholesale prices, from incumbents like Bell, Rogers, and TELUS, and then resell wireless services to customers.³ They tend to target niche market segments, such as price-conscious consumers, small businesses, or certain ethnic communities.

This report intends to contribute to the public discourse on the aforementioned policy proposal and potential regulation changes. The report will identify the potential consequences by assessing and quantifying the impacts of policy and regulation changes to the Canadian telecom industry and economy.

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³. Exceptions exist, for example when a regulator allows temporary MVNO access with a requirement that they must build facilities over time.
2. A framework for assessing the health of a telecom industry

To assess the likely impacts that MVNOs could have on the Canadian telecom industry and economy, we developed a framework with which to assess the health of the telecom industry. First, we define the “industry.” Then we define what we mean by “health.”

We define the telecom industry as comprising of the firms participating in the market and their customers (together making up the “market”), as well as the regulator. The market is defined as the space in which firms compete to sell products and services to customers. The telecom market in Canada is governed by certain rules and regulations that are established by the regulator.

Telecom firms are the competing players in the market, who invest in networks and technology in the pursuit of profit. Their role is to make investment decisions, develop value propositions for customers, and manage their financials in order to provide adequate risk adjusted returns to shareholders while planning for future investment.

As noted above, the regulator defines certain “rules of the game” for the telecom market by setting the rewards and punishments. Ideally, the regulator should aim to establish a healthy market that balances the needs of sellers and buyers in a manner that maximizes the benefits to Canadian society.

Generally, regulatory intervention in the market results in either benefits or costs for each of the market participants. For example, a regulator may choose to benefit buyers over sellers and vice versa, or could provide favourable market dynamics for one set of firms over another.

Regulatory intervention occurs when the regulator believes that the market is out of balance and is thus unhealthy (referred to as a market failure in economic theory). To justify a particular intervention, the regulator should establish that a market failure has occurred, and ensure that the proposed intervention would lead to a better outcome for society compared to the status quo. In other words, every decision to intervene has the potential for unintended consequences that may lead to a worse outcome for the market and society.

An overview of the Canadian telecom industry

Below, we describe how we understand the current telecom market, the role of the regulator and the competing market firms in the context of the telecommunications industry.

**Market**
- Should have a level of competition that allows market forces to balance quality and innovation with consumer affordability
- Should generate investment and produce outcomes that meet the needs of Canadians and support the Canadian economy

**Regulator**
- Identifies and responds to market failures in a way that maximizes societal value, using regulations that are transparent, fair, and create predictable incentives for market firms, balanced with the interest of consumers
- Encourages innovation and investment in high-quality network facilities

**Firms**
- Make competitive infrastructure investments, create sustainable value propositions for customers, and build the financial capability to invest
- For telcos, investment in technology and the quality of the existing network are reliable measures of past health

Taken together, we can determine whether or not a telecommunications industry is healthy. At the core, a healthy industry should be able to fund the up-to-date network infrastructure required to support the success of the economy. When a healthy industry can build and maintain these high quality networks, it should result in a number of goals being achieved simultaneously:

- **Meets the communications needs of consumers at affordable prices**
- **Drives innovation and support future technologies that will underpin the economy**
- **Creates sustainable, high-paying jobs and drive productivity across sectors**
- **Generates meaningful tax revenue for the federal and regional governments**
- **Offers adequate and stable returns to shareholders**

Note: PwC’s definition of a healthy telecom industry was first defined in the July 2020 paper, “The importance of a healthy telecommunications industry to Canada’s high-tech success”
As concluded in a recent PwC report, “The importance of a healthy telecommunications industry to Canada’s high-tech success,” the Canadian telecom market is currently healthy. Canadians have access to high-quality networks at affordable prices and the industry is powering Canadian high-tech growth.

In addition, the industry is contributing to employment, tax revenue, and stable shareholder returns. Canada is well positioned to enter the next phase of communication growth and innovation with the advent of 5G.

However, it needs to be evaluated whether mandating wholesale MVNO access would drive a better outcome for Canadian society or if the regulations would lead to unintended consequences by benefiting some market participants while resulting in an overall loss to Canadian society.

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6. Waterloo EDC, Financial Times and Invest in Canada have all identified Canada an emerging leader in AI
7. Aggregate of company-reported of employee data
8. Statistics Canada, Table 33-10-0006-01, Financial and taxation statistics for enterprises by industry type, CWTA Facts and Figures
9. Based on investor presentations, stock price over time, and dividend payouts. Does not take into consideration recent COVID-19 related stock price fluctuations.
Since the CRTC began regulating wireless in 1985, it has consistently promoted facilities-based competition as the best means to ensuring that Canadians receive high-quality, affordable wireless services. A decision to mandate MVNO access would represent a stark departure from the precedent it has established. In contemplating how the CRTC could regulate (should it decide to), we see three dimensions against which MVNO regulation could be defined.

The first is facilities requirements, which specify the degree to which new entrants must own and operate their own infrastructure. Options range from mandating access only for MVNOs with existing complete wireless network infrastructure (i.e. regional players such as Freedom and Videotron), to mandating access for all MVNOs, including those that have no network infrastructure (including no core network) and only handle marketing, sales and customer care.

The second dimension is how the rates (e.g. price per gigabyte) MVNOs pay MNOs for network access are set. Options include creating a negotiated backstop that requires MNOs and MVNOs to negotiate in good faith, using the existing roaming-rate structure that MNOs pay when their customers roam on another carrier’s network, or introducing a new wholesale rate just for MVNOs. The impact on incumbents depends on the actual rate put in place, which could fluctuate regardless of the rate-setting approach adopted. As a result, these are illustrated below in grey.

Finally, the third dimension is the regulation phase-out period. MVNO access can be mandated for a fixed period of time or indefinitely. Finite phase-out periods incentivize MVNOs to build their own networks, since when the regulation expires, MVNOs either have to independently negotiate wholesale agreements with MNOs or have successfully built their own networks (or both).

![Policy dimension](image)

### Spectrum of regulatory options

<table>
<thead>
<tr>
<th>Facilities requirements</th>
<th>Wireless rates</th>
<th>Phase-out period</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High requirements</strong></td>
<td>Negotiation backstop</td>
<td>Regulation phased out</td>
</tr>
<tr>
<td>Existing regional MNOs get access</td>
<td>Rates commercially negotiated between MVNOs and MNOs</td>
<td>Mandate set for a fixed time period (e.g. five years)</td>
</tr>
<tr>
<td><strong>Medium requirements</strong></td>
<td>Roaming rate</td>
<td></td>
</tr>
<tr>
<td>Hybrid and full MVNOs get access</td>
<td>Existing roaming structure used, rate may be revisited</td>
<td></td>
</tr>
<tr>
<td><strong>Low requirements</strong></td>
<td>Wholesale rate</td>
<td>No phase out</td>
</tr>
<tr>
<td>Thin MVNOs get access$^{10}$</td>
<td>New wholesale rate set (e.g. &quot;retail minus&quot;)</td>
<td></td>
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</tbody>
</table>

10. The CRTC (Telecom Decision CRTC 2015-496) defines a “full MVNO” as an MVNO that owns and operates a core network solution, has the ability to handle customer billing and provisioning, and has a wholesale agreement with an MNO. A “hybrid MNO” (HMNO) is a facilities-based wireline (and possibly wireless) service provider that has a wholesale agreement with a national incumbent MNO, and also has the ability to handle customer billing and provisioning. A “thin MVNO” also has a wholesale agreement with an MNO and also has the ability to handle customer billing and provisioning, but owns no core network solution nor any facilities-based wireline network.
Clearly, there are many forms the regulation could take, should the CRTC decide to mandate wholesale MVNO access. To help frame the discussion of what the regulation could look like, we have highlighted four of the many possible forms of regulation below. Each scenario is characterised by a facilities requirement, a rate setting method, and a phase-out period.

<table>
<thead>
<tr>
<th>Possible regulatory scenario</th>
<th>Facilities requirement</th>
<th>Rates and phase-out</th>
<th>Regulation beneficiaries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mandated access for regional MNOs</strong></td>
<td>Full existing wireless facilities (radio-access and core networks) required</td>
<td>Commercially negotiated with a regulatory backstop; regulation indefinite</td>
<td>Regional disruptors (e.g. Freedom), Internet service providers (e.g. Cogeco), New entrant MVNOs</td>
</tr>
<tr>
<td><strong>Mandated access for regional MNOs and HMNOs</strong></td>
<td>Full existing wireless or wireline facilities required</td>
<td>Commercially negotiated with a regulatory backstop; regulation indefinite</td>
<td>Regional disruptors (e.g. Freedom), Internet service providers (e.g. Cogeco), New entrant MVNOs</td>
</tr>
<tr>
<td><strong>Mandated access for full MVNOs at low wholesale rates (eventually phased out)</strong></td>
<td>Only partial wireless facilities (core network) required</td>
<td>Government sets low wholesale rate; regulation eventually phased out</td>
<td>Regional disruptors (e.g. Freedom), Internet service providers (e.g. Cogeco), New entrant MVNOs</td>
</tr>
<tr>
<td><strong>Mandated access for thin MVNOs at low wholesale rates (indefinitely)</strong></td>
<td>None</td>
<td>Government sets low wholesale rate; regulation in place indefinitely</td>
<td>Regional disruptors (e.g. Freedom), Internet service providers (e.g. Cogeco), New entrant MVNOs</td>
</tr>
</tbody>
</table>

The potential number of new entrants increases from scenario one through three, with scenarios 3a and 3b enabling the greatest number of new competitors (scenarios 3a and 3b are not substantially different in this regard, given the ability of potential MVNOs to outsource access to a core network to third parties). As a result, one could expect the negative financial impact on the incumbent MNOs to increase in the same direction.

While each of these scenarios is possible, there are various preferences among those in support of MVNO regulation. The Competition Bureau advocates incentivizing facilities-based competition from the existing regional disruptors such as Freedom and Videotron, as in the first scenario. They argue that wireless prices are generally 35-40% lower in regions when these disruptors’ market share exceeds 5.5%, an outcome that would be achieve the Federal Government’s 25% target.11

Others have suggested extending mandated access to include non-wireless facilities-based players—so-called hybrid MNOs (HMNOs) such as Cogeco—and full MVNOs such as TekSavvy, as in scenarios 2, 3a and 3b (HMNOs, full MVNOs and thin MVNOs are defined in a footnote on the previous page). Some (including the Competition Bureau) have argued that under these three scenarios, the regional disruptors would be disproportionately affected, putting at risk the progress they have made to lower prices while building their own wireless networks. In addition, hurting regional carriers would be inconsistent with the long-standing policy to promote a 4th carrier in every region to drive more sustainable facilities-based competition.

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Is Canada at risk of joining Israel as a global outlier?

Israel is often labelled as a global outlier due to the severity of the impact that regulatory intervention had on its wireless market when compared to other jurisdictions. Between 2010 and 2018, Israel’s three main incumbents saw revenues decline by 61% and EBITDA margin decline by 45%. As a result, they cut their employee base by 35% and their combined market capitalization dropped 78%.  

To try and maintain financial viability, Israeli network operators were forced to reduce spending, including in network infrastructure investment. Speedtest data from April 2020 indicates that Israel now sits globally at 98th place in terms of wireless network download speeds, far behind unregulated markets such as Canada (5th) and Australia (9th). This is largely due to the country’s lagging adoption of 4G networks, where only 35% of subscribers were on 4G by 2018, versus 75%+ for unregulated markets. In addition, in 2019 the Israeli Ministry of Communications released a report that highlighted a “real concern” about the country’s ability to successfully roll out 5G, given the lagging network quality over the past decade. It appears that the introduction of MVNOs to Israel’s wireless market is already having an impact on future network quality.

The situation in Israel is relevant for Canada. Of all the jurisdictions examined, only in Israel did ARPU decline by more than 25% within two years—a familiar scenario, given the government’s promise to reduce wireless prices by 25% over the same time period. Israel therefore serves as a case study on the potential risks to Canada, should regulation be taken to an extreme and wireless prices continue to drastically fall.

Source: ARPU data from GSMA, market share data from TeleGeography.
12. The Israeli MVNO experience, submitted by Yaossi Abadi on behalf Bell Mobility to the CRTC
13. Data pulled on April 14th from SpeedTest
14. Report warns that Israel cellular operators may lag on 5G network investment, Article published July 4 2019 in The Times of Israel
In this section, we have explored the many policy levers the CRTC currently has at their disposal and identified the risk that Canada could follow a similar path to Israel. Taken together, we must define a realistic scenario upon which to base our analysis of the impact of MVNOs on the telecom industry and Canadian economy.

Should the CRTC decide to regulate, it isn’t possible for us to predict how they may regulate, and as described above the impact of each approach to regulation may be different. We do know, however, that both the Competition Bureau’s analysis of the impact of facilities-based competitors gaining more than 5.5% market share (prices decline 35-40%) and the experience in Israel (ARPU decline of 61%) point to significant declines in ARPU in at least some scenarios. We also anticipate that the federal government will continue to pursue their stated objective of reducing certain wireless prices by an additional 25% within two years, which would add to ARPU pressure.

Ultimately we must define a realistic scenario upon which to base our analysis of the impact on the telecom industry and Canada economy. Based on the many policy levers that the CRTC currently has at their disposal, the relevant experience in Israel, the Government’s plan to reduce certain wireless prices by 25% over two years, and the Competition Bureau’s assessment of the impact of regional facilities-based competitors, in the remainder of this report we assess the impact of a scenario in which mandated wholesale MVNO access in Canada reduces industry ARPU by 30-35% and incumbent MNO market share by 6-8% over the next five years.

It is possible, of course, that mandating access for MVNOs could instead have only a minor impact on pricing, while fragmenting the market and removing a significant incentive for investment. However, we believe the scenario being assessed is possible and that understanding the possible impacts of regulation on the telecom industry and Canadian economy would be helpful to Canadians and decision makers.

**Industry impact model – ARPU index**
Assumes 2020 industry ARPU and corresponding decline

**Industry impact model – market share decline**
Assumes 2020 industry ARPU and corresponding decline
4. Impact of MVNOs on Canadian network operators

We now turn our attention to evaluating the impacts that a 30-35% ARPU decline and a 6-8% loss of incumbent market share would have in Canada. In this section, we model the impact to the Canadian network operators and in the next section, we model the impact to the broader Canadian economy.

To assess the financial impact of MVNOs on the Canadian network operators, we developed an aggregated baseline view of all publicly listed operators in Canada, both national and regional. The baseline view uses 2019 reported financial results across all lines of business. With 2019 revenue of $66B and operating expenditures of $39B, Canadian operators’ average EBITDA margin was 42%.

While EBITDA margin is a popular metric, it needs to be viewed in conjunction with the high capital intensity of the telecom industry. In our analysis, we therefore use the simple free cash flow metric, defined as EBITDA minus capital expenditures. With 2019 capital expenditures of $12B, the industry’s capital intensity was 19% and simple free cash flow was $15B or 22% of revenue. As discussed in the exhibit on the right, Canadian operators’ profits in recent years are in line with their international peers.

Reality check: Is Canada’s telecom industry generating excessive returns?

A key argument often made by those seeking mandated wholesale access for MVNOs is that Canadian MNOs have enjoyed unreasonably high EBITDA margins compared to international peers. However, our research shows that the higher levels of capital investment required to build and maintain a high-quality network in Canada (given the dispersion of a relatively small population over a very large area), while generating healthy free cash flows, necessitates higher EBITDA margins. Instead, we use return on invested capital (ROIC), for comparing the telecom industry’s financial performance internationally.

The average ROIC for Canadian network operators (across all lines of business) between 2015 and 2019 was 8.9%, lower than in the US and Australia and only slightly higher than Europe. This indicates that the return on investment in the Canadian telecom sector is not excessive when compared internationally.

Return on invested capital for network operators in Canada versus key comparable regions

<table>
<thead>
<tr>
<th>Region</th>
<th>ROIC</th>
</tr>
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<tbody>
<tr>
<td>US</td>
<td>13.4%</td>
</tr>
<tr>
<td>Australia</td>
<td>10.2%</td>
</tr>
<tr>
<td>Canada</td>
<td>8.9%</td>
</tr>
<tr>
<td>Europe</td>
<td>8.4%</td>
</tr>
</tbody>
</table>

Note: Industry financial metrics have been rounded for clarity. EBITDA margin and capital intensity calculated based on non-rounded numbers.
15. Note that our simple free cash flow metric does not account for deductions such as spectrum license purchases ($3.4B in 2019) and interest expenses ($3.3B in 2019).
16. Sources: S&P Capital IQ; PwC analysis.
The impact on Canadian network operators due to MVNOs is evaluated based on the forecasted reduction of wireless ARPU and market share by 2025. Specifically, that the wireless industry’s average ARPU declines by 30-35% by 2025 while incumbent operators lose 6-8% market share to MVNOs. By 2025, the introduction of MVNOs would cause operators’ overall revenue to decline by $12B or 16% compared to the baseline forecast.

If operators made no effort to curtail spending (a highly unlikely scenario), then by 2025 the industry’s simple free cash flow would be reduced by almost two thirds compared to the baseline, to $6B. This would reduce the industry’s rate of return on investment to levels that would be impossible to sustain in reality, given the conditions of global capital markets. Therefore, telecom companies would likely be forced to cut operating costs and capital expenditures in the face of MVNO regulation.

Instead our analysis modeled a scenario in which operators take response measures that would reduce their operating expenditures in order to partially offset the revenue declines. The response we modeled would result in a ROIC that would remain below the US, Australian, and European averages and also result in a lower EBITDA margin of 38%.

We also assumed that operators would reduce their capital expenditures such that the industry’s capital intensity would fall from 19% in 2019 to 17% by 2025. The reduced capital expenditure across MNOs reflects their inability to invest at historical levels to expand and enhance wireless and non-wireless networks (including 5G) and enabling IT systems. Following 2025, either steps would need to be taken to bring return on invested capital back into line with global averages (e.g., price increases and consolidation) or capital would continue to flow out of the Canadian industry, resulting in even further declines in investment and service over the medium and long term.

Based on the above assumptions, incumbent operators would need to make immediate and significant reductions to annual operating and capital expenditures in response to the mandate to provide wholesale network access to MVNOs. By 2025, operating expenditures would have to be reduced by $5B while capital expenditures would have to be cut by $3B in order to achieve a stopgap EBITDA margin of 38% and capital intensity of 17%.

The analysis also factors in a $0.5B reduction in operating expenditures for incumbent wireless operators’ costs to acquire and retain wireless subscribers given the market share gains of MVNOs. The $0.5B figure is based on

By 2025, the introduction of MVNOs could force operators to cut spending by $8B in order to avoid an unsustainable decline in return on investment

<table>
<thead>
<tr>
<th>16% Revenue decline</th>
<th>$5B Annual OPEX cuts required</th>
<th>$3B Annual CAPEX cuts required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operators’ revenues would fall due to declining wireless ARPU and market share</td>
<td>Operators would cut OPEX in order to prevent industry EBITDA margin falling below 38%</td>
<td>Operators would cut CAPEX to limit a decline in industry FCF &amp; achieve industry capital intensity of 17%</td>
</tr>
</tbody>
</table>

Note: Industry financial metrics have been rounded for clarity. EBITDA margin and capital intensity calculated based on non-rounded numbers.

17. Wholesale revenue from MVNOs is incorporated as a partial offset to the revenue decline of MNOs’ revenue.
18. Baseline forecasts for 2020-2025 are based on the public financial guidance provided by network operators, complemented by industry forecasts from IDC Canada and Statistics Canada.
19. For the purpose of the analysis, we assume that the industry’s average cost of acquisition per gross wireless subscriber addition and cost of retention per wireless subscriber, will both remain constant at 2019 levels as these costs are core to business operations.
the assumption that the acquisition and retention costs per subscriber will not change. In fact, mandating wholesale MVNO access could cause these costs to change as new competitors enter the market.

To determine the potential impacts of cutting $5B in operating and $3B in capital expenses, we constructed a representative cost structure for the industry. This was built based on publicly available financial and operational data combined with experience working with network operators in Canada and internationally.

In operating expenditures, we anticipate the network operators would find savings in the following areas: employees, retail stores, corporate offices, advertising, and other operating costs. In employee costs, we expect operators to reduce employee headcount as well as variable compensation (e.g. bonuses) and benefits. We also expect operators would move certain roles offshore. Finally, we expect a reduction in contractor spend, resulting in a smaller number of contractors employed.

Taken together, we expect a reduction of 24,000 employees 10,000 contractors by 2025. Along with indirect and induced effects on employment (discussed later), these cuts would cause a significant negative impact on employment rates in Canada.

We also anticipate that operators would reduce operating expenditures associated with retail stores by consolidating their retail store footprint. Closing retail stores would reduce the costs of rent, utilities, repairs and maintenance as well as other facilities costs. We estimate that more than 850 retail stores could be closed by 2025 in response to the introduction of mandated wholesale access to MVNOs and that almost 6,000 retail store employees would lose their jobs as a result (note: this reduction in employees is included in the 24,000 stated earlier). This closure of stores would add to the headwinds faced by the Canadian retail sector.

We also anticipate that corporate office space would be reduced by approximately 25% by 2025. This could be achieved by having fewer employees combined with more condensed office space. We also anticipate that operators would reduce advertising spend by approximately $350M by 2025.

Finally, we expect network operators would cut in other areas of operating expenditures, such as sponsorship and corporate social responsibility (CSR) as well as costs to maintain and operate network infrastructure. In CSR spend, we expect operators to reduce cash and in-kind charitable donations and sponsorships by approximately $135M by 2025. The reduction in CSR spend would negatively impact Canadian charities and communities.

Key impacts due to cutting $5B in annual OPEX by 2025...

<table>
<thead>
<tr>
<th></th>
<th>24,000</th>
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<tbody>
<tr>
<td>fewer employees</td>
<td>(one in five cut)</td>
</tr>
<tr>
<td></td>
<td>10,000</td>
</tr>
<tr>
<td>fewer contractors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$9,500</td>
</tr>
<tr>
<td>less in total compensation per average employee</td>
<td></td>
</tr>
<tr>
<td></td>
<td>850</td>
</tr>
<tr>
<td>fewer retail stores</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$135M</td>
</tr>
<tr>
<td>less in charitable donations</td>
<td></td>
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</table>
Key impacts due to cutting $3B in annual CAPEX by 2025...

Deferred rollout of 5G, with coverage limited to large urban areas only
Deferred rollout of next-generation broadband infrastructure
Deferred wireless and wireline network expansion and maintenance
Lowered global competitiveness of Canadian businesses
Lower business-as-usual network capacity, quality, and reliability
Widened digital divide between those living in urban and rural areas

In capital expenditures, it is expected that network operators would reduce investments both in their networks and enabling systems for operations. In terms of networks, we expect operators would reduce investment across both wireless and wireline lines of business. These reductions would negatively impact the performance and reliability of current networks and slow the rollout of future technologies.

Reductions in wireless network investments would likely result in deferred and curtailed build-out of 5G networks and enabling infrastructure such as fibre, in-building, and small cells required to achieve 5G network quality and connection density. This infrastructure will be critical to enhancing connectivity and enabling novel mobile use cases for consumers and businesses. Lower 5G investment would negatively impact consumer experience and could render Canada’s business landscape less competitive.

For consumers, 5G coverage could be limited to large metropolitan areas only, hence widening the digital divide between Canadians living in urban and rural areas. Meanwhile, cuts to wireline network investments will negatively impact the ongoing rollout of next-generation cable and fibre networks to enable high speeds for both residential and business customers.

Besides reducing network investments, we expect operators to reduce capital expenditure in a wide range of internal programs, most notably including customer service, IT, media (including digital media platforms), and facilities. These cuts could result in a poorer customer experience and hamper the rollout of digital-friendly solutions and business models. In addition, we expect reduced network quality and delayed rollout of new services would have far-reaching negative impacts on innovation across the Canadian economy. These impacts are explored in Part 2 of this report, with a focus on the opportunity cost associated with a delayed transition to 5G, which could result from the introduction of mandated wholesale network access to MVNOs.

It is noteworthy that the telecommunications industry today has one of the highest capital intensities of all Canadian industries (see chart below). With many traditionally capital intensive industries suffering from the COVID-19 crisis (discussed later), in addition to other ongoing downturns (e.g. in oil and gas), it is important not to impose harmful regulation on industries such as telecom that are still investing.

*Note: Capital intensity metric from CRTC and StatsCan different than calculated (see page 13 and 14) in this study due to the CRTC calculating Capital Intensity it based off of only telecommunications revenue. Revenue data used to calculate capital intensity for the purpose of this study was inclusive of all revenue made by Canadian telecommunications companies (e.g. media revenue) which were not accounted for in the CRTC calculation.
5. Impact of MVNOs on the Canadian economy

Current impact of network operators on the Canadian economy

The telecom sector is an important part of the Canadian economy, generating $42B in GDP in 2019 (see chart below). However, the full economic impact is far greater, due to effects on the supply chain and employee spend (known as indirect and induced multiplier effects, respectively). The sector also provides high-value jobs for Canadians. Network operators alone employ approximately 120,000 workers directly and support many more jobs indirectly when contractors and the supply chain are accounted for. Labour productivity in the telecom sector (measured in terms of GDP per worker) is $358,000, almost three times the Canadian average and significantly more than most other sectors (see chart, right).

Real GDP per worker by industry in 2019

<table>
<thead>
<tr>
<th>Industry</th>
<th>2019 Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telecommunications</td>
<td>358</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>142</td>
</tr>
<tr>
<td>Professional services</td>
<td>136</td>
</tr>
<tr>
<td>Retail trade</td>
<td>57</td>
</tr>
<tr>
<td>All industries</td>
<td>130</td>
</tr>
</tbody>
</table>

Real GDP contribution of the Canadian telecommunications sector

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30.9</td>
<td>31.7</td>
<td>32.5</td>
<td>32.1</td>
<td>32.7</td>
<td>34.5</td>
<td>36.5</td>
<td>38.2</td>
<td>40.4</td>
<td>42.1</td>
</tr>
</tbody>
</table>

20. Source: Statistics Canada. Table 36-10-0434-01 Gross domestic product (GDP) at basic prices, by industry, monthly, and IHS Markit for CPI inflation to convert to 2019 dollars.
21. Source: Statistics Canada. Table 14-10-0202-01 Employment by industry, annual.
22. Source: Statistics Canada. Table 36-10-0434-03 Gross domestic product (GDP) at basic prices, by industry, annual average.
As the previous chart shows, labour productivity in the telecommunications sector far exceeds that in other major Canadian industries and is a major contributor to Canada’s high skill, high tech labour market and economy. The high level of skills and training required to perform the work in the sector may also translate to a higher likelihood that these jobs are less susceptible to automation or replacement by artificial intelligence in the near to medium term, making them vital to the health of the Canadian economy going forward.

In addition to generating GDP and providing high-value jobs for Canadians, the telecommunications industry provides critical infrastructure across the country which enables Canadians to reliably communicate at high speeds. Network operators in Canada provide wireless and wireline services and equipment enabling Canadians to communicate across the country.

The importance of this infrastructure and the need for resilience and capacity has been brought to the fore by the COVID-19 crisis, which is discussed in more detail at the end of this section. The investments made by network operators in this critical infrastructure have proved to be vitally important to the Canadian economy in a time when connectivity and communication are more important than ever.

Impacts on the Canadian economy due to the introduction of MVNOs

In order to assess the economic impacts of the industry scenario set out in this report, we have used input-output modelling, which is a method of economic modelling described in further detail in the appendix. This approach enables us to assess the wider economic impacts of the decline in the output of the telecommunications industry for GDP, employment and tax revenue. The approach considers three types of economic impact, each defined as follows.

- **Direct impacts** result from companies’ own activity and employment in the telecommunications sector.
- **Indirect impacts** arise from the activities of the firms in the telecommunications supply chain, including subcontractors.
- **Induced impacts** are the result of consumer spending by employees of the businesses stimulated by direct and indirect expenditures.

The results of our analysis show significant impacts on the Canadian economy as a result of reduced revenues and cuts to operating and capital expenditures. The table to the right shows that, relative to the baseline scenario, in which there is no introduction of MVNO regulation, there would be significant negative impacts on GDP, tax revenues and jobs within the Canadian economy should new MVNO regulations be introduced.

<table>
<thead>
<tr>
<th>Overall impacts on the Canadian economy relative to the baseline scenario with no MVNO regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
</tr>
<tr>
<td>GDP ($M)</td>
</tr>
<tr>
<td>Taxes ($M)</td>
</tr>
<tr>
<td>Jobs</td>
</tr>
</tbody>
</table>

Note that these figures do not include the likely negative economic impacts due to “catalytic effects” where businesses that require high-quality networks may choose not to locate in regions where network coverage or quality is low. This would lower Canada’s business competitiveness, in particular in rural provinces, and thus worsen the impacts on GDP, taxes, and jobs.
The impacts due to reduced operating and capital expenditures on GDP and jobs would accumulate over time, and both the GDP and jobs impacts are expected to persist far beyond 2025. Furthermore, the impacts due to the operating expenditure cuts are significantly greater than those due the capital expenditure cuts.

Three reasons explain the difference. First, the value of annual operating expenditures to be cut by network operators by 2025, at $5B, is greater than that for capital expenditures, at $3B. Second, the overall multiplier effect for the telecom industry, which determines the impacts on GDP and jobs per dollar cut, is estimated to be greater for operating expenditure than for capital expenditure. Third, in regards to the impact on jobs, employee headcount reduction is a more accessible and immediately effective lever in operating budgets and thus it can be expected to be leveraged to a greater degree.

Finally, given the high levels of labour productivity in the telecom industry, it is noteworthy that reductions in indirect and induced jobs comprise the majority of the overall reduction. This reflects the fact that every four jobs in the sector supports approximately 10 jobs elsewhere in the economy. As a result, one should expect a significant spillover effect into the broader Canadian economy, with many more Canadians impacted than just those working in the telecom sector.

Note that this analysis does not capture the full impact that reductions in capital expenditure (and attendant reductions in network quality) would have on productivity and innovation across Canada's digital economy. The full impact due to these effects is explored in Part 2 of this report.

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**Impact on GDP and jobs over time**

The impacts due to reduced operating and capital expenditures on GDP and jobs would accumulate over time, and both the GDP and jobs impacts are expected to persist far beyond 2025. Furthermore, the impacts due to the operating expenditure cuts are significantly greater than those due the capital expenditure cuts.

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Offsetting economic impacts

The regulatory changes discussed in this report are expected to reduce ARPU for MNOs as a result of the introduction of MVNOs to the Canadian wireless market. We have so far considered the potential consequences to the industry and the associated multiplier effects in the wider economy. However, it is important to recognise that the industry impact would also translate to consumer savings through lower wireless service prices at an aggregate level, which may lead to offsetting economic impacts. The value of this is uncertain and will depend on the use of these cost savings, in particular whether they are used to pay down debt, increase savings or spent on other consumer products, amongst other factors.

In any of these cases, our analysis suggests any offsetting jobs created will generally result in a trade-off between high-tech, high-value jobs and lower-productivity jobs, many of which are vulnerable to replacement in the medium term through automation. This observation is especially true when considering the future likely impacts on 5G networks in Canada (quantified in Part 2 of this study). Our analysis suggests that average labour income in the expected lost telecom jobs is over 50% higher than the average for the likely jobs that will be created by any stimulus impact resulting from consumer savings.

It is also important to note that in the current period of economic decline and recession, the normal mechanisms through which an economy re-allocates resources do not function as well. In particular, there are questions over the whether the labour market would be able create the almost 100,000 jobs needed to replace those lost, especially given the historically high levels of consumer debt.
Impact of COVID-19 on Canadian telecom networks

During early 2020, Canada faced the global COVID-19 pandemic. To prevent the spread of the virus, the public has been told to practice “social distancing” and businesses have been forced to close offices and stores, drastically impacting all Canadians. As a result, demand for fast and reliable network access has increased dramatically for work, education, healthcare, and socializing.

The Canadian network operators have responded by maintaining network resiliency and boosting capacity. For example, Canadian MNOs have made additional investments in critical capacity and increased their focus on supporting essential services such as hospitals. In addition, operators have supported Canadians by offering relief to customers and making donations to food banks.

Compared to other countries, Canada has done well. In Spain, service providers have asked customers to video stream in off-peak hours, download large files only if necessary, and avoid using collaboration tools such as Skype or Microsoft Teams.\(^\text{23}\) In Israel, there have been reports of slower-than-usual home internet with frequent service interruptions—likely due in large part to a decade of limited infrastructure investment.\(^\text{24}\) Meanwhile, in Canada, despite some limited and temporary service interruptions, no Canadian incumbent reported major outages. In fact, wireless users observed no significant changes in 4G download speeds between the last week of January and the fourth week of March, and maintained some of the fastest 4G download speeds worldwide.\(^\text{25}\)

The role of regulators as we emerge from the COVID-19 crisis

Regulators can take a leading role in the response to COVID-19. In the US, the Federal Communications Commission (FCC) has granted AT&T, Verizon, and T-Mobile temporary access to unused AWS-3 spectrum at no cost. In addition, the FCC has committed to holding auctions for 3.5 GHz and the satellite operators’ C-band spectrum by the end of 2020, which should accelerate the deployment of 5G.

Coming out of the COVID-19 crisis, the pressure on the Canadian industry to maintain high-quality networks and transition to 5G will grow, as society continues to become ever more digitized. The regulator can play an important role in supporting the industry by ensuring that network operators have the financial health to invest in high-quality networks. In addition, the COVID-19 crisis has reminded us of the importance of ensuring all Canadians have access to reliable and high-quality networks. Going forward, the government, regulators, and network operators will need to work together to ensure that they are collectively addressing the digital divide between urban and rural areas.

Like many Canadians, network operators are also facing economic challenges due to the pandemic. The effects of mandated wholesale access for MVNOs would only amplify these challenges. And additional cuts to capital investment would likely only widen the digital divide, rather than help to close it. As Canada emerges from the crisis, the CRTC will need to carefully find balance in its regulatory decisions. Failing to do so could further exacerbate the unintended consequences of mandated wholesale MVNO access, which could lead to a compounding impact on jobs, network investments, and Canadians.

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\(^\text{23}\) Article in Fierce Telecom, published March 16, 2020, “Spanish carriers see a 40% spike in network traffic due to COVID-19”
\(^\text{24}\) Article from the Israeli press
\(^\text{25}\) Opensignal Limited, “Mobile Experience during the COVID-19 pandemic: 4G Download Speed,” April 2020
\(^\text{26}\) CBC article published March 20, 2020, “Telecom networks deal with ‘unprecedented’ pressure as Canadians work from home”
Revisiting the health of the Canadian telecom industry

The analysis has demonstrated that MVNOs carry risk to the Canadian telecom industry, as mandated wholesale MVNO access could reduce industry ARPU by 30-35%. Although wireless prices would come down for some Canadians, it would likely be at the expense of critical wireless and wireline network infrastructure, high-value jobs, retail locations, employee benefits, and charitable donations.

The regulator is at risk of putting the Canadian telecom industry into unhealthy territory. Lagging networks, hurting Canadian competitiveness, lost jobs, lower tax revenue and at-risk shareholder returns, all contribute to the pain. Canadians should take note: while lower phone bills may have some benefits, they also come at significant cost.

| Indicators of a healthy industry                                                                 | Canada's industry today
today                                                                 | Impact on industry tomorrow                   |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Meets the communications needs of consumers at affordable prices</td>
<td>Canada offers leading quality mobile services at affordable prices</td>
<td>Plans may get cheaper, but Canada is at risk of providing lower quality network access than global peers</td>
</tr>
<tr>
<td>Drives innovation, supports future technologies that will underpin the economy</td>
<td>Canada is recognized as a global leader in AI and blockchain across tech, research and start-ups</td>
<td>Investments in 5G, cable and fibre networks will decrease, hurting Canadian competitiveness globally</td>
</tr>
<tr>
<td>Creates sustainable, high-paying jobs and drive productivity across sectors</td>
<td>The Canadian telecom industry directly employs over 120K and tens of thousands more indirectly</td>
<td>Canadian telcos may lose up to 23K jobs by 2025, and almost 70K jobs indirectly, for a total of over 90K jobs</td>
</tr>
<tr>
<td>Generates meaningful tax revenue for the federal and regional governments</td>
<td>The telecom industry provided over $2B of corporate income taxes in 2019, plus contributes sales tax, spectrum auctions, etc.</td>
<td>Canada could lose a cumulative $2.5B in tax revenue by 2025, and very likely lower proceeds from spectrum auctions</td>
</tr>
<tr>
<td>Offers adequate and stable returns to shareholders</td>
<td>Leading network operators in Canada have generated consistent shareholder returns</td>
<td>Shareholder value at risk of erosion, impacting shareholders, as well as institutional investors (e.g. CPP)</td>
</tr>
</tbody>
</table>

27. For sources, see footnotes on p.8.
The health of the Canadian telecom industry is at risk

Regulating wholesale network access to MVNOs may deliver some benefits to Canadians through reducing wireless prices in Canada. However, this assessment has demonstrated that the proposed policy changes would likely have significant negative consequences. Significant value would be eroded from the industry. The Canadian economy would lose high value jobs, retail locations would close, and charitable donations reduced. Investments in Fibre and 5G networks would be delayed or cancelled, a wider digital divide could emerge between urban and rural Canadians, and Canadian competitiveness globally could be jeopardized.

As noted previously, during the unfolding of the COVID-19 crisis, Canadian telecoms were the connectivity backbone of the country. Policymakers, regulators, the business community, and consumers all have an interest in the future of Canada's telecommunications infrastructure. And everyone will feel the impact if regulation mandating wholesale MVNO access is introduced.

<table>
<thead>
<tr>
<th>Federal government</th>
<th>Regulator (CRTC)</th>
<th>Business community</th>
<th>Canadian consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Canadian GDP would reduce by $10B by 2025</td>
<td>● The Canadian telecom industry could move from a healthy to an unhealthy industry</td>
<td>● The business community would feel a sizeable impact, leading to reduced revenue, and lost jobs</td>
<td>● Up to 90K high quality, well-paid jobs could be lost (incl. direct, indirect, induced), impacting families and communities</td>
</tr>
<tr>
<td>● The government would face a $2.5B reduction in taxes</td>
<td>● 5G network rollout could be delayed or eliminated for certain communities</td>
<td>● Cuts to 5G network investments would hurt Canadian competitiveness vs. other G7 countries</td>
<td>● Staff benefits and bonuses may be cut</td>
</tr>
<tr>
<td>● Health benefits and bonuses would be cut and discretionary spending impacted</td>
<td>● Investments in network reliability, quality and capacity could be deferred or eliminated</td>
<td>● Canada’s tech sector, (including AI, blockchain) may be impacted, slowing Canadian innovation</td>
<td>● 850+ local retail stores could close, hurting high streets</td>
</tr>
<tr>
<td>● The digital divide would increase due to investment cuts to wireline and delayed 5G rollout</td>
<td></td>
<td>● Charitable donations could decrease by $135M, hurting local communities</td>
<td></td>
</tr>
</tbody>
</table>
Appendix: Economic impact assessment methodology

The future economic impact of MVNO regulation in Canada has been modelled through the economic analysis framework outlined in the figure below. The approach had made use of customised input output modelling using detailed expenditure data for MNOs to estimate multiplier effects as well as industry-wide multipliers published by StatsCan.

<table>
<thead>
<tr>
<th>Impact channels</th>
<th>Operating expenditures</th>
<th>Capital expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating expenditures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating expenditures</td>
<td></td>
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<tr>
<td>Induced impacts</td>
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<tr>
<td>Induced impacts</td>
<td></td>
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</tr>
<tr>
<td>Total economic impact</td>
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<td></td>
</tr>
</tbody>
</table>

Direct, indirect, and induced economic impacts

Economic impacts have been estimated at the Direct, Indirect and Induced levels. These impacts, individually and collectively, represent how the reduced output and reduced operating and capital expenditures of Canadian MNOs ripple throughout Canada’s economy. The philosophy behind I-O analysis is that spending on goods and services has attendant impacts throughout the economy. For instance, operational expenditures on an MNO’s marketing operations will generate demand for the inputs to this process, such as labour and raw materials, which in turn generates additional demand that extends beyond the initial spending. The input-output model used for the purpose of this report estimates the relationship between a particular economic activity for a given good or service and the resulting impacts throughout the economy (i.e. including demand for other goods and services, and tax revenues). For the purpose of this report, economic impact was estimated for the following measures of economic activity:

- **Direct impacts** result from companies’ spending on suppliers and employees.
- **Indirect impacts** arise from the activities of the firms providing inputs to a company’s suppliers (in other words, the suppliers of its suppliers).
- **Induced impacts** are the result of consumer spending by employees of the businesses stimulated by direct and indirect expenditures.
- **Total economic impact** is equal to the sum of the Direct, Indirect, and Induced economic impacts.
Impact modelling outputs

Economic impacts, for each of the previously defined impact channels, and at the Direct, Indirect and Induced level, are estimated for the following measures of economic activity

- **Value-added or gross domestic product (GDP):** The value added to the economy, or the output valued at basic prices less intermediate consumption valued at purchasers’ prices. GDP includes only final goods to avoid double counting of products sold during an accounting period.

- **Employment:** The number of jobs created or supported. It is expressed in terms of total headcount in this report (i.e. the number of part-time and full-time workers).

- **Taxes on production and products (P&P):** Taxes payable on goods and services when they are produced, delivered, sold, transferred or otherwise disposed of by their producers plus taxes and duties on imports that become payable when goods enter the economic territory by crossing the frontier or when services are delivered to resident units by non-resident units.

- **Personal income tax (PIT):** The amount of provincial tax revenues generated from taxes on the income of employees and self-employed individuals.

- **Corporate income tax (CIT):** The amount of provincial tax revenues generated from taxes on the profits of corporations.
Study limitations

Receipt of new data or facts: PwC reserves the right at its discretion to withdraw or make revisions to this report should we receive additional data or be made aware of facts existing at the date of the report that were not known to us when we prepared this report. The findings are as of March to April 2020 and PwC is under no obligation to advise any person of any change or matter brought to its attention after such date that would affect our findings.

By its nature, forward looking information used in this report will not occur as forecasted and unanticipated events and circumstances may occur that may materially alter our assumptions. We have not undertaken any review of whether the future oriented data provided comply with existing standards, such as those issued by the CPA Canada or any other relevant accounting body.

Data limitations: PwC has relied on the information sourced from OECD, Recon Analytics, Government of Canada, CWTA, Statistics Canada, Capital IQ, GSMA, among others. PwC has relied upon the completeness, accuracy, and fair presentation of all information and data obtained from participating business and the various data sources, which were not audited or otherwise verified. The findings in this report are conditional upon such completeness, accuracy, and fair presentation, which have not been verified independently by PwC. Accordingly, we provide no opinion, attestation or other form of assurance with respect to the results of this study.

This report and related analysis must be considered as a whole: Selecting only portions of the analysis or the factors considered by PwC, without considering all factors and analysis together, could create a misleading view of our findings. The preparation of our analysis is a complex process and is not necessarily susceptible to partial analysis or summary descriptions. Any attempt to do so could lead to undue emphasis on any particular factor or analysis.

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