Comprehensive Wealth

Comprehensive Wealth in Canada 2018 – Measuring What Matters in the Long Term

Prepared for:
Ivey Foundation

Prepared by:
International Institute for Sustainable Development

October 2018

IISD
International Institute for Sustainable Development

Published by the International Institute for Sustainable Development.

International Institute for Sustainable Development

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Acknowledgements

This report was prepared under the direction of Lynne Wagner, Group Director, SDG Knowledge of the International Institute for Sustainable Development (IISD).

Financial assistance and initial project inspiration were provided by the Ivey Foundation. Thanks are due in particular to Andrea Moffat and Bruce Lourie for their vision and commitment.

The lead author was Robert Smith, IISD Senior Associate and Principal of Midsummer Analytics. Research assistance was capably provided by Kieran McDougal of IISD. Stefan Jungcurt of IISD was project manager. Matthew TenBruggencate and Zahra Sethna of IISD provided communications management. Katherine Clark of IISD provided production assistance and Tom Penner of Firefly Communications provided editorial assistance.

Major contributions to the development of the ecosystem indicators were made by Wynet Smith and Ryan Cheng, of the no-longer-operating Global Forest Watch Canada.

A great deal of the data used in the report come from Statistics Canada and the authors thank all those who work there for their ongoing efforts to provide Canada with timely, reliable, relevant and accessible statistics on matters of broad national importance. Thanks are due in particular to Karen Wilson, Nazrul Islam Kazi and Wulong Gu for their assistance in interpreting and analyzing the data on produced, financial, natural and human capital.

The Conference Board of Canada managed an advisory committee of experts who generously devoted their time to reviewing the report. Their comments substantially improved the final product, and we are grateful to them. A letter of endorsement from the committee members is found on the following page. Thanks are due, in particular, to Brent Dowdall, Senior Manager, Research and Business Development, Conference Board of Canada; Craig Alexander, Chief Economist, Deloitte; David Campbell, President, Jupia Consultants; Frances Donald, Head of Macro Strategy for Asset Allocation, Manulife; Brian Emmett, Chief Economist, Imagine Canada; Jennifer Robson, Professor of Political Management, Carleton University; and Toby Sanger, Economist, Canadian Union of Public Employees.

Every effort has been made to ensure that the report is free from errors in interpretation, analysis or presentation. Any errors that remain in spite of this are the sole responsibility of the IISD project team.

Letter of Endorsement

October 11, 2018

Message from the Advisory Committee on Comprehensive Wealth

Comprehensive wealth is emerging as an important concept in providing decision-makers with a broader perspective on how their policies or decisions have wide ranging impacts. Typically, measures of wealth focus on economic or financial components, leaving natural, social, and human capital as secondary concerns.

We came together as an Advisory Committee because we believe that comprehensive wealth is both an important economic issue and one that has not been fully or adequately measured in Canada. The research conducted by International Institute for Sustainable Development is a significant step in the direction of making measures of comprehensive wealth more rigorous and more accurate.

The Conference Board of Canada brought us together to review the research and provide insights to the research team at the International Institute for Sustainable Development. Our work consisted of a review of the preliminary draft and a conference call to discuss our perspectives, followed by a subsequent review of the revised version of the report prior to publication.

We believe that the findings in this report constitute the most complete assessment of comprehensive wealth possible in Canada today. The research effectively synthesizes varying components of wealth into an inclusive and comparable measure. It should also be noted that the report acknowledges that there remain a number of challenges to obtaining a more rigorous analysis of Canadians' comprehensive wealth. As such, this research reflects the reality that comprehensive wealth measurement remains a work in progress.

This report is a thought-provoking contribution to a discussion that we need to have about measuring wealth. It is important for policy makers to understand how our well-being is impacted by these broader factors.

We hope that the results of this research can contribute to a broader understanding of the benefits of measuring comprehensive wealth.

David Campbell, President, Jupia Consultants Inc.

Frances Donald, Head of Macroeconomic Strategy, Manulife Asset Management

Brian Emmett, Chief Economist, Imagine Canada

Jennifer Robson, Associate Professor, Political Management, Kroeger College, Carleton University

Toby Sanger, Executive Director, Canadians for Tax Fairness

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EXECUTIVE SUMMARY

Canadians are fortunate to enjoy levels of well-being that are the envy of much of the world. Having achieved such success, it would be reasonable for them to ask whether it is sustainable. After all, even if they are well off today, Canadians want their children and grandchildren to be just as well off, if not more so. It is noteworthy, then, that most Canadians tell pollsters they don't believe the future will improve on the present. The 2018 G7 leaders' communiqué reflected this concern. In it, heads of state noted that short-term indicators like GDP alone are insufficient for measuring success and that countries must begin to compile indicators that focus on prosperity and well-being.

What matters in the long run is not GDP—which focuses on measuring income—but wealth. More specifically, it is a country's *produced, natural, human, financial and social capital* that determine its prospects for the future. Together, these five types of capital make up what is known as *comprehensive wealth*. Comprehensive wealth matters because it is the foundation for producing all the goods and services—both market and non-market—needed to support well-being. For well-being to be sustainable, comprehensive wealth must be stable or growing over time on a per capita basis. If it is not, the country is eroding its productive base, living off its inheritance rather than building for the future.

This report represents IISD's second effort at measuring comprehensive wealth in Canada. Building on our initial effort in 2016, it provides the most complete analysis of comprehensive wealth possible in Canada today. Based on data from Statistics Canada and other reliable sources, the reports' findings suggest that concern for Canada's future is well-founded. In spite of a robustly increasing GDP since the 2008 financial crisis, our analysis reveals fragility in the foundation of this growth. Produced capital, the nation's stock of assets such as infrastructure, buildings and machinery, is increasingly concentrated in housing and oil and gas extraction. Natural capital, our endowment in minerals, fossil fuels, timber, land and ecosystems, is facing threats from climate change, physical depletion of key minerals and heavy losses in the value of the oil sands. Human capital—the combined skills and knowledge of Canadians and the country's most valuable single asset by far—has not grown in per capita terms in more than three-and-a-half decades. Financial capital (like stocks and bonds) is heavily reliant on stock market growth, and consumers have amassed historic levels of debt, both of which are vulnerabilities in the face of rising interest rates.

Based on our analysis, we conclude that Canada's development has been unsustainable for much of the period since 2008. While Canadians clearly feel this intuitively, they do not have the information they need to confirm their intuition. This is because comprehensive wealth is not measured in Canada—or anywhere—today. Bits and pieces of the portrait are available from Statistics Canada, but a complete, regular and comprehensible assessment is missing. In contrast, Canadians are fed a regular and rich diet of short-term statistics like GDP—monthly, quarterly and annually—and the media are fully engaged in helping people understand and use them.

We believe that Canada, indeed all countries, must begin measuring comprehensive wealth to balance the short-term view of progress offered by GDP. The federal government should fund Statistics Canada to report on comprehensive wealth alongside its already world-class reporting on GDP. Canada is better positioned than any other nation to show leadership here, as Statistics Canada already measures more of the components of comprehensive wealth than any other statistical agency. Funding the agency to complete its efforts and add comprehensive wealth to Canadians' regular diet of statistics would require a relatively modest investment but would pay major dividends.

With comprehensive wealth to use as another lens on progress, Canadians would know with confidence whether their well-being was on a sustainable path. If not, they would be able to hold their leaders accountable. Just as importantly, decision-makers would have an essential new tool to guide decision making, ensuring that impacts on long-term well-being are fully considered. Today, the decision-making scales are tipped in favour of short-term economic growth—it is time that they be balanced.

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List of Abbreviations

AAC	annual allowable cut
AHCCD	Adjusted and Homogenized Canadian Climate Database
CANSIM	Statistics Canada's online database[1]
CES	Canadian Election Study
CW	comprehensive wealth
DCWI	Domestic Comprehensive Wealth Index
GDP	gross domestic product
GFWC	Global Forest Watch Canada
GSS	General Social Survey (of Statistics Canada)
HELOC	home equity line-of-credit
IHDP	International Human Dimensions of Global Environmental Change Program (of the United Nations)
IIP	international investment position
IWR2018	2018 Inclusive Wealth Report (Managi & Kumar, 2018)
LCTS	Land Cover Time Series
NCWI	National Comprehensive Wealth Index
NNI	net national income
OECD	Organisation for Economic Co-operation and Development
PBO	Parliamentary Budget Office
PIAAC	Programme for the International Assessment of Adult Competencies (of the OECD)
RRSP	registered retirement savings plan
TFSA	tax-free savings account
UNU	United Nations University
UNEP	United Nations Environment Programme

[1] The acronym no longer has a meaning. It has simply become the name of the database.

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1
INTRODUCTION

1.1 The Need for New Measures of Progress

Canadians are fortunate, by and large, to enjoy high levels of well-being. Most live comfortably by global standards, with few lacking access to good food, clothing and shelter. High-quality public education and health care are nearly universally available. The cities and towns where Canadians live are generally safe, and the country's air and water are typically of good quality. Good jobs at fair rates of pay are available to most who want them and when Canadians are not at work they can relax in nature that is still close at hand. Canadian society is open to the rest of the world, benefiting from the free flow of people, goods, services and ideas across its borders.

Of course, there are areas where Canada could do better, not least in providing members of the country's Indigenous communities with the same levels of well-being enjoyed in the rest of Canada. These legitimate concerns notwithstanding, it is fair to say that the well-being of the average Canadian is the envy of much of the world.

Having achieved this status, it would be reasonable for Canadians to step back regularly and ask whether the foundation of their well-being remains sound—whether it is sustainable in the long run. After all, even if Canadians enjoy high levels of well-being today, they want the same for their children and grandchildren.

It is noteworthy, then, that many Canadians say they are worried about the future. In a 2018 survey on a broad range of topics, the Environics Institute found that 42 per cent of Canadians were most concerned about two long-term issues: climate change and war. More immediate concerns such as terrorism, the economy, world hunger and the decline of democracy ranked lower. Nearly half (48 per cent) of Canadians reported being basically pessimistic about the direction of the world compared with 42 per cent who were basically optimistic (Environics Institute for Survey Research, 2018). In a similar 2018 study of global views on economic health, the U.S.-based Pew Research Center found that while most Canadians felt that the current economic situation in Canada was good (63 per cent), the majority (67%) believed that their children would be financially worse off than them when they grow up (Pew Research Center, 2018).

In spite of Canadians' concerns for the future, ensuring that life improves in the short term remains the principal goal of governments at all levels. This is reflected in the indicators commonly used to gauge national progress in Canada – or any other nation, for that matter. The unemployment rate, the inflation rate and, especially, gross domestic product (GDP) all gauge how well the economy and society are doing today. The unemployment rate reveals how many people want work today but cannot find it. The inflation rate shows how quickly life today is getting more expensive. GDP measures how much income there is to spend—again, today. None of these influential indicators focuses explicitly on the well-being of the next generation or, for that matter, how those alive today might be doing in the next few years.

It is often said that the baby boom generation grew up with the assumption that they would be better off than their parents. Whether this assumption holds for today's generation is an open question—and one not easily answered. As just noted, the tools that countries have at hand to measure progress are largely directed at answering short-term questions. The chief economist of the World Economic Forum summed up well the need to change this when she asked whether the current generation is "living at the expense of tomorrow" and "building up debts that we will simply leave to future generations?" (Blanke, 2016). In a similar vein, the head of the International Monetary Fund has noted that "there are lots of things that we don't measure well. We have to . . . assess, and probably change, the way we look at the economy" (Thomson, 2016).

Knowing where Canada, or any country, is headed in the future—that is, knowing whether national well-being is sustainable—requires measures that go beyond short-term indicators. What matters in the long run is wealth: more specifically, *comprehensive wealth*.

To the extent that wealth is measured—which is insufficiently in most countries—reporting focuses on produced and financial capital. Comprehensive wealth goes beyond this to add:

- The *natural capital* found in forests, lakes, minerals, land and the other elements of the natural environment
- The *human capital* bound up in the skills and knowledge of the people that make up the workforce, and
- The *social capita*l resulting from civic engagement, trust and cooperation of the population.

Though not as well known as produced and financial capital, natural, human and social capital are no less essential to a nation's progress than machinery, buildings, stocks and bonds.

Tracking the five elements of the comprehensive wealth "portfolio" is important because of the link between wealth and well-being. The assets that make up the portfolio are the basis for producing nearly all goods and services that people require: obvious things like food, electricity and health care, but also clean air, healthy forests and safe communities. The consumption of these goods and services is a large part of what creates well-being for individuals and for nations as a whole—that is why comprehensive wealth is so important.

For a nation to claim it is progressing (or developing) as time goes by, consumption levels must be sustained. More consumption today at the expense of less tomorrow is not development; rather, it is simply forcing those to come to pay for benefits enjoyed today. Understanding whether a nation is truly developing, then, requires understanding how its comprehensive wealth is evolving. Simply measuring how quickly GDP is growing is not enough. It is essential to know whether the asset base that underpins GDP—that is, comprehensive wealth—is growing alongside GDP. If it is not, then economic growth rests on an unsustainable drawing down of capital. Still, in spite of its importance as a measure of sustainability, no country measures comprehensive wealth today.

It is encouraging, then, to see the international community calling on countries to go beyond GDP in their efforts to gain insight into development and its sustainability. In their communiqué from the 2018 summit in Charlevoix, Quebec, the leaders of the G7 countries recognized "that economic output alone is insufficient for measuring success" and acknowledged "the importance of monitoring other societal and economic indicators that measure prosperity and well-being" (G7, 2018). Canada's prime minister has also underscored the need for a new, longer-term view, noting that Canada's greatest asset is not its resources but its resourcefulness—that investing in education to help people learn, think and adapt is essential to improving their lives, and that confident countries invest in their future (Justin Trudeau, Prime Minister of Canada, 2016).

The United Nations (UNECE, 2009) and the Nobel Prize-winning economist Joseph Stiglitz (Stiglitz et al., 2009), among others, see comprehensive wealth as a key means of moving beyond GDP. A few organizations have actually started measuring it. The World Bank published its first figures in the 1990s (Hamilton & Clemens, 1999) and has added a wealth-related indicator to its global development indicators. A team led by Professor Partha Dasgupta of Cambridge University with colleagues at UNEP, Kyushu University and elsewhere has released comprehensive wealth reports with estimates for most countries in 2012, 2014 and 2018 (UNU–IHDP & UNEP, 2012, 2014; Managi & Kumar, 2018).

In our view, moving beyond GDP means complementing it rather than replacing it with measures of comprehensive wealth. Both are required to assess the nation's development. GDP says much about the latest quarter but is silent on the prospects for the future. Comprehensive wealth, in contrast, focuses on the long term, helping answer questions about well-being and sustainability that for the most part go unanswered today. As the president of the C.D. Howe Institute has put it, "GDP is so twentieth century." Measuring wealth is "the Next Big Thing" (Robson, 2015).

1.2 About This Report and Its Findings

This report is an update and expansion of the International Institute for Sustainable Development's 2016 report on comprehensive wealth in Canada (Smith, Bizikova, & McDougal, 2016), hereafter referred to as the 2016 report. The 2016 report represented one of the first efforts to measure comprehensive wealth in Canada and one of the first to measure comprehensive wealth for a single country using detailed national statistics.[2] It discussed the concept of comprehensive wealth in detail and outlined why we believe indicators of comprehensive wealth are an essential complement to GDP and other short-term measures commonly used to measure national progress. The report introduced a conceptually "ideal" suite of comprehensive wealth indicators and presented the results of our first effort to compile them using the best available data.

This update builds upon the 2016 report in several ways:

- It extends the original timeframe (1980–2013) to 2015, capturing more recent trends of significance around natural capital.
- It adds the category of financial capital and all the associated assets and liabilities, filling a significant gap in the 2016 report's coverage of the comprehensive wealth portfolio.
- It adds built-up land[3] as an asset within the category of natural capital (previously, farmland was the only land asset included).
- It adds inventories as an asset within the category of produced capital.[4]

Readers familiar with the concept of comprehensive wealth will find this update understandable as a stand-alone document. Those for whom the concept is new may, however, benefit from first reviewing the material in the 2016 report; in particular, Sections 2 through 5 in Part I where the concepts and methods that have been applied in this update report are laid out. New readers might also benefit from reviewing the material in the annexes at the end of this report—in particular, Annex 6, which explains the methods used to estimate human capital and Annex 8 which explains the method used to construct the overall aggregate indicator of comprehensive wealth presented here (what we call the National Comprehensive Wealth Index).

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2 Comprehensive wealth in Canada has been measured in three earlier studies – *the Index of Economic Well-being* compiled by the Ottawa-based Centre for the Study of Living Standards (Osberg & Sharpe, 2011), a series of global reports covering 140 countries prepared by Professor Partha Dasgupta of Cambridge University with colleagues at UNEP, Kyushu University and elsewhere (UNU–IHDP & UNEP, 2012, 2014; Managi and Kumar, 2018) and a series of World Bank reports measuring "the wealth of nations" (World Bank, 2006, 2011 and 2018).

3 Built-up land includes land under buildings, roadways, railways and other built infrastructure.

4 With the addition of financial capital, built-up land and inventories, all elements of the comprehensive wealth portfolio and all important assets measured by Statistics Canada as part of its *National Balance Sheet Account* are included in this study. The only assets measured by Statistics Canada in the national balance sheet but not included here are weapons systems and so-called "consumer durables" (such as furniture, vehicles and major appliances). Weapons systems are excluded on the grounds that they make no meaningful contribution to well-being. Consumer durables are excluded not because they make no contribution to well-being but because they have high rates of depreciation; their purchase is, therefore, more akin to current consumption than to capital investment in our view.

It should be noted that our thinking on the measurement of comprehensive wealth has evolved somewhat since the 2016 report, so the treatment of some of the indicators there differs from that here. Furthermore, as already noted, the analytical and temporal scopes of this study are considerably expanded from those in the 2016 report. For these reasons, the findings of the two studies cannot be directly compared. **The findings presented here should be taken as our best and most complete effort at estimating comprehensive wealth in Canada.**

1.2.1 Our Findings in Brief

Our findings reveal trends about Canada's progress that are not apparent from looking at GDP alone. Viewed through the lens of GDP, Canada has progressed quite well since the global financial crisis in 2008. In contrast, we find that comprehensive wealth was either declining or growing on a fragile basis during those years, suggesting that Canada's development after the financial crisis was not fully sustainable and Canadians' long-term well-being was at risk.

The differing trends in GDP and comprehensive wealth and what they say about Canada's progress are, to us, practical evidence supporting our view that comprehensive wealth is an essential complement to GDP. We therefore call for the government to begin measuring it and using the measures to guide policy to ensure the maintenance of Canada's comprehensive wealth portfolio. At the moment, only half of the story of the nation's progress is being properly told.

Much more about our findings and what we believe they suggest in terms of areas where action could be taken to increase the resilience Canada's comprehensive wealth portfolio is said in Chapter 3.

1.2.2 What This Report Does Not Do

Though the findings in this report represent what we believe is the most complete assessment of comprehensive wealth possible in Canada today, there are aspects of the analysis that fall short of the ideal.

Most importantly, it is not possible today to measure social capital in monetary terms. This means that social capital is not included in the measures of aggregate comprehensive wealth presented here; only produced, natural, human and financial capital are included in those measures. Thus, they fall somewhat short of being truly "comprehensive." More is said about assets missing from the analysis and other potential sources of error in Annex 1.

In addition, resources available for the project did not permit us to undertake an assessment of the distribution of wealth among different sectors of the Canadian economy or different regions of the country. This would have been desirable, since wealth inequality and its possible economic, environmental and social consequences is a topic that has received considerable attention in recent years. It is our hope that future analyses will address the question of distribution.

Finally, though data on some forms of capital (especially produced and financial capital) are available for years more recent than 2015, our analysis ends in that year because it is the most recent for which Statistics Canada's natural capital data are available. This means the report is largely silent on trends in comprehensive wealth since 2015, some of which have been quite dramatic (for example, declining levels of produced capital in some industries). Where we felt that a particular post-2015 trend was too important to be ignored, we have mentioned it in our discussion, though in nothing like the detail in which we discuss the trends up to 2015.

1.2.3 Reading This Report

This report is divided into four chapters. Following this introduction, Chapter 2 defines comprehensive wealth in further detail and presents our arguments in favour of it as a measure of national progress.

Chapter 3 summarizes our findings regarding the evolution of comprehensive wealth in Canada from 1980 to 2015 and discusses their significance for well-being in Canada. It also recommends actions we believe would increase the resilience of Canada's comprehensive wealth portfolio. The chapter ends with a discussion of how comprehensive wealth could be used as a lens to improve future decision making.

For those interested in further information about the concepts, methods and data sources used in the report, Chapter 4 presents technical details of the individual comprehensive wealth indicators. The indicators are presented in six sections, one each for overall comprehensive wealth, produced capital, natural capital, human capital, financial capital and social capital. For each indicator, the following is presented:

- The geographic scope of the indicator
- The time series for which the indicator has been compiled
- The frequency with which the indicator can be compiled
- A description of the indicator
- The relevance of the indicator to comprehensive wealth
- The methods and data sources (and their limitations) used to compile the indicator
- The statistical reliability of indicator
- An analysis of the trends in the indicator

Though this report is largely about assessing the status of the asset stocks that make up comprehensive wealth, it is recognized that stocks are just part of what is relevant to comprehensive wealth. Changes in stocks are the result of flows to and from them; for example, the flow of timber out of forests and the flow of education and skills training into human capital. Understanding comprehensive wealth is, then, as much about measuring flows as it is about measuring stocks. A complete assessment of all the flows related to comprehensive wealth would have made the report unmanageable in size and scope, however, so it has not been undertaken. To demonstrate what such an assessment might look like, the natural capital indicators are supported by a case study on "green growth" indicators that considers some of the flows relevant to natural capital. The case study, which is presented in Text Box 9 at the end of Section 3.4, makes use of the green growth indicators framework proposed by the OECD (OECD, 2011).

Supplementary information relevant to understanding comprehensive wealth, its measurement and the findings here is included in several annexes.

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2
WHAT IS COMPREHENSIVE WEALTH AND WHY MEASURE IT?

2.1 Measuring What Matters in the Long Run

Comprehensive wealth measures the assets a nation has at its disposal. It starts with assets that would be familiar to most people: *produced capital* like buildings and equipment and *financial capital* like stocks and bonds. It then expands the portfolio to make room for less familiar, but equally important, assets:

- The *natural capital* found in forests, lakes, minerals, land and the other elements of the natural environment
- The *human capital* bound up in the skills and knowledge of the people that make up the workforce
- The *social capital* resulting from civic engagement, trust and cooperation of the population

Together, these five capital stocks—produced, financial, natural, human and social—make up the comprehensive wealth portfolio.

Most people are familiar with *produced capital* and *financial capital*. They are what normally come to mind when thinking of the nation's assets: roads, railways, ports, houses, machinery and the wide variety of other manufactured assets found in the economy, in addition to stocks, bonds and other forms of financial assets. Investments by governments, businesses and households are often aimed at building up stocks of produced and financial capital.

Natural capital includes market natural resources such as timber, minerals, oil and gas. It also includes ecosystems of all kinds; for example, wetlands that help create clean drinking water and forests that act as carbon storehouses. Ecosystems are not only important for supporting life—they are also economically valuable, though their value is rarely realized through the market.

The collective knowledge, skills and capabilities of the labour force make up *human capital*—the result of lifelong learning in both formal and informal settings. Formal education is an important source of human capital but on-the-job learning and what we learn from our families and peers are equally important. Education helps make individuals more productive, which in turn can increase the productivity of their coworkers. Education also helps people contribute more fully to society as a whole. Human capital is the largest source of wealth in most countries and in developed countries in particular.

Social capital—the norms and behaviours that define interactions between members of society—is another broad component of the comprehensive wealth portfolio. Systems of laws and governance shape society and the economy. Cultural norms play an important role at home and in the workplace. Social ties and networks provide support for people trying to get ahead or overcome hard times. The norms and behaviours that define social capital dictate the use, distribution and value of the other capital assets and therefore play an important role in creating wealth. Some nonetheless consider social capital to be an enabling factor that contributes to the value of the other forms of capital rather than a distinct form of capital itself (UNU–IHDP & UNEP, 2012).

See Text Box 1 for definitions of some of the basic terms used in this report.

Text Box 1. Basic Terms related to comprehensive wealth

An asset is a valuable economic resource, such as a machine or an oil deposit, owned by an individual, business or government. Assets are durable and can be used repeatedly in production processes (unlike things like fuel that can only be used once). Assets eventually wear out and require replacement, however.

Capital is the term given to a collection of assets; all the machinery, buildings and other manufactured assets in the economy, for example, make up produced capital.

Income is the money received from the sale of goods and services produced through the use of capital. At the level of the nation as a whole, income is measured as GDP.

Comprehensive wealth is the value of all the assets a nation has at its disposal: *produced capital* like buildings and machinery; *financial capital* like stocks and bonds; *natural capital* like forests and mineral deposits; *human capital* in the form of an educated and productive workforce and *social capital* in the form of effective systems of cooperation. Comprehensive wealth is the basis for the production of the wide range of good and services—both market (e.g., clothing and automobiles) and non-market (e.g., clean air and scenic vistas)—that are consumed by individuals.

Well-being is the personal satisfaction derived from consumption of goods and services. A nation's aggregate well-being is the sum of the well-being of its citizens. It is essential to recognize that well-being is understood here to result from the consumption of goods and services produced both within and outside the market. Consumption is therefore defined broadly to include the enjoyment of any valued good or service, including highly abstract services like the beauty of a scenic vista.

It should be noted that comprehensive wealth and well-being are not the same thing, though they are closely related. As the basis for the production of both market and non-market goods and services, comprehensive wealth is also the basis upon which much well-being lies (recognizing that some well-being, such as that resulting from spiritual beliefs or intimate relationships, derives from sources that cannot be captured in statistical measures).

National development (or progress) is a situation in which aggregate well-being increases over time.

Sustainable development, as the term is used here,[a] requires the maintenance of the capital stocks that make up the comprehensive wealth portfolio, as they are the basis for the consumption that leads to well-being. Since well-being is fundamentally an individual concept, it is not just the overall size of asset stocks that matters but the assets available per capita; therefore, sustainability must be assessed in terms of maintenance of per capita rather than aggregate capital stocks.

To the extent that assets may be substituted by one another, sustainability need not require that each asset stock be maintained separately. Some may grow while others decline, so long as the total portfolio does not decline. Some assets are considered "critical," however, and must be separately maintained to ensure sustainability (for example, the ozone layer). The concept of critical capital is pursued further in Section 2.4.

[a] It is recognized that there are many competing definitions of sustainable development and that the one used here may not reflect some of the concerns often associated with sustainability; for example, poverty or rights. The notion here that sustainability requires keeping capital stocks intact over time has a long history, dating back at least to the seminal work of the late David Pearce at University College London (see, for example, Pearce and Turner, 1990). Pearce's characterization of sustainability as requiring the maintenance of capital stocks was one of the first efforts to define it in a manner that lent itself well to quantification. A number of other prominent economists have also proposed maintenance of capital as the essential criterion for sustainability, including Partha Dasgupta at the University of Cambridge, Kirk Hamilton at the World Bank, Joseph Stiglitz at Columbia University and Kenneth Arrow at Stanford University. See Section 2.2 for further details.

2.1.1 Why Should Comprehensive Wealth Count?

As noted in Chapter 1 and explained in more detail below (Section 2.3), comprehensive wealth is the basis of future well-being. If comprehensive wealth is growing, development is almost certainly sustainable, and well-being will increase over time. If comprehensive wealth is declining, well-being will eventually follow suit.

In spite of comprehensive wealth's value as a lens on future well-being, Canada does not measure it—at least not fully. No country does. In fact, many countries measure no element of the comprehensive wealth portfolio at all. Yet essentially every country measures GDP and most track a variety of other indicators that focus on short-term well-being too. This results in an imbalance in the information decision-makers have at their disposal. Ample information related to short-term well-being can be found but much less exists to reveal whether progress in creating well-being can be sustained in the future.

The relative lack of national data on wealth is at odds with the way businesses are run—corporate accountants keep both income statements (GDP) and balance sheets (wealth). There are many reasons why countries, too, should keep both income statements and balance sheets. Knowing what a nation has to draw upon in its quest to improve citizens' well-being—that is, its comprehensive wealth portfolio—is no less important than knowing how much income the economy generated last quarter.

Fortunately for Canadians, Canada is one of the few countries with a tradition of measuring wealth. Statistics Canada has long maintained a national balance sheet that reports the value of the country's produced and financial capital and, more recently, a portion of its natural capital. Neither human nor social capital is included, however, and we know of no plans to do so.

In measuring wealth in considerable (if not comprehensive) detail, Canada is well ahead of most countries. Yet the wealth indicators Statistics Canada produces receive less attention than GDP and other short-term measures of progress. This has changed somewhat in recent years, as concerns have been raised over growing debt levels of Canadian households. Still, in our view, wealth receives much less than it deserves.

2.1.2 The Need to Assess the Sustainability of Well-Being

We believe that that GDP should be complemented with measures of comprehensive wealth. Both are needed to assess progress (see Text Box 2). The goal of this report is to demonstrate how adding comprehensive wealth to Canada's progress measures would reveal trends not fully evident based on the current suite. In our view, there is much to be gained from doing so, as the case studies of how comprehensive wealth measures could be used in decision making show (see Section 3.8). It really does matter what gets measured and, right now, an important aspect of national progress—sustainability—is not being properly assessed, putting Canada's enviable levels of well-being at risk.

Ultimately, it is the role of governments to measure comprehensive wealth. Canadians are fortunate to have a national statistical agency with a global reputation for innovation and quality. Statistics Canada already measures more of the elements of comprehensive wealth than nearly any other statistical agency. This report calls for the federal government to mandate and fund Statistics Canada to complete its measures of comprehensive wealth and publish them on a regular basis, as it has long done with GDP. The basic estimates of comprehensive wealth compiled for this study (see Chapter 3) demonstrate that

it is feasible to measure most elements of comprehensive wealth in Canada using existing concepts, data and methods. Statistics Canada is a world leader among statistical agencies. A decision on its part to begin regular publication of comprehensive wealth measures would send a strong signal to other countries that wealth measurement deserves greater attention.

Simply publishing estimates of comprehensive wealth would not, of course, make any difference to the sustainability of Canadians' well-being. Decision-makers would have to use the estimates to design and evaluate policies to expand Canada's comprehensive wealth, just as estimates of GDP have long been used to guide policies focused on ensuring growth in income.

Evidence is mounting that the current, short-term focus of most progress measures is no longer adequate. Climate change, concerns about the competitiveness of the workforce, protectionism, mounting levels of debt, rapid evolution of energy markets, population aging and worries over social cohesion are just some of the reasons for concern about long-term well-being. Getting a firm handle on the evolution of Canada's comprehensive wealth and what it reveals about the prospects for future well-being has never been more important. This is all the more true since our analysis of the trends in comprehensive wealth (see Chapter 3) suggests that the foundation of Canada's well-being been, at best, fragile since 2008.

Before turning to our findings, we first discuss the relationship between comprehensive wealth, well-being and sustainability in more detail to clarify why we believe comprehensive wealth is a key measure of progress.

Text Box 2. GDP as a measure of national progress

GDP, which measures the income generated by the economy during a given period, is one of the most frequently cited and influential indicators of our time. In Canada, it is reported by Statistics Canada on a monthly, quarterly and annual basis for the country as a whole, for provinces and territories and by industry. Politicians, investors, businesspeople, researchers, journalists and the public at large eagerly anticipate each release and use the numbers to judge how well the economy and the nation are doing. GDP is similarly influential across the world.

Though not strictly conceived as a measure of progress, GDP has come to be synonymous with that idea. If GDP is growing, the country is, broadly speaking, said to be moving in the right direction. If GDP growth is weak or, worse, if GDP is falling, things are not going well and intervention to change its course is called for.

Other things being equal, it is reasonable to take growing GDP as a sign that well-being is improving, at least in the here and now. For most people, additional income is a good thing. To the extent that additional income does not come with hidden costs that undermine well-being, GDP is appropriate as a measure of national progress.

Other things are, however, not always equal and there are many reasons why increasing GDP may not be correlated with increased well-being. None of the following threats to well-being, for example, would show up in GDP (or would show up in perverse ways by boosting economic activity as a result of well-being losses):

- Environmental degradation that worsens as the economy grows
- Increasing property losses due to extreme weather
- Insufficient investment in education and training
- Loss of security requiring increased spending on crime protection
- Increasing income inequality
- Growing time stress for families.

Criticisms of GDP for failing to capture or distorting the costs of economic growth are long-standing and well known. Our view is that many of them are valid and we support efforts to address them. We argue that this is not enough, however. Even if GDP growth were perfectly correlated with increased current well-being, it would still be insufficient as a measure of progress. This is because the determinants of future well-being fall outside GDP's scope, no matter how well it is measured. High income today is no guarantee of high income in the future, period. That is why this report calls for measures that go beyond GDP to complete the suite of indicators available to assess national progress.

2.2 What Is Well-Being and What Makes It Sustainable?

Well-being is defined here as the benefits people gain from the "consumption of goods and services."[5] We place "consumption of good and services" within quotation marks here to make clear that we are talking about something other than what is commonly understood by this phrase. Ordinarily, "consumption" refers to the purchase of goods and services in the marketplace and their use to meet personal needs: for example, purchasing food, cars and movie tickets and then using them for meals, transportation and entertainment. Market consumption of this sort contributes to well-being in myriad ways and is an important part of what we mean by consumption here. Our definition goes beyond this, however, to include the consumption of goods and services created outside the market, many of which we pay nothing for at all. The pleasure experienced by a hiker taking in a clear mountain view and the security parents feel knowing their children are safe at school are examples of the consumption of non-market services. Consumption of such non-market goods and services takes place all the time and also contributes to well-being in myriad ways. Other examples of the relationship between the consumption of non-market goods/services and well-being include:

- **Good:** clean air; **benefit:** health
- **Good:** firewood; **benefit:** warmth
- **Service:** pollination of crops by wild insects; **benefit:** food
- **Service:** absorption of industrial pollutants; **benefit:** reduced manufacturing costs
- **Service:** volunteerism; **benefit:** social cohesion
- **Service:** ease of engagement with strangers; **benefit:** reduced costs of doing business.

Since we define well-being as the benefits from consumption of market and non-market goods and services, it is clear that well-being is a current-period concept. Consumption happens in the here and now and the well-being it creates also happens in the here and now.

It is, however, possible to think of another dimension of well-being. That is *future* well-being, both of those alive today and those not yet born.

Future well-being cannot, by definition, be measured. Who will be alive in the future, what their tastes will be and what consumption opportunities they will have are all unknown. Nor can the present be used as a guide to future. The unpredictability of the world means that today's levels of well-being may or may not persist into the future.

What can be done, however, is measure whether the resources needed to create future well-being are being passed on from the present, just as they were inherited from the past (we define what we mean by "resources" shortly below—for now, it is helpful just to think of them in generic terms as "things needed to create well-being").

[5] We acknowledge that there is well-being associated with activities that should not be thought of as consumption, such as that derived from the love of one's family or from deeply held spiritual beliefs. Though they are clearly important to overall levels of life satisfaction, these very personal sources of well-being are out of scope for the discussion here. It is worth noting, however, that some minimum level of well-being of the type we are talking about (consumption-derived well-being) is needed to enjoy the benefits of other sources of well-being. Without opportunities to consume food and water, life is eventually untenable even with ample amounts of non-consumption-derived well-being.

Since we are talking about future well-being, it is necessary to be clear about what is meant here by "the future." In principle, any time beyond the present can be thought of as the future. In the context of assessing national well-being, however, it is not practical to think of the future in this way. The resources available to ensure well-being at the broad societal level don't change that quickly. In practice, the shortest timeframe over which it makes sense to think about—and measure changes in—these resources is a quarter of a year, and this what we have in mind here.[6]

The essence of the *sustainability of well-being is*, then, ensuring that the same (or greater) resources are passed on from one quarter to the next. If this is regularly the case, we can say we are developing sustainably. If not, development—that is, the enhancement of well-being—is unsustainable and the future will offer lower well-being than the present.

If it is the ability to create well-being in the future that is the essence of sustainability, then we must be clear about what the "resources" required to create well-being are. Since well-being is defined as the flow of benefits from consuming market and non-market goods and services, it is really the creation of those goods and services that is key.

The processes involved in creating the many market and non-market goods and services we consume are obviously complex. They can be simplified, however, by thinking of them as different ways of combining the assets that make up the comprehensive wealth portfolio.

Produced capital, like computer networks, buildings, roads and vehicles, is combined with human capital in the form of labour and ingenuity to produce many market goods and services. Natural capital is needed, too, in the production of market goods and services. It provides space for activities such as farming and living and serves as a source of raw materials like timber and minerals. As noted above, natural capital also provides many essential non-market goods and services: scenic views, wild berries and pollution absorption among many others. Social capital serves as a kind of lubricant to keep the market system running efficiently, as well as providing important non-market sources of well-being; the benefit of trust in one's neighbours, as noted above, for example.[7]

2.2.1 Linking Comprehensive Wealth, Well-Being and Sustainability

Together, the assets of the comprehensive wealth portfolio, in various combinations, are the basis for the production of all the market and non-market good and services that account for our consumption and, ultimately, for our well-being. In other words, they are the "resources" that must be passed on from one quarter to the next if well-being is to be sustained.

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[6] The question of how many consecutive quarters of consistently growing or shrinking resource levels would be needed to make a determination about sustainability is difficult to answer. Certainly, it would be unreasonable to say that one quarter of decline would be reason to declare well-being on an unsustainable path. For practical purposes, it would seem reasonable to apply the same guideline that is used in the assessment of economic recessions (two consecutive quarters of decline in real GDP) and say that two consecutive quarters of decline in resource levels would be required before anything could be said about the trend in sustainability.

[7] Financial capital, for its part, contributes to well-being somewhat differently in the context of comprehensive wealth. It represents the claims that Canadians have on the income of other countries or, vice versa, the claims that other countries have on the income of the Canadian economy. Financial capital does not, therefore, play a direct role in production of goods and services but, rather, acts as a source of additional (or lost) income that increases (or decreases) the opportunities for consumption of market goods and services. This is explained in more detail in Chapter 3.

The sustainability of well-being, then, comes down to maintaining the assets of the comprehensive wealth portfolio and passing them on from one quarter to the next. If the portfolio is maintained or expanded over time, then the prospects for producing the goods and services needed to maintain well-being are also maintained or expanded.

An obvious question at this point is what exactly must be maintained. The total number of factories, cars, educated workers, trees, lakes, mineral deposits, corporate shares, savings bonds and engaged, trusting citizens? In some sense, yes. But this is not a very useful way to think about the maintenance of comprehensive wealth, for two reasons. First, it would be cumbersome to keep track of all these things statistically. More importantly, it is difficult to compare them against one another. How does one factory compare against a hectare of trees in terms of supporting well-being? Are Canadians better or worse off if they own more corporate shares but levels of community trust fall?

The problems of comparability and ease of measurement are greatly reduced if all elements of the comprehensive wealth portfolio are measured using the same yardstick. Practically speaking, this means measuring them in terms of their monetary value (the argument in favour of monetary measurement is explored more fully in Section 2.4). Monetary measurement permits simple indicators to be compiled and different assets to be compared against one another. To account for the fact that asset prices change over time, the values need to be adjusted for inflation (in statistical jargon, they need to be in "real" rather than "nominal" terms). Since population is also growing over time, it is not just the total real value of the portfolio that needs to be maintained, but the value per person.

Given the above, we can now make a general statement about what is needed to ensure the sustainability of well-being:

> *Sustaining well-being requires that the real value of comprehensive wealth per capita be stable or rising from one quarter to the next.*

In this report, we refer to the real value of comprehensive wealth per capita as the *National Comprehensive Wealth Index (NCWI)*.

According to economic theory, the NCWI is a nearly ideal measure of sustainable development (Arrow et al., 2012; Hamilton & Clemens, 1999; Dasgupta 2001 and 2014; Dasgupta & Mäler, 2000; Stiglitz et al., 2009; World Bank, 2011 and 2018; UNU–IHDP & UNEP, 2012; Managi & Kumar, 2018). The NCWI is a powerful indicator of sustainability because the assets that make up the index are the basis for producing most market and non-market goods and services[8] and this consumption serves, in turn, as the basis for a great deal of well-being.[9] Thus, if the real per capita value of comprehensive wealth is increasing over time, development (that is, increasing well-being) is likely sustainable,[10] since the basis for well-being (that is, the production of goods and services for consumption) is growing faster than the rate of inflation and population growth. If it is falling over time, development is unsustainable and well-being is either declining or will fall at some point in the future.

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8 As explained in the following section, assets that are "critical" to well-being should be excluded from aggregate measures of comprehensive wealth and measured using stand-alone indicators.

9 As noted earlier, some well-being is derived from activities that cannot rightly be thought of as "consumption," such as that derived from the love of one's family or from deeply held spiritual beliefs.

10 Growing real per capita wealth is not a guarantee of increased well-being in the future since those in the future may squander their inheritance and reduce their well-being in spite of being provided with the basis for increased well-being from those that came before them.

2.3 How Comprehensive Wealth Is Measured

The assets that comprise comprehensive wealth can be measured in two ways. For assets that are tangible, like forests, there is first the possibility of using physical units. A forest can be measured in terms of its area or volume, for example.

Some assets are poorly suited to physical measurement, however, either because they are intangible or because keeping track of them in physical terms would simply be too daunting a statistical task. Human capital, for one, is not easily captured in physical terms because it is intangible. The same is true of financial capital. Much produced capital would also be difficult to measure in physical terms even though it is tangible and can, in principle, be counted. It would be a challenge, for example, to measure the housing stock in terms of the numbers of houses or square metres of floor space. Moreover, not all houses are created equal. A well-built house with modern doors, windows, appliances and so on contributes more to well-being than does a poorly maintained house of the same size from 70 years ago.

The alternative to measurement using physical units is to measure assets in terms of their monetary value. A great advantage of this is that nearly all assets, both tangible and intangible, can be measured in monetary terms. A further advantage of monetary measures is the ability to "add up" the value of assets of different sorts. The value of a forest can be added to the value of a pulp mill to come up with an overall value for natural and produced capital owned by a forest company. Further, since prices reflect relative values, monetary valuation has the advantage of automatically weighting different assets according to their contribution to well-being.

In spite of these advantages, not all assets can, or should, be expressed in monetary terms (Stiglitz et al., 2009). Some assets are critical to well-being. Any degradation in them imposes direct and irreplaceable costs on well-being, and their monetary value is, therefore, not relevant. They are, effectively, priceless. For this reason, it is both appropriate and sufficient to provide physical measures alone for critical assets, meaning that they cannot (and should not) be included in aggregate measures of comprehensive wealth such as the NCWI defined above.

The question of which assets are critical to well-being is not easily answered. For the purposes here we have chosen to present indicators in physical units for ecosystems and the climate on the grounds that both of these asset types provide goods and services that are not readily replaced and, therefore, could be considered critical. This seems particularly true of the climate. It is arguably less true in the case of ecosystems, as some of their goods and services can be replaced—within limits—by other assets. The water purification service of lakes and rivers, for example, can be replaced by drinking water treatment plants. Thus, it might be acceptable to measure the value of ecosystems (at least in terms of some of their goods and services) in monetary terms. The practical possibilities for doing so are limited today by both data and methods, however, so we have not attempted monetary valuation here.

For those assets that can be appropriately valued (that is, those that are not critical), what is needed is an estimate of their full social value. The social value of an asset takes into account the costs and benefits of its use not just for its owner but for society as whole. Education, for example, provides benefits to the individual in the form of higher wages or the enjoyment of learning. But it also provides benefits to society as a whole, as educated individuals are more likely to engage productively in society.

For all practical purposes, market prices are the closest measure available to the social value of assets. However, markets do not always function perfectly and, as a result, do not necessarily reflect the full value an asset holds for society. For instance, the price of education might not reflect the broad benefits of more engaged citizens, so education might be "too cheap" compared to its benefits. The market value of assets that have negative consequences—such as creating pollution—when used might be too high if the costs of those consequences are not reflected in their prices. This may well be true for fossil fuel assets, for example, since climate change impacts are not fully reflected in their prices. In spite of these concerns, we use market prices wherever we can find them to value assets in this study, as there is no practical alternative. We accept that this will cause distortions in the results to the extent that market prices diverge from prices that fully reflect both private and social benefits.

Regularly published market prices are readily available for produced and financial capital from Statistics Canada. Statistics Canada also regularly publishes market prices for some natural capital (fossil fuels, minerals, timber, agricultural land and built-up land). Human capital is estimated in market prices on an occasional basis by Statistics Canada; however, those these estimates are considered experimental rather than official. The valuation of social capital is less well-developed. Statistics Canada recently released its first foray into the measurement of social capital but avoided valuation altogether by using a variety of non-monetary indicators. The sources of data used in this study are covered in detail in Chapter 4 and Annex 1.

Comprehensive Wealth

3
COMPREHENSIVE WEALTH IN CANADA—FINDINGS AND RECOMMENDATIONS

In this chapter we summarize the findings of our analysis of comprehensive wealth in Canada and discuss their implications for the sustainability of the country's development. Our high-level findings and recommendations are summarized in Section 3.1. Those interested in only the "big picture" of comprehensive wealth in Canada may wish to stop after reading this section. Those looking for further details will find deeper discussions of the trends in overall comprehensive wealth in Section 3.2 and in each of the five elements of the comprehensive wealth portfolio in Sections 3.2 to 3.7. Section 3.8 discusses how comprehensive wealth could be applied as a lens to improve future decision making, using a case study focused on the proposal to develop Ontario's Ring of Fire chromite deposit.

3.1 Main Findings and Recommendations

3.1.1 Evidence of Unsustainability and Declining Resilience of Wealth

Based on the most comprehensive assessment of wealth possible in Canada today,[11] we find that Canadian development was on an unsustainable path twice in the years from 1980 to 2015: first from 1988 to 1992 and again from 2008 to 2012. Real comprehensive wealth per capita as measured by the National Comprehensive Wealth Index (NCWI) (which was noted in the previous chapter to be a nearly ideal indicator of sustainability) declined steadily during both of these periods (Figure 1).

During the first period (1988–1992), all elements of the NCWI that could be measured for this report showed declines or stagnation. The decline in the second period was concentrated in the areas of natural, human and financial capital, with produced capital growing (though slowly) during that period (see Table 1 in Section 3.2).

The second decline may well have continued beyond 2012 to 2015 (and further) had it not been for unprecedented growth in one element of Canada's comprehensive portfolio—financial capital—that began in 2013. This growth was the result of historically strong gains in Canadians' foreign stock holdings—most notably U.S. equities—and declines in the value of the Canadian dollar. It was not, it should be noted, the result of increased Canadian foreign investment, which was negative in net terms from 2008 to 2015 (and since).

Given the above trends (which are discussed in much more detail in the remainder of the report), our view is that Canadian development could be characterized as fragile at best after the 2008 global financial crisis, with atypical trends in financial markets accounting for most of the growth in comprehensive wealth from 2009 to 2015. At worst, development was clearly unsustainable, with comprehensive wealth declining in real per capita terms in five out of the seven years from 2008 to 2015. Though complete data to assess more recent years were not available for this study, those that were suggest that development remained fragile and/or unsustainable after 2015 (see Text Box 3 for a discussion of sustainability in the years prior to 2008.)

[11] As discussed further in Text Box 4 and Annex 1, it is not possible to include social capital and some types of market natural capital (commercial fish and water resources) at this time in our analysis.

It is worth noting that this view, which can only be arrived at by a detailed consideration of trends in comprehensive wealth, contrasts with the view of Canada's progress offered by GDP. By that measure, Canada has performed quite well since 2008, with real GDP per capita increasing at an average annual rate of 1.3 per cent from 2009 to 2015. The diverging views offered by these two measures supports our contention that both are necessary in the assessment of national progress.

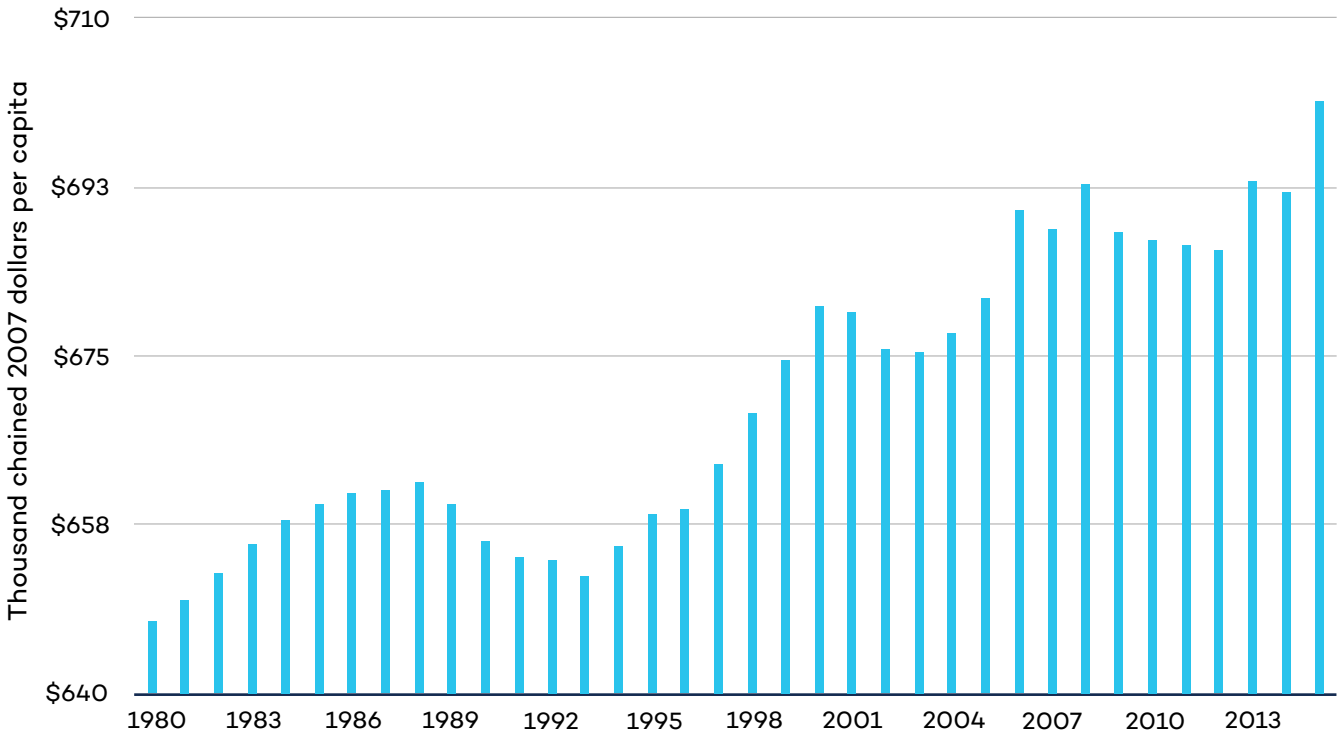

Figure 1. National Comprehensive Wealth Index (scale adjusted for emphasis), 1980–2015

Source: Current study based on Statistics Canada and other data sources (see Annex 1).

Additional evidence of fragility in Canada's development—and therefore in Canadians' well-being—is revealed through a more detailed look at the comprehensive wealth portfolio using both the sub-indexes of the NCWI and non-monetary indicators of non-market natural capital (ecosystems and the climate) and social capital. The trends in these measures reveal long-term shifts in the nature and distribution of Canada's assets that make wealth (and, ultimately, well-being) less resilient to external shocks:

- Canada's largest and most important asset[12]—its human capital—did not grow in real per capita terms from 1980 to 2015, raising questions about how well equipped the workforce is to deal with the challenges faced by the economy: low productivity growth, the need for innovation and economic diversification and U.S. protectionism, to name a few.
- Canada's investments in produced capital (like buildings and machinery), while growing substantially in real per capita terms over the period, became increasingly concentrated in just two areas: housing and oil and gas extraction infrastructure. By 2015, 25 per cent of all business sector-produced capital was invested in oil and gas extraction, up from 9 per cent in 1980.

[12] On average from 1980 to 2015, human capital accounted for 78 per cent of national comprehensive wealth.

- Canada's market natural assets (minerals, fossil fuels, timber, agricultural land and built-up land), traditionally a backbone of the country's wealth, declined in real per capita terms by 17 per cent from 1980 to 2015 as a result of physical depletion of 15 of 19 of Canada's key natural resource assets (see Table 5 on page 47 for details). The value of Canada's oil and gas assets fell precipitously in 2015 (83 per cent in nominal terms) on the heels of the drop in oil prices. While oil prices are notoriously volatile (and have since regained some of their losses), current trends in global energy markets suggest that oil prices are likely to trend downward in the long term, raising the risk of stranding some of the 25 per cent of Canada's business sector-produced assets invested in oil sands extraction.
- Canada's key ecosystems—forests, wetlands, grasslands and lakes/rivers—declined in physical extent (though modestly in comparison to their size) and became increasingly impacted by human development. Climate variables evolved consistently with the predictions of climate change, meaning that the climate system's weather-regulating benefits declined and adding another layer to the threats facing ecosystems and the wealth they represent.
- In a positive trend, the real per capita value of Canada's net foreign financial assets grew more quickly than net foreign financial liabilities, with assets outstripping liabilities in 2015. This meant that non-residents, likely for the first time in Canada's history, had no claim on Canadian income and Canadians had a claim on some of the income generated elsewhere. The importance of this historic development was tempered, however, by the fact (noted above) that growth in net foreign financial assets relied on unprecedented trends in foreign stock markets and Canadian-dollar exchange rates rather than on actual investments.
- Canadian households took on unprecedented levels of debt, shifting their investments toward housing and away from financial assets, inflating house prices and leaving the rest of the economy reliant on foreign lenders for nearly three quarters of investment flows after 2012. The last time the Canadian economy relied on foreign sources for such a large share of investment was in the mid-1960s.
- Canada's social capital appeared to hold steady, but not grow, over the period, with various indicators of civic engagement and trust/cooperative norms showing differing trends. Diversity in social networks and trust in institutions showed steady increases, while voter turnout in federal elections generally declined (rebounding somewhat in the two most recent elections). Other social capital indicators showed little change in either direction over the period.

As a result of the above trends, Canada's comprehensive wealth portfolio could suffer additional losses from relatively small and foreseeable changes in economic, environmental or social conditions. The most likely of these—rising interest rates and a cooling of the housing market—began to play out at the end of 2017 with consequences yet to be determined at the time of writing.

Text Box 3. Contingent versus absolute sustainability

Outside the period of clearly declining comprehensive wealth from 1988–1992, we find that Canadian development was *contingently* but not *absolutely* sustainable in the years between 1980 and 2007, since consumption grew much more quickly than growth in comprehensive wealth alone would support, however.[a] Comprehensive wealth was essentially stable or slowly growing during the years 1980–1987 and 1993–2007, providing a basis only for stable or slowly growing consumption. This meant that other factors were at play in increasing consumption during these years, and development could not be said to be absolutely sustainable.

One factor that played a role in allowing consumption to grow faster than wealth was the rapid expansion of household debt that began after 1997. By 2015, the household sector had taken levels of debt never before seen in Canada. That growing indebtedness helped households regularly spend above their means during those years.

Other factors that may have played roles in allowing consumption to outstrip wealth include improved terms of trade for natural resources; realization of profits on houses and financial assets; the effects of an aging population moving into retirement and spending its savings; and, less benignly, weak investment in produced, natural and human capital. The assessment of sustainability during the years 1980–1987 and 1993–2007 is contingent on assessing the role these other factors played in supporting consumption. Though an analysis of that scope was beyond what was possible in this study, Annex 3 provides some discussion in that direction.

[a] We define absolute sustainability as the situation in which the observed value of national comprehensive wealth is sufficient to generate the observed value of national income given the prevailing rate of return on capital in the economy (allowing for growth in productivity) at all points in time.

3.1.2 Recommendations

Viewed through the lens of comprehensive wealth, we believe the long-term sustainability of well-being in Canada faces challenges that should not be ignored. Looking at the big picture, comprehensive wealth was either declining or growing on a narrow basis from 2008 to 2015 and probably beyond. Looking more closely, among other trends, human capital has been stagnant since 1980; produced capital is increasingly concentrated; many market natural resources have been depleted; and climate change represents a broad threat to sustainability. The overall portrait is, in our view, one of fragility. Given this, a number of areas emerge where action could be taken to increase the resilience of Canada's comprehensive wealth portfolio.

Increase human capital, especially for young workers: As for all developed countries, human capital is Canada's most important asset, accounting for some 80 per cent of comprehensive wealth. It is a particular concern, then, that per capita human capital did not grow at all in Canada from 1980 to 2015. The reasons for this are not fully clear. Aging of the population certainly played a part, though other countries with aging populations have managed to increase their human capital. The concern is amplified by the fact that the trend in human capital was weakest among young workers. Since young workers eventually take over from older workers, it is essential that they not have lower human capital than those they replace. It would be all too easy to allow this to happen, as early life experiences do much to shape later success. As the governor of the Bank of Canada has said, a long period of unemployment for a young worker can leave a scar that lasts "a lifetime" (Poloz, 2017). Not just unemployment but also underemployment is a concern for young workers in Canada today.

Continue addressing the challenges of climate change: Climate change is one of the most serious threats to well-being in Canada and globally. It has the potential to disrupt nearly every aspect of the economy, the environment and society; everything from agriculture to forestry, water, infrastructure, human health, transportation and species distribution is at risk. Viewed through the comprehensive wealth lens, climate change poses particular risks to natural capital but threatens the value of produced, human, financial and social capital as well. We therefore strongly support current federal and provincial efforts to price carbon as part of Canada's contribution to the Paris agreement on climate change. Even if the global community succeeds in its Paris goals, however, the world is committed to some warming. That is why we recommend action to protect Canada's comprehensive wealth portfolio from losses in value due to the impacts of climate change by increasing the resilience of assets. Infrastructure such as transportation networks, ports and buildings needs to be designed and built with flooding and other extreme weather in mind. Crops need to be developed in anticipation of the rainfall patterns of the future, not today's. Cities need to be prepared to deal with wider extremes of heat and cold for their vulnerable populations.

Diversify natural and produced capital: Our analysis reveals two areas where there was substantial concentration of Canada's comprehensive wealth portfolio between 1980 and 2015: market natural capital and produced capital. In the case of market natural capital, Canada's sub-soil asset mix moved away from a broad suite of minerals and conventional oil, gas and coal assets toward a focus on oil sands and potash. Concentration on just a few resources is questionable for any country, particularly one for which resource development has traditionally been so important. It is all the more questionable given current trends in global energy markets, with Canada's oil sands facing supply-side competition from rapid growth in U.S. oil and gas production and renewables and weakening growth in fossil fuel use on the demand side.

In terms of produced capital, Canada's asset mix moved heavily toward two assets: houses and oil and gas extraction infrastructure. The combined share of houses and oil and gas extraction infrastructure in economy-wide produced capital grew from 45 per cent to 60 per cent. Looking at just business-sector produced capital, oil and gas infrastructure grew from 9 per cent to 25 per cent. Greater action to encourage investment in other industries is needed. To this end, we support the federal government's infrastructure investment strategy but note that businesses need to step up and do more as well.

Encourage households to start lending again: Prior to 1997, the Canadian household sector routinely saved enough that it had money left over to lend to other parts of the economy. Since then, the sector has routinely spent all of its disposable income—and then some—leaving the majority of lending in Canada to come from non-residents. Excessive borrowing from foreign lenders worsens Canada's financial capital situation and lowers comprehensive wealth, other things being equal.

As the household sector reduced its saving rate, it also changed its investment focus, putting more of its eggs in the real estate basket and fewer in financial assets like stocks and bonds. Not only did this reduce household liquidity—a concern now that interest rates have begun to rise—but it also shifted investment away from relatively more productive assets like corporate equities.

Overall, sustainability of well-being in the long term would be better served if households were less leveraged and held more balanced asset portfolios. We therefore support the policies put in place in late 2017 to cool the housing market. These, we believe, should be complemented with policies to encourage more households to invest in financial assets.

Pay greater attention to social capital: Social capital is arguably the most complex and least understood element of the comprehensive wealth portfolio. It is also facing wide-ranging pressure today, as traditional concepts of family, community and nationhood are challenged and reinvented, fueled by the instantaneous flow of information and ideas of the information age. The need to measure social capital has never been greater. While Statistics Canada already measures some of its elements, its data are infrequent and incomplete.

Canada is fortunate to have some of the most respected social capital researchers in the world, including John Helliwell at the University of British Columbia and Christopher Barrington-Leigh at McGill University, among others. These experts are making good headway in defining and measuring social capital and understanding its role as a form of wealth. Their work deserves greater attention and support.

Measure and report comprehensive wealth: Dealing with the challenges faced by Canada's comprehensive wealth portfolio is, it goes without saying, complex. It is not made any easier by the fact that data on comprehensive wealth are not regularly measured and reported in Canada (or anywhere, for that matter). In contrast, GDP—which tells a different and more positive story about progress in the last decade—is published regularly by Statistics Canada, widely reported by the media and commonly used to guide public and private decision making alike.

Our final recommendation, then, is that Statistics Canada be funded by the federal government to begin regular compilation and reporting of comprehensive wealth. As with GDP and many other influential indicators, comprehensive wealth measures should be reported on a quarterly basis. The measures should cover all elements of the comprehensive wealth portfolio: produced, natural, human, financial and social capital. To the extent possible, they should be compiled in monetary terms so that they can be combined into a single index as in this study. The index should be complemented with non-monetary indicators for assets—like non-market natural capital and social capital—that cannot or should not be measured in monetary terms.

Statistics Canada is arguably better positioned than any other nation's statistical agency to take on this role. It already publishes complete and high-quality data on produced and financial capital on a quarterly basis. Uniquely among statistical agencies, it also measures some natural capital on a quarterly basis, though these measures are incomplete; notably, estimates for the value of commercial timber, fish and water are not produced by the agency. Statistics Canada does not regularly measure human or social capital, though it has done extensive research and published research studies on both. Presumably that work could serve as the basis for regular reporting in those areas. The measurement of comprehensive wealth is truly an area where Canada could show international leadership with relatively modest investments to improve existing data.

Of course, simply publishing estimates of comprehensive wealth would do nothing to assure the sustainability of Canadians' well-being. The measures would have to be used to guide decision making, just as GDP and other indicators are used today. With comprehensive wealth measures in place, decision-makers would have a more balanced perspective on progress. No longer would short-term growth in income be, by default, the main focus of attention. It would be complemented by an equally important focus on the asset base underlying Canadians' well-being and its maintenance. In Section 3.8 at the end of this chapter, we offer a simple example of what this might look like, using Ontario's proposed Ring of Fire chromite development as an example.

3.2 Detailed Trends in Overall Comprehensive Wealth[13]

The most comprehensive measure of wealth that can be compiled for Canada today—what is called here the National Comprehensive Wealth Index (NCWI)—grew 8.4 per cent in total over the 35 years from 1980 to 2015. Text Box 4 defines the NCWI and its limitations (most notably, its exclusion of social capital) in more detail.

In 1980, the NCWI stood at $647,000 per Canadian (2007 dollars).[14] By 2015, it had risen to $701,000, for an annual average growth rate of 0.23 per cent.

Looking at the individual elements of the comprehensive wealth portfolio, **human capital**—the largest of Canada's assets by far—was nearly flat over the period. The average Canadian held just slightly less human capital in 2015 ($496,000) than in 1980 ($498,000).

Market natural capital declined at a relatively steady rate of 0.50 per cent annually, from $103,000 to $86,000 per capita, for a total decline of 16.5 per cent over the period.

Produced capital increased 1.47 per cent annually, also relatively steadily, from $67,200 to $112,000 per capita (a total increase of 66.7 per cent).

Financial capital increased sharply over the period, rising from -$12,300[15] to $9,000.

We find **social capital**, which cannot yet be valued in monetary terms and, therefore could not be included in the NCWI, to be stable but not growing on the basis of a series of non-monetary indicators.

Our analysis also considers **non-market natural capital** that should not or cannot[16] be evaluated in monetary terms: ecosystems and the climate system. On the basis of a series of non-monetary indicators, we find that **ecosystems** declined in both extent and quality and the **climate system** evolved in line with the predictions of climate change.

Our overall findings are summarized in Figure 2, Table 1 and Table 2 and discussed further in the remainder of this section. They are based on the most up-to-date concepts, methods and data available today (see Annex 1 for further details) and are generally corroborated by comparison with the few other studies of comprehensive wealth that have considered Canada (see Annex 2 for further details). The remaining sections in this chapter discuss the individual elements of the comprehensive wealth portfolio in considerable detail.

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13 **Note to readers:** The discussion in this section is technical and assumes some prior knowledge of the subject. Readers unfamiliar with the concepts and data involved might wish to read Sections 3.3 to 3.7 first.

14 All wealth figures in this report are quoted in real—that is, inflation-adjusted—per capita terms using chained 2007 dollars as the unit of measure, unless otherwise indicated.

15 The average Canadian had negative financial capital in 1980. This was possible because, unlike other forms of capital, financial capital includes both assets and liabilities. When financial capital is negative, it means that liabilities are larger than assets. Financial capital and the role it plays in comprehensive wealth are discussed in more detail in Section 3.6 and in Indicator FC1 in Chapter 4.

16 See Section 2.4 for a discussion of where monetary valuation is and is not appropriate in measuring comprehensive wealth.

Text Box 4. The National Comprehensive Wealth Index – Basic definition and limitations

The NCWI measures the real (inflation-adjusted) per capita value of Canada's aggregate produced, natural, human and financial capital. It is constructed as a weighted index of the various assets that make up the produced, natural, human and financial capital portfolios.

More technically, it is a Törnqvist volume index constructed from several sub-indexes: the Fixed Capital Index; the Inventory Index; the Market Natural Capital Index; the Human Capital Index and the International Investment Position index (see indicators PC1, PC2, NC1, HC1 and FC1 in Section 4 for further details of these sub-indexes). The NCWI is a close variant of the Fisher volume indexes Statistics Canada uses to report growth in GDP.

Ideally, it would have been possible to include social capital in the NCWI as well, but the concepts, methods and data required to place a monetary value on social capital have not yet been fully developed. Work in that direction is progressing, however (Hamilton et al., 2016), so future versions of the NCWI may incorporate social capital. For now, social capital is assessed here on the basis of non-monetary indicators (see indicators SC1 to SC9 in Chapter 4).

The other major gap in the NCWI is the exclusion of two forms of market natural capital (commercial fish resources and commercial water resources such as hydroelectric reservoirs) due to gaps in data and methods.

A fuller discussion of the assets missing from the NCWI is found in Annex 1.

Indicator CW1 in Chapter 4 offers a basic discussion of the NCWI methodology; Annex 8 covers the methodology in more detail. IISD's 2016 report on comprehensive wealth (especially Part I) provides a more detailed discussion of what comprises the NCWI (where it was simply called the Comprehensive Wealth Index).

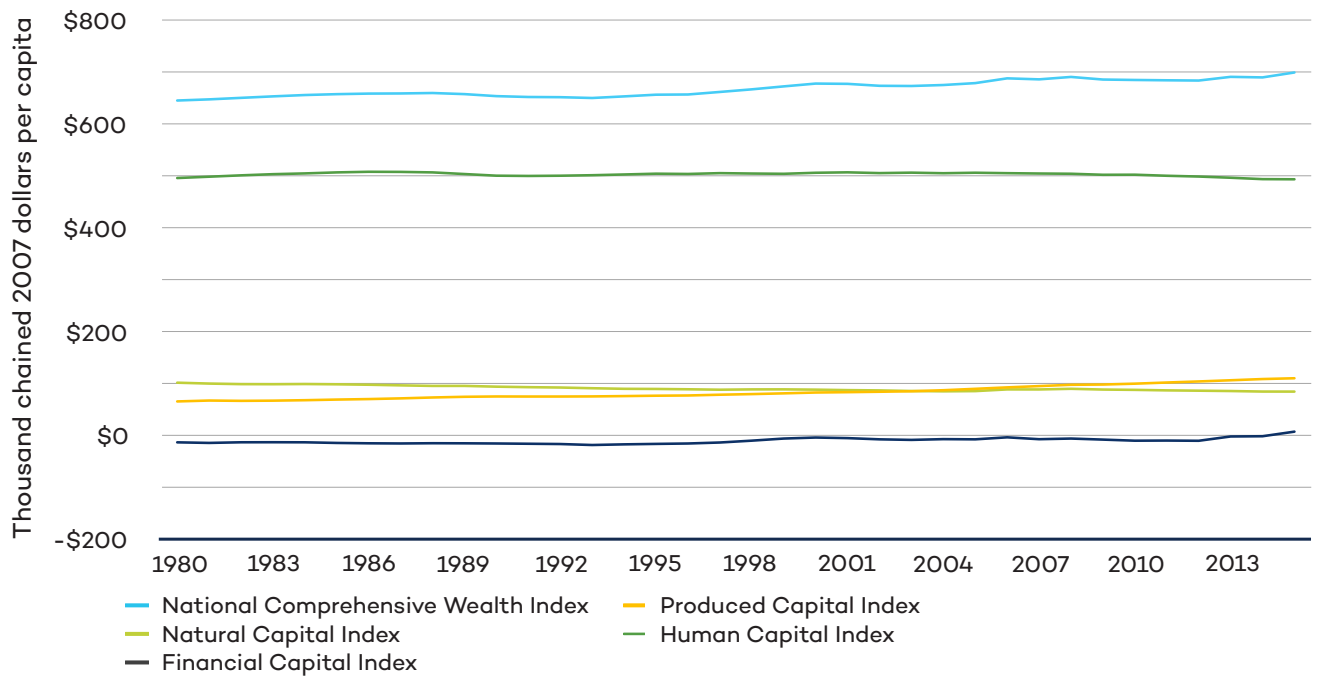

Figure 2. National Comprehensive Wealth Index and component sub-indexes, Canada, 1980–2015

Source: Current study based on Statistics Canada and other data sources (see Annex 1).

Table 1. National Comprehensive Wealth Index and component sub-indexes, Canada, 1980–2015

Year	NCWI	Produced Capital Index	Natural Capital Index	Human Capital Index	Financial Capital Index	Year	NCWI	Produced Capital Index	Natural Capital Index	Human Capital Index	Financial Capital Index
	Thousand chained 2007 dollars per capita						Thousand chained 2007 dollars per capita				
1980	$647	$67.2	$103	$498	$(11.6)	1998	$669	$81.4	$90.4	$507	$(8.4)
1981	$650	$68.9	$102	$500	$(12.8)	1999	$675	$82.8	$90.5	$506	$(4.3)
1982	$652	$68.4	$101	$503	$(11.5)	2000	$680	$84.4	$89.9	$508	$(2.4)
1983	$655	$68.7	$100	$505	$(11.4)	2001	$679	$85.1	$89.0	$509	$(3.5)
1984	$658	$69.6	$101	$507	$(11.6)	2002	$676	$85.9	$88.5	$507	$(5.8)
1985	$660	$70.8	$100	$509	$(12.8)	2003	$675	$86.8	$87.3	$508	$(6.9)
1986	$661	$71.8	$99.4	$510	$(13.5)	2004	$677	$88.8	$86.7	$507	$(5.5)
1987	$661	$73.1	$98.2	$510	$(13.8)	2005	$681	$91.5	$87.1	$508	$(5.8)
1988	$662	$74.9	$97.2	$509	$(13.3)	2006	$690	$94.3	$90.4	$507	$(2.0)
1989	$660	$76.2	$97.2	$506	$(13.5)	2007	$688	$96.8	$90.3	$507	$(5.6)
1990	$656	$76.8	$95.7	$502	$(13.8)	2008	$693	$99.3	$91.6	$506	$(4.3)
1991	$654	$76.7	$94.7	$502	$(14.4)	2009	$688	$99.8	$90.1	$504	$(6.4)
1992	$654	$76.7	$94.0	$502	$(14.9)	2010	$687	$101.5	$89.5	$504	$(8.5)
1993	$652	$76.9	$92.7	$503	$(16.8)	2011	$686	$103.7	$88.6	$502	$(8.2)
1994	$655	$77.5	$91.6	$505	$(15.5)	2012	$686	$105.8	$88.0	$501	$(8.6)
1995	$659	$78.3	$91.3	$506	$(14.7)	2013	$693	$108.0	$87.3	$498	$(0.3)
1996	$659	$78.7	$90.7	$506	$(13.9)	2014	$692	$110.4	$86.3	$496	$0.1
1997	$664	$80.2	$89.8	$507	$(12.0)	2015	$701	$111.9	$86.2	$496	$9.0

Source: Current study based on Statistics Canada and other data sources (see Annex 1).

Table 2. Summary of trends in the elements of the comprehensive wealth portfolio, Canada, 1980–2015

Indicator	Per capita level in 1980	Per capita level in 2015	Annual growth rate 1980–2015
	Chained 2007 dollars		
National Comprehensive Wealth Index	$647,000	$701,000	0.23 per cent
Produced Capital Index	$67,200	$112,000	1.47 per cent
Market Natural Capital Index	$103,000	$86,000	-0.50 per cent
Financial Capital Index	-$11,600	$9,000	N/A
Human Capital Index	$496,000	$495,000	-0.01 per cent
Non-market natural capital	n/a	n/a	Unknown, but available non-monetary indicators suggest declines in key ecosystems and the climate system
Social Capital	n/a	n/a	Unknown, but available non-monetary indicators suggest stability

Source: Current study based on Statistics Canada and other data sources (see Annex 1).

3.2.1 The NCWI in More Detail

Looking at the trend in Canada's NCWI more closely, several features stand out. First, the long-term trend, though upward, was weakly so. Growth in the NCWI was below what other advanced countries achieved during similar time periods. Using methods similar to ours (see Annex 2 for details), the global *Inclusive Wealth Report 2018* (Managi and Kumar, 2018) found that comprehensive wealth grew on average by 1.18 per cent in other G7 countries from 1990 to 2014; we find that it grew at a rate of 0.13 per cent in Canada during those years.

Second, movement in the NCWI was not uniformly upward (this is more easily seen in Figure 1 earlier in which the scale was adjusted to make the year-to-year movements more apparent). The index generally declined during three periods: 1988–1993; 2000–2004 and 2008–2012. The first of these can be linked to the 1990–1991 recession. The second corresponds to the end of the dot-com stock market boom and the third corresponds to the end of the long rise in oil prices that began in the late 1990s as well as the global financial crisis of 2008.

The final feature of note is that rate of change in the last few years of the time series–specifically from 2013 to 2015–was unusually large. The NCWI grew by more in 2013 and 2015 (1.04 per cent and 1.37 per cent) than in any other year from 1980 to 2015, with the exception of 2006 (when it grew by 1.35 per cent). What sets 2013–2015 apart was the historically rapid growth in the value of Canada's financial capital; more precisely, growth in the value of its net holdings of foreign financial assets (see Text Box 5 for an explanation of financial capital and its relation to comprehensive wealth).

In 2012, Canadians held -$8600 in net foreign financial assets per capita; by 2015, this figure had grown (and changed sign) to $9,000. This meant that, likely for the first time in the country's history,[17] Canadian net holdings of foreign financial assets had outstripped non-resident net holdings of Canadian financial assets. This switch was the result of historically strong growth in the U.S. stock market and declines in the value of the Canadian dollar, both of which increased the value of Canada's foreign assets. It was not the result of increased net holdings of foreign financial assets, as non-residents bought more Canadian financial assets than Canadians bought foreign financial assets during this time. Thus, while positive from the perspective of Canadians who owned foreign assets in their pension funds and other investments, the growth in the NCWI was driven by financial market trends that were atypical.

[17] See Section 3.5.2 for an explanation why this switch was likely historic.

Text Box 5. The role of financial capital in comprehensive wealth

Since financial capital is made up of both assets and liabilities, its contribution to comprehensive wealth is more complex than for other types of capital (for which the concept of liabilities does not apply).

For every financial asset, there is always a corresponding liability of equal size; for example, a savings account held by an individual is an asset (positive) for the individual but a liability (negative) for the bank where it is held. Together, the individual's asset and the bank's liability sum to zero. If the individual and the bank in question are both Canadian, then the funds in the bank account make no net contribution to Canada's comprehensive wealth, as they cancel one another out.

If one of them is non-Canadian, however, there is an impact on Canada's comprehensive wealth. If, say, the individual is Canadian and the bank is foreign, the funds in the account make a net contribution (positive) to Canada's wealth. If, vice versa, the bank is Canadian and the individual is foreign, the opposite is true.

Thus, the only financial capital that contributes to comprehensive wealth at the national level is the net foreign financial assets owned by Canadians; that is, the difference between the value of foreign financial assets (less foreign liabilities) owned by Canadians and Canadian financial assets (less liabilities) owned by non-residents.

This net value is referred to in statistical terms as Canada's "international investment position." It represents the claim that Canadians have on the income of other countries (when positive) or (when negative) the claim others have on Canadian income. In other words, when they hold more net foreign financial assets than non-residents hold net Canadian financial assets, Canadians are entitled to a flow of income from other countries proportional to the size of their net holdings. Correspondingly, when non-residents hold more net Canadian assets than Canadians hold net foreign assets, non-residents are entitled to a share of Canada's income.

Further details are provided in Section 3.5, especially Section 3.5.1.1, and in Indicator FC1 in Chapter 4.

3.2.2 Domestic Versus National Comprehensive Wealth

The discussion of financial capital just above provides a useful point to introduce the distinction between *national* and *domestic* comprehensive wealth.

National comprehensive wealth consists, as outlined above, of all five elements of the comprehensive wealth portfolio: produced, natural, human, financial and social capital, with financial capital represented by net foreign financial assets. *Domestic* comprehensive wealth, in contrast, comprises only four of the five, leaving out net foreign financial assets.

Domestic comprehensive wealth, therefore, represents the wealth bound up in just those assets found within the geographic boundaries of Canada. In adding net foreign financial assets, national comprehensive wealth represents the wealth bound up in domestic assets plus the wealth represented by Canada's claim on income generated in other countries or, vice versa, other countries' claims on income generated in Canada.

Though the DCWI is the narrower of the two measures, it is the produced, natural, human and social capital assets of the domestic comprehensive wealth portfolio that drive the production of goods and services—both market and non-market—within Canada. Domestic comprehensive wealth is, therefore, the *productive base* upon which income, consumption and, ultimately, well-being for most Canadians are founded.[18]

National comprehensive wealth is also relevant to well-being, of course, since the claim on foreign income represented by net foreign financial assets provides for increased consumption (or decreased if it is other countries that have a claim on Canada's income). For most Canadians, however, the gain/loss in income associated with financial capital is small relative to overall income, so national comprehensive wealth does not reveal much about well-being that is not already captured in domestic comprehensive wealth. Moreover, financial capital contributes to well-being only in the form of increased capacity for consumption of market goods and services and then only for those Canadians who own foreign financial assets. Financial capital can also be quite volatile, as it is sensitive to changes in relative rates of growth in the value of Canadian and foreign currencies and securities markets.

Making a distinction between the national and domestic variants of comprehensive wealth here is useful not only because they represent different capital bases to draw upon and impact well-being in different ways, but also because there happen to be noteworthy differences between the trends in the two. It is therefore worth considering trends in domestic and national comprehensive wealth separately; this is done in Figure 3 and in the discussion that follows.

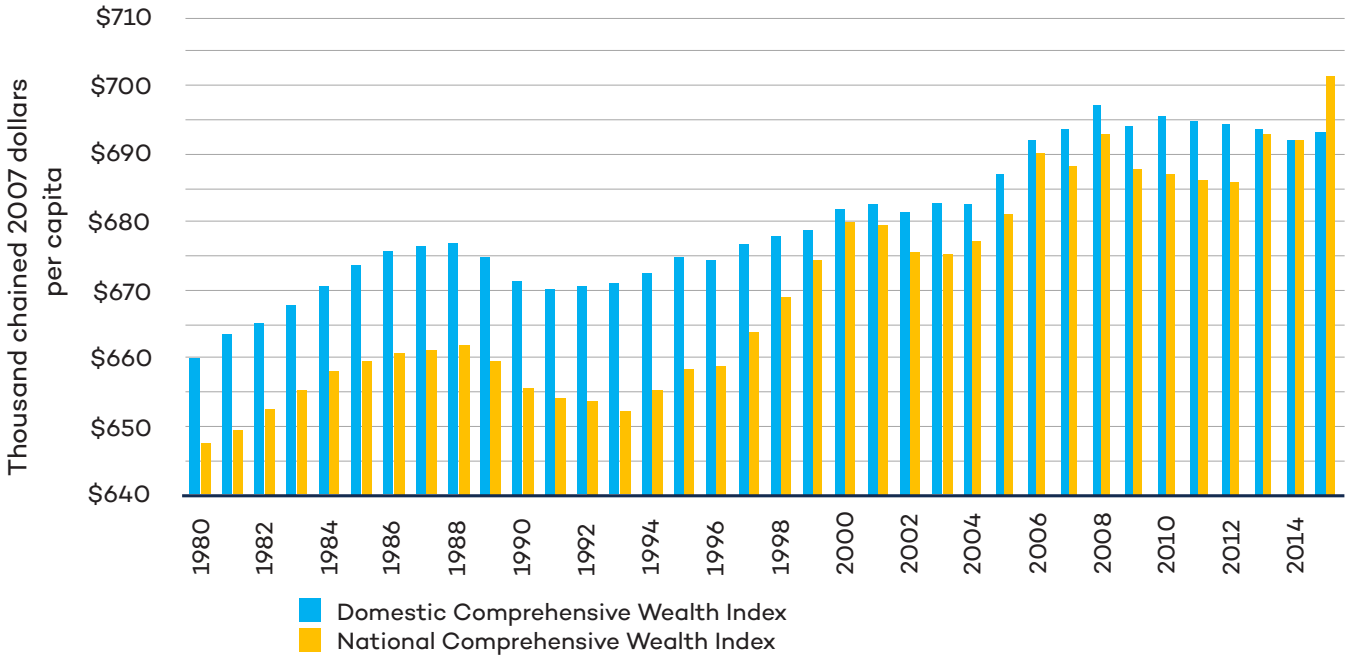

Figure 3. Domestic CWI, National CWI, Canada, 1980–2015

Source: Current study based on Statistics Canada and other data sources (see Annex 1).

As Figure 3 shows, the Domestic Comprehensive Wealth Index (DCWI) was consistently larger (by 0.5 to 3 per cent) than the NCWI for most of the period from 1980 to 2015. The exceptions were the years

[18] It is worth recalling here how well-being was defined in Chapter 2 (see Section 2.3); that is, as the benefits arising from the consumption of the various market and non-market goods and services produced using the assets of the comprehensive wealth portfolio.

2013 to 2015, when the NCWI was essentially equal to or greater than its domestic counterpart. This is explained by the fact mentioned earlier that the value of Canadian foreign financial asset grew rapidly after 2012. In all other years studied here (and likely in all years prior as well), non-residents held more Canadian financial assets than vice versa and national comprehensive wealth was, therefore, smaller than domestic comprehensive wealth. What this meant was that until 2015 non-residents had a claim on some of the income that Canada's domestic comprehensive wealth generated. From the point of view of well-being, then, the switch to positive net foreign financial assets was a boon, meaning that Canadians were able to keep all of the income generated from their domestic comprehensive wealth in addition to having a claim on some of the income generated by other countries.

Looking at the trends in domestic versus national comprehensive wealth more closely, it is apparent that the drop in the NCWI from 2000–2004 all but disappears from a domestic perspective. The DCWI declined slightly around this time but not by nearly as much, or for as long, as the NCWI. The decline in comprehensive wealth resulted mainly from the impact of the dot-com bust on the foreign financial assets owned by Canadians. This had a substantial effect on the NCWI but little impact on Canada's domestic assets and, therefore, on the DCWI.

Setting aside the minor downturn in the DCWI during the dot-com bust, then, Canadian domestic comprehensive wealth underwent two periods of persistent declines from 1980 to 2015: 1988–1992 and 2008–2014. These same periods also appear as downturns in the NCWI (though the latter period was shorter in the national context—four years rather than six) and it is these two periods that we focus on in the discussion that follows.

Lines representing real net national income (NNI) per capita[19] and real final consumption expenditure per capita have been added in Figure 4 below to provide context for the discussion, since, as noted above, comprehensive wealth is the basis for income, consumption and, ultimately, well-being.

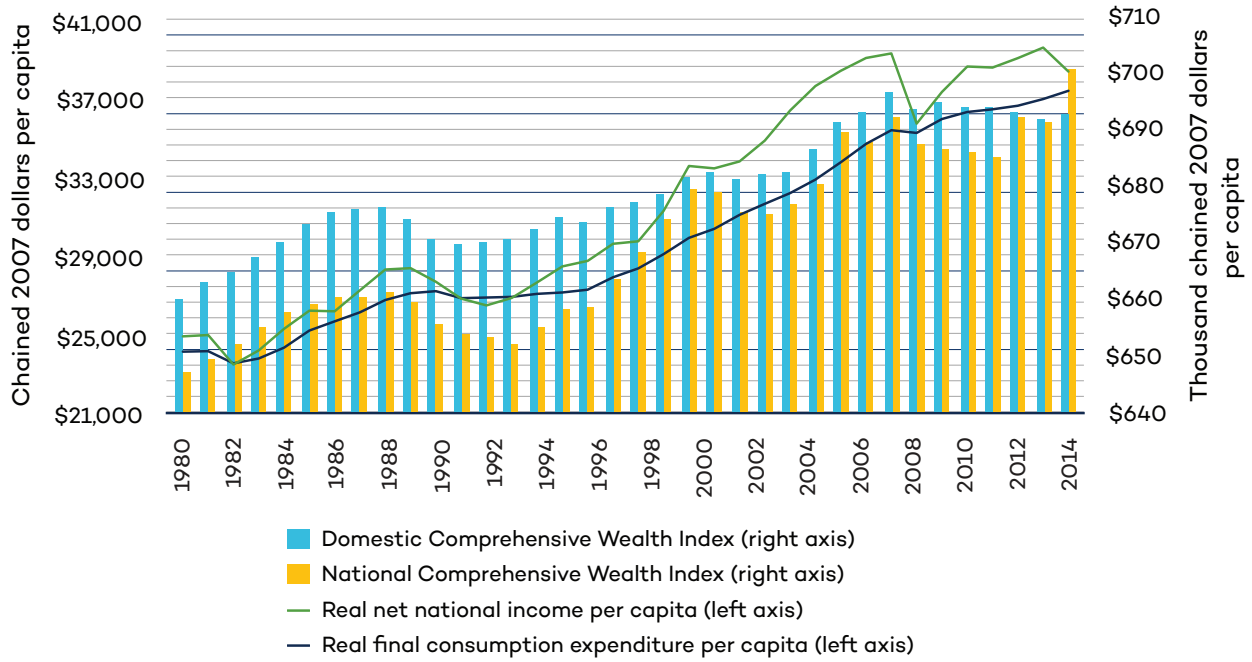

Figure 4. Domestic CWI, National CWI, real net national income per capita and real final consumption expenditure per capita, Canada, 1980–2015

[19] Net national income is equal to GDP plus net foreign primary income less consumption of fixed capital.

3.2.3 Evidence of Unsustainability and Lost Resilience in More Detail[20]

3.2.3.1 Declining Real Comprehensive Wealth per Capita

As outlined in the previous chapter (Section 2.3.1), comprehensive wealth is in theory a nearly ideal indicator of sustainability. When real comprehensive wealth per capita is stable or rising, development is likely on a sustainable path. When it is falling, development—and well-being—are unsustainable over the long term.

On their own, then, the two periods of decline in the NCWI and the DCWI are theoretical signals that development was on an unsustainable path during those years. The fact that the downturns were prolonged (four years and four to six years depending on which index one considers)[21] suggests that the forces underlying them were well entrenched. It is worth noting that a decline in GDP much shorter than four to six years would be reason for the public, journalists and policy-makers to raise concerns and call for action to change economic course. Just six months of consecutive declines in real GDP is the accepted definition of a recession—and recessions always attract a great deal of attention.

In the case of the DCWI, it is likely that the index did not stop declining entirely after 2014. Though it grew in 2015 by 0.16 per cent, data available at the time of writing indicate that real per capita human capital declined again in 2016[22] and that real per capita non-residential produced capital stocks declined for the first time since the early 1990s. Missing natural capital data make it impossible to be certain whether the index fell in 2016 or not but it seems likely it did; there is no particular reason to believe that stocks of natural capital increased from 2015 to 2016 given their long downward trend up to 2015. Thus, in the case of the DCWI, it may well be that Canada saw nearly continual declines for eight or more years following the 2008 global financial crisis.

For its part, it is almost certain that the NCWI fell in 2016 after its rises in 2013 and 2015, since the real per capita value of Canada's financial capital dropped by almost half from 2015 to 2016 due to changing financial market conditions. Financial capital climbed back to its 2015 level again in 2017, however, reflecting the volatility of markets.

3.2.3.2 Diverging Trends in Wealth, Income and Consumption

Since income is the return on wealth, and consumption of goods and services is a function of income, it is expected that the trends in wealth, income and consumption should be similar. Looking at Figure 4, however, this was not always the case in Canada between 1980 and 2015, especially not during the second (post-2007) downturn in wealth.

Considering first at the initial downturn in comprehensive wealth from 1988 to 1992, real NNI per capita declined almost concurrently with wealth[23] and began growing again when wealth did in 1993. From 1988 to 1992, the NCWI and DCWI declined by 1.22 per cent and 0.93 per cent in total respectively, while real NNI per capita declined by 6.67 per cent in total. Real final consumption expenditure per capita, for its part, did not decline from 1988–1992, but its growth slowed and then stopped almost entirely, not recovering until 1997.

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20 This section expands on the discussion already presented in Section 3.1.1.

21 Though the post-2007 decline in national comprehensive wealth was not as prolonged as that in domestic comprehensive wealth—four years instead of six—the reasons why national wealth began growing again in 2013 had, as mentioned above, less to do with strength in the Canadian economy than they did with strength in the U.S. economy. See the discussion in Section 3.6.1.1 for further details.

22 Human capital peaked in real per capita terms at $509,000 in 2001. Subsequently, it fell in every year but three until 2016.

23 It is interesting to note that both the DCWI and NCWI began falling a year before NNI (and GDP), so the signal that something was "wrong" with the economy would have come earlier had either of those measures been tracked at the time.

The trends in income and consumption during the post-2007 downturn were different. Real NNI per capita dropped substantially (9.31 per cent) in 2009 (the peak year for fallout from the global financial crisis) but then started growing again rapidly in 2010, regaining its 2008 level by 2014. Real final consumption expenditure per capita, for its part, hardly stopped growing at all during the second downturn (with a brief drop of 0.40 per cent in 2009), though its rate of growth (0.98 per cent annually from 2008 to 2014) was slower than previously (2.47 per cent from 1997 to 2008). The NCWI and DCWI, for their parts, declined by 0.25 per cent and 0.12 per cent on average and by 1.01 per cent and 0.71 per cent in total respectively.

The fact that real NNI and, especially, consumption per capita continued to grow relatively strongly during the post-2007 downturn in comprehensive wealth raises a further question about the sustainability of Canada's development. Against the backdrop of declining real comprehensive wealth per capita, the rising per capita levels of income and consumption are counterintuitive. Given the relationship between income and wealth, it is not clear how Canada was able to manage growing levels of income and consumption on a declining wealth basis for so long. This question is relevant, in fact, not just to the post-2007 period but to the entire period of study years, as the 1980–2015 growth rates in real NNI per capita and real final consumption expenditure per capita (1.28 per cent and 1.3 per cent annually respectively) surpassed the annual growth of the NCWI and DCWI (0.23 per cent and 0.14 per cent respectively) by wide margins.

Part of the answer is found in what happened to debt over the same time period, especially household debt after 1997. As discussed in greater detail below (Section 3.5.3), growth in consumption from 1997 to 2015 was supported in part by rapidly growing levels of household—and, after the 2008 financial crisis, government—debt.[24] By 2015, the household sector had taken levels of debt never before seen in Canada and higher than those in many other developed countries.[25] That growing indebtedness helped households regularly spend above their means. Real household final consumption expenditure per capita exceeded real household disposable per capita income[26] in 2008, 2011 and 2014 and was very close to doing so in the other years between 2008 and 2015 (in fact, household consumption exceeded disposable income in all but five years from 1997 to 2015). This excess spending, in turn, boosted economic activity, creating more income and yet more opportunities for consumption.

Rising levels of household and government debt are not the only plausible explanations for the divergence between growth in income and growth in comprehensive wealth. Other possibilities, some of which are more benign in terms of their impact on well-being than others, include improved terms of trade for natural resources; realization of holding gains on houses and financial assets; the effects of an aging population moving into retirement and spending its savings; and, less benignly, weak investment in produced, natural and human capital. Annex 3 discusses the divergence between income and comprehensive wealth and its possible explanations in further detail.

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[24] Though Canadian governments have long histories of borrowing to support spending, the period 1997 to 2008 was unique in that governments were net borrowers in only two of those years (2002 and 2003). This was the result of significant efforts, especially at the federal level, to curtail spending in the name of reducing deficits and government debt. This ended in 2008, however, as governments began net borrowing again to support economic growth after the global financial crisis.

[25] It is worth noting that the build-up of household debt continues to this day.

[26] Disposable income is the amount of income available for spending on market goods and services or saving without the need to run down assets or incur liabilities. Final consumption is the amount actually spent by households and governments on goods and services. The difference between the two is saving, which can either be used to acquire new assets or be lent.

From the perspective of economic growth, households' debt-financed spending was a boon. Real GDP per capita grew 0.58 per cent annually on average from 2008 to 2014 despite the declines in wealth during those years. The extent to which this growth could be considered sustainable is another question, since it rested on continual, extended debt accumulation that was itself unsustainable. Still, anyone looking at GDP as a measure of progress during that time would have concluded that, overall, the economy was moving along well. In contrast, anyone looking at trends in the NCWI or DCWI—had they been available to look at—would have seen reason to raise concerns about falling levels of wealth and the potential for current or future losses in well-being.

It must be noted that concerns were raised during this period (and continue to be raised) about some elements of the comprehensive wealth portfolio, mainly produced and financial capital. The growth in household debt has, in particular, been the topic of much discussion, and policy action was taken in 2017, with early signs of success, to cool the housing market and bring household debt growth under control.[27]

Weak investment in produced capital has also been a topic of considerable concern, and the federal government has stepped up with a plan to invest in public infrastructure to help offset this.

The trends in natural, human and social capital remain much less well known and even less discussed, however. Overall, trends in wealth—especially the human, natural and social elements of comprehensive wealth that are not fully measured by Statistics Canada—still receive less attention than trends in GDP, employment, wages, prices and other short-term indicators. As a result, headlines remain dominated by generally positive news about economic growth,[28] and trends in wealth appear far less often on Canadians' radar screens.

The Resilience of Well-Being Has Been Reduced

On top of theoretical signals of unsustainability and income/consumption growth that were buoyed by unsustainable growth in household debt, Canada's comprehensive wealth portfolio has evolved in other ways since 1980 that have made well-being, if not strictly unsustainable, less resilient to external shocks. To reiterate the summary given in Section 3.1, we find that:

- Canada's largest and most important asset—its human capital[29]—did not grow in real per capita terms from 1980 to 2015, raising questions about how well equipped the workforce is to deal with the challenges faced by today's economy: improving productivity growth, the need for innovation and economic diversification and U.S. protectionism, to name a few.
- Canada's investments in produced capital (like buildings and machinery), while growing substantially over the period, became increasingly concentrated in just two areas: housing and oil and gas extraction infrastructure. By 2015, 25 per cent of all business-sector produced capital was invested in oil and gas extraction, up from 9 per cent in 1980.

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27 According to Statistics Canada, household debt as a share of disposable income began falling at the outset of 2018 after having peaked in the summer of 2017.

28 See, for example, Shmuel (2014) and Blatchford (2017).

29 On average from 1980 to 2015, human capital accounted for 78 per cent of national comprehensive wealth.

- Canada's market natural assets (minerals, fossil fuels, timber, agricultural land and built-up land), traditionally a backbone of the country's wealth, declined in real per capita terms as a result of physical depletion of 15 of 19 assets.[30] The value of Canada's oil and gas assets fell precipitously in 2015 (86 per cent in nominal terms) on the heels of the drop in oil prices. While oil prices are notoriously volatile (and have since regained some of their losses), current trends in global energy markets suggest that prices are likely to trend downward in the long term, raising the risk of stranding some of the 25 per cent of Canada's business-sector produced assets invested in oil sand extraction.
- Canada's key ecosystems—forests, wetlands, grasslands and lakes/rivers—declined in extent (though modestly in comparison to their size) and were increasingly affected by human development. Climate variables evolved consistent with the predictions of climate change, meaning that the climate system's weather-regulating benefits declined, adding another layer to the threats facing ecosystems.
- In a positive trend, the real per capita value of Canada's net foreign financial assets grew more quickly than net foreign financial liabilities, with assets outstripping liabilities in 2015. This meant that non-residents, likely for the first time in Canada's history, had no claim on Canadian income and Canadians had a claim on some of the income generated elsewhere. The importance of this historic development was tempered, however, by the fact (noted above) that growth in net foreign financial assets relied on favourable trends in foreign stock markets and exchange rates rather than on actual investments.
- Canadian households took on unprecedented levels of debt, shifting their investments toward housing and away from financial assets, inflating house prices and leaving the rest of the economy reliant on foreign lenders for nearly three quarters of investment flows after 2012. The last time the Canadian economy relied on foreign sources for such a large share of investment was in the mid-1960s.
- Canada's social capital appeared to hold steady, but not grow, over the period, with various indicators of civic engagement and trust/cooperative norms showing differing trends. Diversity in social networks and trust in institutions showed steady increases, while voter turnout in federal elections generally declined (rebounding somewhat in the two most recent elections). Other social capital indicators showed little change in either direction over the period.

3.2.4 Did Well-Being Decline as Theory Suggests?

As noted above, declining real comprehensive wealth per capita is, in theory, a signal that development is unsustainable and well-being is declining or will do so at some future point.

Since real comprehensive wealth per capita declined in Canada from 1988 to 1992 and again from 2008 until at least 2012 (2014 in the case of DCWI), it is reasonable to ask whether well-being also declined during or following these periods. Answering this question is complex, not least because some of the consumption that supports well-being is purely psychological; for example, the enjoyment of an unpolluted mountain view. Many forms of consumption, particularly those related to consumption of market goods and services, can be addressed with existing data relatively easily, however (see Text Box 6 for a discussion of what the costs of climate change in terms of non-market consumption might have been).

[30] Only reserves of gold, potash, oil sands and bituminous coal increased over the period in physical terms.

Looking at the first period of decline in wealth, Figure 4 shows that market consumption, as measured by real final consumption expenditure per capita, grew relatively little from 1988 to 1992 compared with the periods immediately preceding and following. This suggests that the decline in wealth in those years did lead to a loss in market consumption, and, therefore, well-being, compared to what might have been the case had the decline not occurred. The same is true of the post-2007 decline in wealth; market consumption fell relative to what it might have been (see Text Box 7 for details).

The post-2007 period was different, however, in that households were borrowing heavily at that time,[31] using debt to help finance consumption that income alone could not support. This "excess" consumption, and the economic growth it helped create, kept growth in real final consumption expenditure per capita from slowing more than it would have otherwise. The consumption-dampening effect of declining wealth was offset by the consumption-enhancing effect of borrowing. Supporting well-being through continually growing levels of debt is, of course, unsustainable in the long run. It amounts not so much to maintaining well-being as to shifting the timing of its enjoyment from the future to the present. A decline is inevitable—even if it is put off to some point in the future.

It should be noted as well that the growing household debt during this time was, effectively, a form of capital consumption. Had the household sector not borrowed so heavily to support its consumption, more of its disposable income would have been available for lending to other sectors of the economy (as was the typical case prior to 1997). Had households lent more, businesses and governments would have had less need to borrow from foreign lenders.[32] Less borrowing from foreign lenders would have, other things being equal, improved Canada's international investment position. An improved international investment position would have eliminated some of the decline in comprehensive wealth.

As well as amounting to implicit capital consumption, supporting well-being through household borrowing came with costs in terms of increased financial stress on households. If financial conditions were to change quickly, many households report that they would find themselves in difficult financial straits.[33]

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31 Prior to 1997, the household sector was typically a net lender rather than a net borrower.

32 Domestic banks and other financial-sector lenders only have so much capacity to provide investment funds. Any shortfall has to come from foreign lenders in the instance that households are, themselves, not lending but actually borrowing in net terms.

33 In its 2017 *Survey of Employed Canadians*, the Payroll Association of Canada found that 47 per cent of working Canadians would have difficulty meeting their financial obligations if their paycheque were delayed by a week. The figures were even higher for younger workers. Of those aged 30–39, 55 per cent would have difficulty making ends meet if a paycheque were delayed; the corresponding figure for those aged 40–49 was 51 per cent. Overall, 41 per cent of workers reported spending more than their net pay. Nearly a quarter (22 per cent) said they would have trouble coming up with $2,000 within a month in the event of a financial emergency (Canadian Payroll Association, 2017). In a similar survey by Abacus Data, 30 per cent of Canadians aged 18 to 37 said they had no savings and 22 per cent said they had less than $5,000 (Carrick, 2018).

Text Box 6. Climate change and losses in non-market consumption

Assessing losses in well-being derived from non-market consumption of the benefits of natural capital is difficult, as some of the benefits are purely psychological. Even those that are more tangible, such as the benefits of harvesting wildlife, are difficult to assess because the consumption is not well measured. One benefit of natural capital that does seem to show clear signs of decline since the late 2000s, however, is regulation of climate extremes. This is costing families, business and government billions of dollars in damage to buildings, roads and other infrastructure, not to mention the cost of disruptions to lives.

The Insurance Bureau of Canada (IBC, 2015) reports that insurance payouts for damage to produced assets (homes, buildings, infrastructure) due to extreme weather events are increasing in Canada. Since the 1980s, such payouts have doubled every five to ten years. With $3.4 billion in payouts due to floods in Alberta and Toronto, an ice storm in eastern Canada and other extreme weather, 2013 was a record-breaking year (IBC, 2015). It was surpassed, however, by a single event in 2016, the Fort McMurray wild fire. That fire is estimated to have caused $3.58 billion in insured property losses (IBC, 2016a). It was by far the largest single payout for a natural disaster in Canada, more than doubling the $1.74 billion figure for the Alberta floods in 2013. Since then, there has been severe flooding in Quebec in spring of 2017 and wildfires in the interior of British Columbia in the summer. Spring 2018 brought a record-setting flood to the Saint John River in New Brunswick and severe flooding to interior British Columbia.

As noted, these record-setting events are causing increased insurance payouts. Six straight years of real insurance losses exceeding $1 billion (2015 prices) were witnessed in Canada from 2009 to 2014 (IBC, 2016b; Feltmate & Moudrak, 2016). In contrast, real insured losses averaged only $400 million a year between 1983 and 2008 and only two years saw losses exceeding $1 billion. The Insurance Bureau of Canada (IBC) notes that storms previously expected only once every 40 years are now expected every six years (IBC, 2013).

Severe weather is not, of course, solely attributable to climate change. Though scientists cannot yet estimate with confidence what share of extreme weather-related insured losses can be attributed to climate change, it is increasingly possible to link the two (World Resources Institute, n.d.). The upward trend in extreme weather and its costs is, in any case, clear (Figure 5) and some of it is certainly due to climate change.

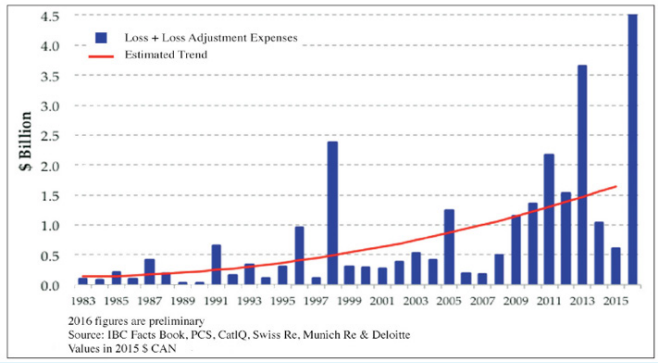

Figure 5. Catastrophic insured losses from natural disasters, 1983–2016
Source: Insurance Bureau of Canada, 2017. Figures have been adjusted to account for inflation.

Text Box 7. Evidence of declines in market consumption

Market consumption, as measured by real final consumption expenditure per capita, did not decline overall from 1988 to 1992 (though it did decline in 1991 by 1.35 per cent) (see Figure 4). Neither did it grow robustly, however, sitting just 0.49 per cent above its 1988 value four years later in 1992. Growth in consumption following 1992 was relatively weak as well, with 1996 real final consumption expenditure per capita just 1.54 per cent higher than in 1992. Overall, from 1988 to 1996, real final consumption expenditure per capita grew just 0.25 per cent annually on average. In contrast, it had grown at an average annual rate of 1.19 per cent from 1980 to 1988; afterwards (1997–2008), it grew at 2.25 per cent annually. The period 1988–1996 clearly stands out from those before and after in terms of growth in market consumption, providing evidence that the decline in wealth from 1988 to 1992 did lead to a loss in consumption and, therefore, well-being.

It is interesting to note that the decline in consumption did not begin immediately when comprehensive wealth began to fall in 1988. Real NNI per capita, for its part, began falling one year after wealth in 1989 and real final consumption expenditure per capita continued growing for two years before finally falling in 1991. After 1991, as noted above, consumption remained relatively flat until 1996 even though comprehensive wealth began growing again in 1992 (1993 for the domestic variant). This provides support for the theoretical notion that if even if well-being does not fall immediately when comprehensive wealth falls, it will fall at some point in the future.

Looking at the period of decline in comprehensive wealth after 2007, consumption again did not drop overall between 2008 and either 2012 or 2014 (though it did decline by 0.40 per cent in 2009). Further, unlike in 1988–1992 when its growth slowed substantially, consumption continued to grow quite strongly in the post-2007 period. Its rate of growth (0.75 and 0.76 per cent annually to 2012 and 2014 respectively) did slow relative to its exceptionally robust rate from 1997 to 2008 (2.25 per cent) however. Again, this provides evidence that the decline in wealth led to a loss in consumption and well-being.

3.2.5 Summary of Trends in Overall Comprehensive Wealth

Based on the most comprehensive assessment of wealth possible in Canada today, we find evidence that Canadian development was on an unsustainable path from 1988 to 1992 and again from 2008 to at least 2012. Real comprehensive wealth per capita as measured by both the NCWI and DCWI declined during these periods, providing theoretical signals of unsustainability. The DCWI, the measure most relevant to Canadians' well-being, declined for at least another two years (2013 and 2014) and likely continued declining in 2016 after a small rise in 2015. The NCWI's strong growth after 2012 was a positive development, though the growth was predicated on holding gains on foreign (especially U.S.) financial assets and by downward trends in the Canadian dollar rather than on material changes in the productive base of the Canadian economy.

We find evidence that well-being, as measured by the consumption of market goods and services, declined during and, in the case of the 1988–1992 downturn, immediately following the periods of decline in the wealth indexes. In the case of the post-2007 decline, it may be that the full reckoning in terms of lost consumption is yet to come. As noted, the household sector used increasing levels of debt to help support consumption during this period, meaning that well-being was backstopped by implicit and unsustainable capital consumption. This represented a delay in the loss of well-being rather than its strict maintenance. Interest rates began rising and housing markets cooling in Canada as of 2017, so losses in well-being may be unavoidable for some households in the near term.

We also find that the post-2007 decline in comprehensive wealth occurred in context of long-term shifts in the nature and distribution of assets that made Canadians' wealth (and, ultimately, well-being) less resilient to external shocks. Among other changes from 1980 to 2015, Canada witnessed growing concentration of produced capital in housing and oil and gas extraction infrastructure; the physical depletion of many market natural assets and, in recent years, deep losses in the wealth associated with the oil sands; growing threats to ecosystems and weather regulation from climate change; and vulnerability of financial capital to changing market conditions. As a result, the comprehensive wealth portfolio could suffer additional losses from relatively small—and foreseeable—changes in economic, environmental or social conditions.

3.3 Detailed Trends in Produced Capital

Produced capital is assessed in this study on the basis of two monetary indicators, the Fixed Capital Index and the Inventory Index, both of which are sub-indexes of the overall NCWI.

The Fixed Capital Index measures the real per capita value of fixed capital stocks owned by households, businesses and governments: residential and non-residential structures;[34] machinery and equipment[35] and intellectual property.[36]

The Inventory Index measures the real per capita value of the inventories of goods held by the business sector. Inventories are treated separately from fixed capital because the two play different roles in the production of goods and services and, therefore, contribute to well-being in different ways.[37]

The trends in the inventory and fixed capital indexes and the factors driving them are discussed in detail in the remainder of this section. Technical details of the indicators as well of summaries of their trends are presented in Chapter 4 (see indicators PC1 and PC2).

3.3.1 Fixed Capital Index

The overall trend in the Fixed Capital Index from 1980 to 2015 was strongly upward (Figure 6). Canada's fixed capital stocks grew at an average annual rate of 1.70 per cent in real per capita terms over the period. While this trend is, other things being equal, positive in terms of ensuring the sustainability of well-being, a closer look at it reveals that fixed capital became increasingly concentrated in just two assets over time, houses and oil and gas extraction infrastructure, tightening its coupling with Canada's weakening oil and gas assets.

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[34] Non-residential structures include industrial, commercial and institutional buildings, such as plants, warehouses, shopping centres, office buildings, schools and hospitals, plus highways, bridges, railway tracks, canals, waterworks, sewage systems, dams, hydro or thermal generating plants, telephone lines, oil and gas facilities and other built infrastructure.

[35] Machinery and equipment includes goods with an expected service life of one year or more, such as furniture, motor vehicles, office machines and mobile equipment (built-in equipment is part of non-residential structures).

[36] Intellectual property includes the products of research, development, investigation or innovation leading to knowledge that its owners can benefit from because its use is legally restricted (for example, by a patent).

[37] Inventories are finished and semi-finished goods produced during earlier production periods kept on hand to help businesses smooth out production processes and sales. While they represent a temporary store of value to businesses and are, therefore, a form of wealth, they do not play a role similar to that of fixed capital in production processes and are treated separately here for that reason.

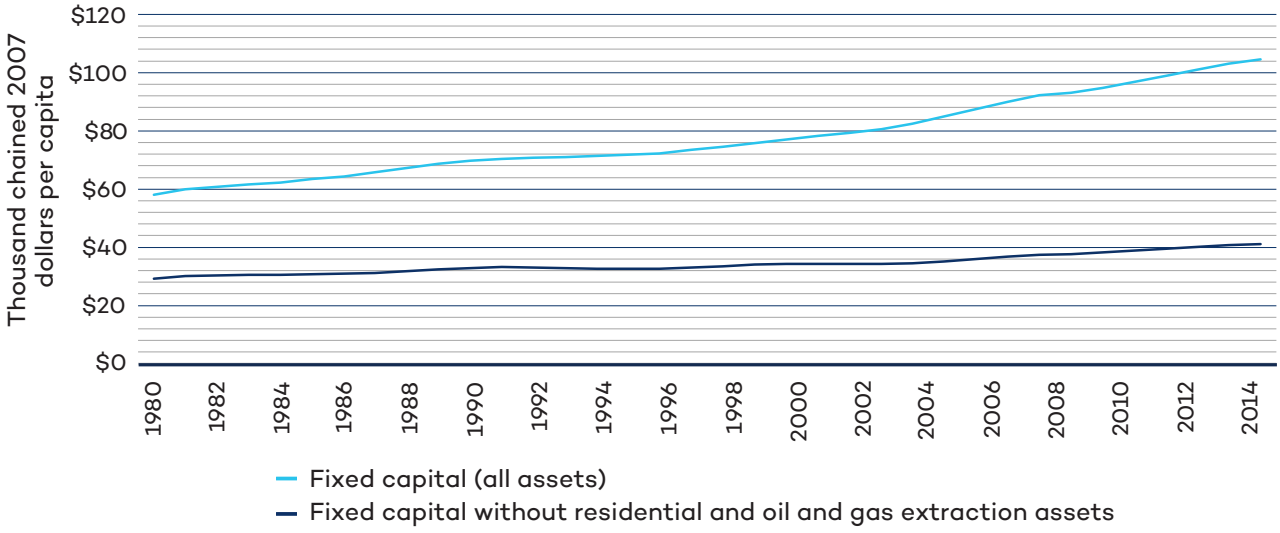

Figure 6. Fixed Capital Index, Canada, 1980–2015

Source: Current study based on Statistics Canada data.

3.3.1.1 Oil and Gas and Housing—Growing concentration of fixed capital

The majority of the growth in fixed capital from 1980 to 2015 was concentrated in two areas of the economy: housing and the oil and gas extraction industry.[38] With housing and oil and gas extraction included, the Fixed Capital Index increased by about $46,500 over the period. When these two asset categories are taken out, the absolute increase in the index drops to $11,900 per person, meaning that more than three quarters of the growth in the index from 1980 to 2015 was due to housing and oil and gas extraction infrastructure. As a result, the combined share of residential buildings and oil and gas extraction infrastructure in fixed capital grew from 45 per cent in 1980 to 60 per cent in 2015. The share of housing alone grew from 39 per cent to 47 per cent. In contrast, the manufacturing industries' share of the total dropped from 8 per cent to 3 per cent over the period. Looking only at non-residential assets, oil and gas extraction infrastructure accounted for 9 per cent of those assets in 1980; by 2015, it accounted for 25 per cent. The manufacturing industries' share fell from 13 per cent to 6 per cent.

These trends point to growing concentration in Canada's fixed capital. The oil and gas extraction industry is increasingly dominant, and capital stocks owned by other industries, especially the manufacturing industries, are losing share or growing more slowly. In 1980, the 10 industries[39] with the largest holdings held 69 per cent of all non-residential fixed assets; by 2015, the holdings of the top 10 industries had risen to 75 per cent in total. This is consistent with Canada's relatively low global ranking in terms of economic diversification. According to the United Nations,[40] Canada ranked 26th of 35 OECD members in 1995 in terms of export concentration[41] and 13th in terms of the divergence of exports from global patterns. In both cases, Canada was the least diversified of the G7 nations. By 2015, Canada's position had improved only slightly, moving into 22nd and 12th places respectively among OECD members and jumping ahead of Japan into 6th place among G7 countries (Table 3).

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38 By the "oil and gas extraction industry," we are referring to both the conventional oil and gas extraction industry as well as the unconventional—or oil sands—industry.

39 At roughly the 3-digit level of Statistics Canada's NAICS industrial classification.

40 UNCTAD, *Product concentration and diversification indices of exports and imports* (online database) (http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=120).

41 Concentration measures the degree to which exports are dominated by relatively few products.

Table 3. Measures of economic diversification, OECD countries, 1995 and 2015

	Concentration of exports				Divergence of exports from global pattern			
Rank	1995		2015		1995		2015	
1	Czechia	0.045	Italy	0.052	United Kingdom	0.231	United States	0.247
2	Netherlands	0.053	Austria	0.062	France	0.262	Germany	0.318
3	Italy	0.055	Poland	0.065	United States	0.271	Netherlands	0.324
4	Hungary	0.058	Turkey	0.073	Germany	0.278	France	0.330
5	France	0.059	Portugal	0.078	Netherlands	0.343	Spain	0.337
6	Austria	0.061	Netherlands	0.081	Italy	0.352	United Kingdom	0.343
7	United Kingdom	0.070	Latvia	0.088	Spain	0.361	Sweden	0.346
8	United States	0.075	Sweden	0.089	Czechia	0.367	Italy	0.348
9	Poland	0.080	Denmark	0.095	Austria	0.378	Austria	0.360
10	Estonia	0.081	Belgium	0.096	Belgium	0.378	Belgium	0.371
11	Germany	0.082	United States	0.097	Japan	0.385	Poland	0.373
12	Switzerland	0.090	France	0.098	Mexico	0.390	Canada	0.378
13	Slovakia	0.092	Luxembourg	0.102	Canada	0.406	Czechia	0.406
14	Denmark	0.092	Spain	0.102	S. Korea	0.410	Hungary	0.411
15	Slovenia	0.094	Germany	0.105	Hungary	0.413	Mexico	0.413
16	Portugal	0.104	United Kingdom	0.112	Sweden	0.432	Latvia	0.422
17	Greece	0.105	Estonia	0.116	Slovakia	0.455	Portugal	0.424
18	Luxembourg	0.108	Czechia	0.118	Slovenia	0.460	Denmark	0.427
19	Turkey	0.111	Mexico	0.122	Denmark	0.473	Japan	0.433
20	New Zealand	0.117	Hungary	0.125	Portugal	0.482	Turkey	0.435
21	Belgium	0.117	Japan	0.135	Poland	0.490	S. Korea	0.436
22	Australia	0.121	Canada	0.140	Estonia	0.506	Slovenia	0.437
23	Mexico	0.122	Finland	0.141	Switzerland	0.517	Slovakia	0.454
24	Japan	0.124	S. Korea	0.148	Finland	0.529	Estonia	0.469
25	Sweden	0.127	Slovenia	0.166	Luxembourg	0.539	Finland	0.507
26	Canada	0.132	New Zealand	0.167	Israel	0.553	Luxembourg	0.535
27	Latvia	0.137	Slovakia	0.183	Australia	0.555	Greece	0.561
28	Spain	0.142	Australia	0.228	Ireland	0.555	Israel	0.572
29	S. Korea	0.148	Ireland	0.243	Greece	0.592	Norway	0.638
30	Ireland	0.169	Greece	0.253	Latvia	0.623	Switzerland	0.639
31	Finland	0.203	Switzerland	0.267	Turkey	0.633	Australia	0.662
32	Israel	0.273	Israel	0.273	Norway	0.641	Ireland	0.685
33	Chile	0.305	Chile	0.324	New Zealand	0.646	New Zealand	0.687
34	Norway	0.351	Norway	0.334	Chile	0.775	Chile	0.768
35	Iceland	0.397	Iceland	0.450	Iceland	0.775	Iceland	0.807

Note: Shaded cells indicate member countries of the G7.

Source: United Nations Conference on Trade and Development (UNCTAD), Product concentration and diversification indices of exports and imports (online database) (http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=120)

Another reason for concern about the growing dominance of the oil and gas extraction industry is its tight coupling with Canada's natural capital base. As the preceding section showed, the value of Canada's natural capital shrank dramatically overall between 1980 and 2015 and oil and gas assets were especially hard hit. If oil prices remain relatively low, the possibility that some of the fixed capital Canada has invested in the oil and gas extraction industry could become "stranded" cannot be dismissed. Companies had, in fact, already begun scaling back their investments in the industry in 2015. Real investment per capita in oil and gas extraction fell by more in percentage terms in 2015 (30 per cent) than in any other year since 1980 with the exceptions of 2009 (41 per cent) following the global financial crisis and 1986 (34 per cent) following an earlier major decline in oil prices. The decline in 2015 was unique, however, in being the only one to be followed by a second year of decline; real per capita investment fell by a further 25 per cent in 2016 before returning to growth in 2017.[42]

As a result of the declining investment in 2015 and 2016, the oil and gas industry's total capital stock declined in real per capita terms in 2016, leading to the first decline in overall real per capita business sector capital stocks since the recession of 1991–1992.

The Canadian Association of Petroleum Producers has expressed concern about the trend in oil and gas industry investment, noting that as Canadian companies have been scaling back investment, their competitors in the U.S. have been doing just the opposite. While the U.S. is Canada's biggest customer for oil, it has also become its biggest competitor, exporting growing amounts of oil and natural gas to the same emerging markets Canada seeks to supply. Since 2014, Canada has struggled to maintain its position as a reliable place for investment in oil and natural gas development, with global capital being redirected to other countries (McMillan, 2018). In that year, foreign direct investment in oil and gas extraction represented 23 per cent of all foreign direct investment in Canada; by 2017, the industry's share had fallen to 20 per cent.[43]

These numbers put in perspective the sustainability risk associated with the evolution of fixed capital in Canada. The main driver of fixed capital growth in the business sector, the oil and gas extraction industry, is tightly coupled with a natural asset that has fallen substantially in value and faces an uncertain future. Oil prices have recovered somewhat from their low in 2015. If they recover further, the value of Canada's oil and gas assets may recover too, which could reinvigorate investment in oil and gas extraction. But if prices remain relatively weak—a plausible scenario given current global trends (see the discussion earlier in the section on natural capital)—the loss in the value of the oil and gas assets may persist and eventually be accompanied by permanent losses in the value of the complementary fixed capital assets.

Turning briefly back to housing, the fact that homes make up a significant share of Canada's total fixed capital is not new. As far back as 1961, residential assets made up about 39 per cent of total fixed capital. That share remained more or less constant until the mid-1980s, when it began to grow, reaching a peak of 48 per cent in the mid-2000s. It has remained stable at that level since.

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42 The most recent oil and gas industry investment data from Statistics Canada (Statistics Canada, *Capital expenditures, oil and gas extraction industries*, CANSIM Table 029-0052) are in nominal terms and thus not directly comparable with the real figures quoted here. They show that nominal per capita investment in oil and gas extraction climbed by 12 per cent in 2017 compared with declines of 29 per cent and 33 per cent in 2016 and 2015 respectively. Nominal investment per capita in 2017 ($1,171) remained well below the levels seen before in 2015 ($1,469) and earlier however.

43 Statistics Canada, *International investment position, Canadian direct investment abroad and foreign direct investment in Canada*, CANSIM Table 376-0052. Retrieved from http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=3760052&&pattern=&stByVal=1&p1=1&p2=31&tabMode=dataTable&csid.

This growing housing stock is, other things equal, a positive development from the perspective of comprehensive wealth. Canadians obviously gain much from living in good-quality houses and, if maintained well, houses are an important means of transferring wealth from one generation to the next. Houses do not, however, contribute to the production of goods and services other than shelter, so the increased share of Canada's fixed capital represented by housing reflects a relative reduction in the domestic capacity to produce other goods and services.

A related concern with the growth in the housing asset is the degree to which investment in housing crowds out investment in other forms of capital. As discussed in detail in the following section on financial capital, households flipped from their traditional role as net lenders (that is, providers of money for investment elsewhere in the economy) to a net borrowing position during the 1990s. The low interest-rate regime that began in 1997 provided an incentive to households to start accumulating homes and associated assets[44] and this accumulation has come at the expense of financial assets. Since the acquisition of financial assets is the main means by which households invest in the business sector, the increased investment in housing at the expense of financial assets has meant that businesses have had to look elsewhere for their investment funds. In recent years, this has been mainly foreign investors (see the discussion in the next section for further details).

3.3.2 Inventory Index

The Inventory Index, which measures the real value of inventories held by businesses and governments per capita, was more or less stable from the mid-1980s to 2015 at a value of about $7,000 (Figure 7), meaning that the wealth represented by inventories of finished and semi-finished goods did not change greatly over the period (aside from an initial decline from 1980 to 1984).

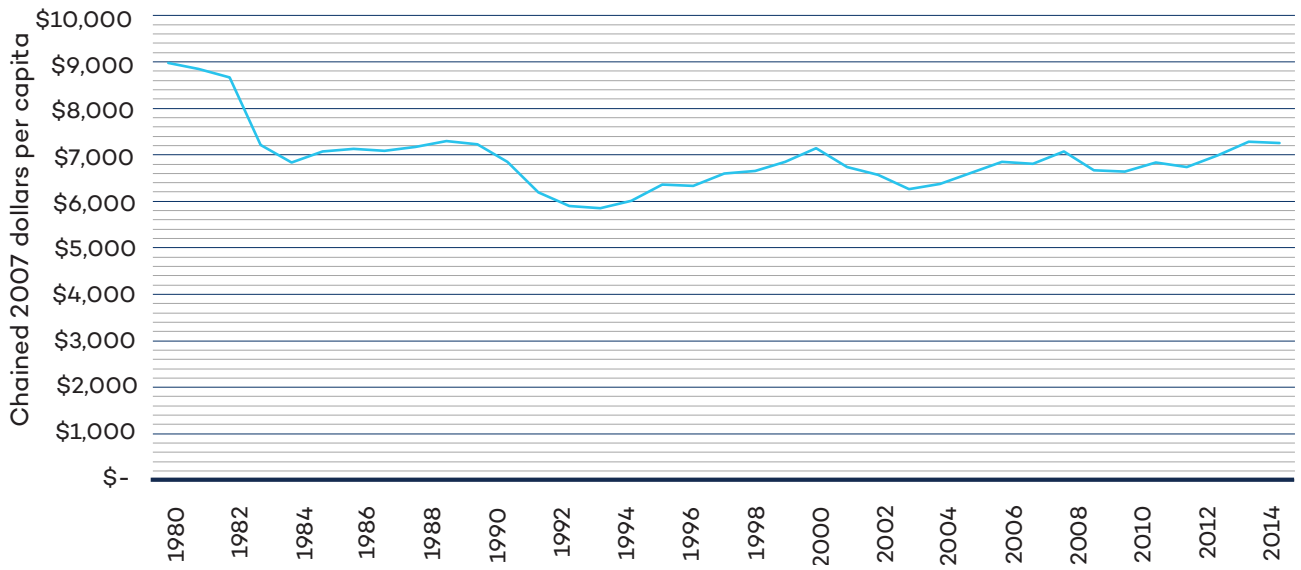

Figure 7. Inventory Index, Canada, 1980–2015

Source: Current study based on Statistics Canada data.

[44] Land and durable consumer goods such as furniture and electronics.

3.3.3 Summary of Produced Capital Trends

Produced capital was a relative bright spot in the evolution of Canada's comprehensive wealth from 1980 to 2015, as stocks of produced capital (fixed capital plus inventories) grew strongly in real per capita terms over the period. However, this otherwise positive trend was tempered by the fact that the growth in fixed capital was heavily concentrated in just two assets, housing and oil and gas extraction infrastructure. As a result, Canada's fixed capital became more concentrated over the period: the share of houses and oil and gas extraction infrastructure in fixed capital grew from 45 per cent in 1980 to 60 per cent in 2015. Rather than contributing to the diversification of Canada's economy, then, investments in fixed capital over the period tended toward putting "more eggs in one basket." There are several reasons for concern about this.

With respect to housing, the large investments over the period obviously benefited homeowners' wealth (growing debt burdens notwithstanding) but they did little to increase the overall productive capacity of the economy. Investments in housing also crowded out household investment in financial assets, leaving the rest of the economy with reduced domestic investment.

With respect to oil and gas infrastructure, the concern is partly that so much of the business sector's fixed capital—fully one quarter—is tied up in just one industry and partly that this infrastructure is tied to Canada's oil and gas assets, which are facing considerable uncertainty themselves. The risk of stranding some of this fixed capital if oil and gas assets do not recover the value they have lost in recent years is not negligible.

3.4 Detailed Trends in Natural Capital

Natural capital is assessed on the basis of a suite of monetary and non-monetary indicators grouped into three themes (Table 4). Both monetary and non-monetary indicators are required because 1) it is not possible yet to measure all natural assets in monetary terms due to shortcomings in basic data and, to a lesser extent, in valuation concepts and methods; and 2) some forms of natural capital are essential to well-being and, therefore, should be measured separately from all other forms – for these, physical indicators are best suited.

The three natural capital indicator themes are:

- *Market natural capital*—trends in the overall value-weighted quantities of natural assets that yield goods and services sold in the market economy.[45]
- *Ecosystem*—trends in key ecosystem assets, such as forests and wetlands.
- *Climate*—trends in key variables reflecting the stability of the climate, one of the most important and threatened elements of natural capital today.

[45] Market natural capital includes Canada's fossil fuel reserves (conventional oil, oil sands, natural gas and coal), mineral reserves (copper, diamonds, gold, iron, lead, molybdenum, nickel, potash, silver, uranium and zinc), timber stocks, agricultural land and land under buildings and other infrastructure. Other market natural capital assets—including commercial fish stocks; the water in hydroelectric, irrigation and drinking reservoirs; and wildlife stocks used for hunting and fishing—could not be included in the index because data on their physical extents and values do not exist.

The trends in the natural capital indicators are summarized in the remainder of this section and presented in detail in Chapter 4 of the report.

Text Box 9 presents a set of complementary "green growth" indicators focused on the economy and its use of natural capital.

Table 4. Natural capital indicators

Theme	Indicator
Market natural capital (monetary)	• Market Natural Capital Index (NC1)
Ecosystems (non-monetary)	• Forest Extent (NC2) • Wetland Extent (NC3) • Surface Water Extent (NC4) • Grassland Extent (NC5)
Climate (non-monetary)	• Precipitation (NC6) • Temperature (NC7) • Snow Cover (NC8) • Glacier Mass (NC9) • Water Yield (NC10) • Sea Ice Extent (NC11)

Note: Bracketed text refers to the indicator number used in Chapter 4 of this report.

3.4.1 Market Natural Capital Index

The Market Natural Capital Index, which is the natural capital sub-index of the overall NCWI, fell significantly from 1980 to 2015. The real per capita value of Canada's market natural capital declined from $103,000 in 1980 to $86,000 in 2015, a total decline of 17 per cent and an average annual decline of 0.5 per cent (Figure 8). The rate of decline was steady over the period with the exception of the mid-2000s, when additions to physical reserves of oil sands and, to a lesser extent, potash drove the value temporarily upward. See Indicator NC1 in Chapter 4 of this report for further discussion of the Market Natural Capital Index, including a discussion of its calculation.

The downward trend in Canada's Market Natural Capital Index was the result of two forces, each acting in the opposite direction. Downward pressure on the index came from declines in physical quantities of most commercial natural assets. Only per capita stocks of bituminous coal, gold, oil sands and potash increased in physical terms between 1980 and 2015 (Table 5). Per capita quantities of all other commercial natural assets declined. Some mineral assets, in particular, declined significantly. Lead reserves[46] per capita were less than 1 per cent of their 1980 level in 2015. Reserves of zinc, molybdenum and silver per capita had all fallen to less than one-eighth of their 1980 extents by 2015. Nickel, copper, natural gas liquids, uranium and conventional crude oil reserves were all below half their 1980 per capita amounts. The remaining assets either increased over the period or declined by less than half of their 1980 per capita amounts.[47]

[46] Reserves are defined as deposits that are economically profitable to exploit given prevailing resource prices and technology.

[47] It is worth noting that, except for iron and built-up land, all assets that declined in per capita terms also did so in absolute terms—so the declines were not simply a matter of population growth in most cases.

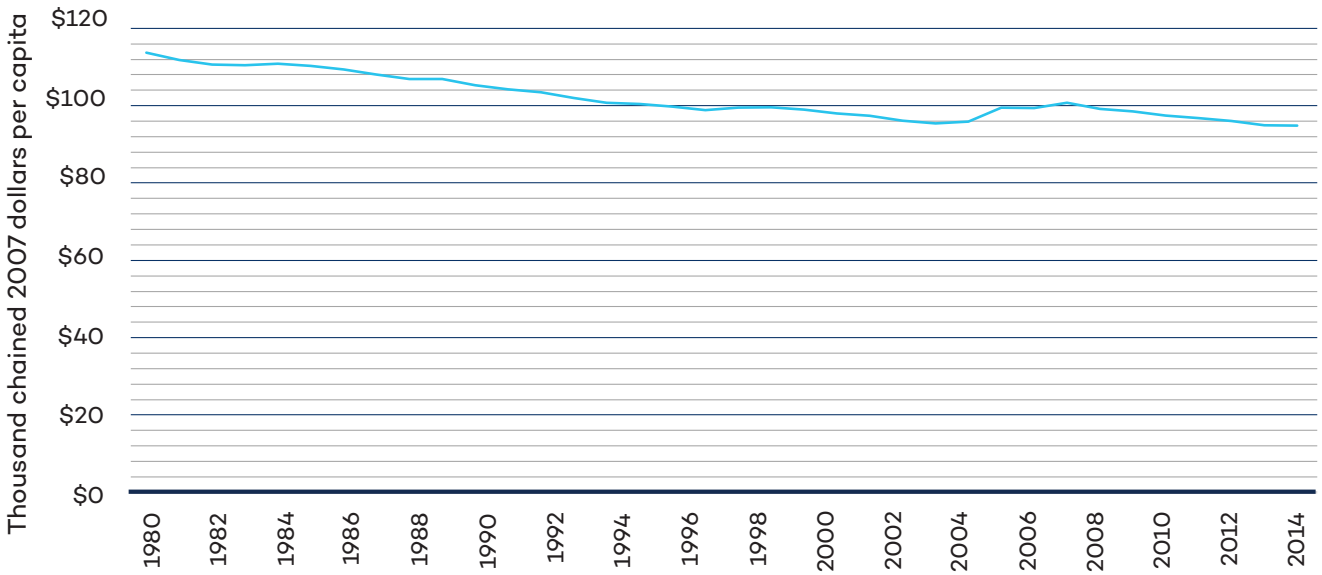

Figure 8. Market Natural Capital Index, Canada, 1980–2015

Source: Current study based on Statistics Canada and other data sources (see Annex 1).

The declines in mineral and fossil fuel assets do not necessarily mean that Canada is running out of these assets in absolute physical terms. It may be that there remain unknown deposits waiting to be discovered through future exploration and development. Or there may be deposits that are already known but are infeasible to extract due to either economic or technical conditions (for example, the Ring of Fire chromite deposit in northern Ontario). Undiscovered or uneconomic resource deposits make no contribution to wealth today, however (although they have the potential to contribute to wealth in the future if they are developed into exploitable reserves). Thus, they do not figure in the Market Natural Capital Index.

What the losses do mean is that resource companies have not, in general, been willing or able to replace existing reserves of most minerals and some fossil fuels as fast as they have been depleted. The fact that reserves have not been replaced as fast as they've been depleted may reflect increasing scarcity and, therefore, difficulty in finding new deposits. Or it may be that the market for the resources is weakening and companies have limited incentive to look for new deposits. Whatever the reason, the fact that reserves are not keeping up with depletion diminishes the contribution these resource assets make to Canada's comprehensive wealth over time, other things being equal. Their contribution will continue to diminish unless something changes to permit companies to begin replacing reserves at a rate equal to or faster than their population-adjusted depletion.

Table 5. Index of per capita physical quantities of market natural assets, Canada, 2015 (1980 = 100)

Lead	0.6
Zinc	7.4
Silver	10.8
Molybdenum	12.5
Nickel	23.3
Copper	40.4
Natural gas liquids	42
Uranium	48.5
Conventional crude oil	49.5
Commercial timber	59.4
Natural gas	59.5
Agricultural land	65.4
Iron	68.4
Sub-bituminous coal and lignite*	70.9
Built-up land	92.2
Gold	164.3
Bituminous coal	122.7
Potash	294.7
Crude bitumen (oil sand)	782.7

Note: Bituminous coal index is for 2000 rather than 2015 due to the confidentiality of coal statistics after 2000.

Source: Current study based on Statistics Canada data.

Upward pressure on the Market Natural Capital Index came from increases in the physical quantities and relative prices of two market natural assets in particular: oil sands and potash.[48] Changes in the quantities of natural assets with relatively high values have a greater impact on the index than assets that are worth less and those impacts are amplified when prices change at the same time as quantities do. In Canada, both the physical size and relative prices of potash and, especially, oil sands assets increased substantially over the period. The increasing size and value of these assets pushed the value of the index up, offsetting some—but not all—of the losses caused by the physical depletion of other resources. Without oil sands and potash, the Market Natural Capital Index would have fallen considerably more than it did (Figure 9). In real per capita terms, the index excluding oil sands and potash fell from $103,000 in 1980 to $79,000 in 2015 (an annual average decline of 0.75 per cent compared to the 0.5 per cent annual decline in natural wealth including all assets).

The other asset with a significant influence on the Market Natural Capital Index is built-up land. It is by far Canada's most valuable market natural asset, accounting for 62 per cent of their value on average from 1980 to 2015. Built-up land is so valuable because of the role it plays in the real estate market; the land under buildings can often be worth as much or more than the buildings themselves. Since the quantity of built-up land per capita declined slightly over the period (Table 5), the trend in built-up land contributed to the decline in the Market Natural Capital Index.

[48] Though gold reserves also increased over the period, gold assets are worth less than oil sands, potash or built-up land and, so, their increase had a smaller impact on the index.

The above shines a light on how much Canada's natural capital wealth is tied to trends in just three natural assets—potash, oil sands and built-up land—at least one of which (oil sands) has an uncertain future due to concerns over pipeline expansions, environmental impacts and competition from other fossil fuel and renewable energy sources (see Text Box 8 for further discussion of oil sands and Canada's natural wealth). Future declines in the quantities of any of these assets will have disproportionate impacts on the value of natural capital and, by association, comprehensive wealth.

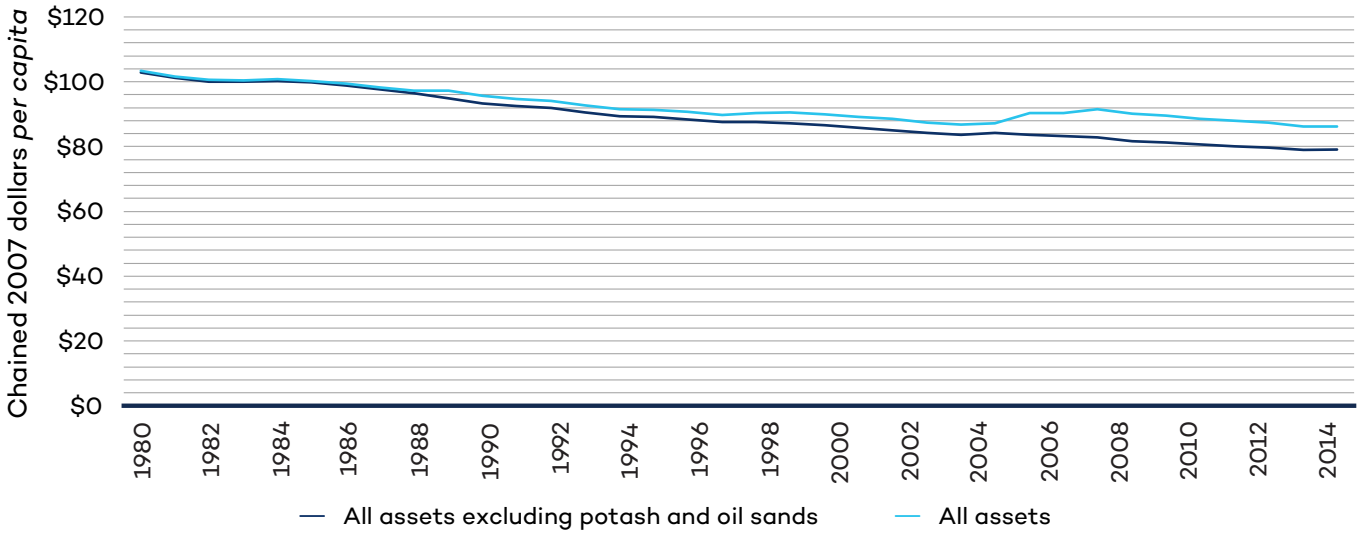

Figure 9. Market Natural Capital Index with and without oil sands and potash, Canada, 1980–2015

Source: Current study based on Statistics Canada and other data sources (see Annex 1).

Text Box 8. Physical versus economic depletion of natural assets—the case of the oil sands

As noted, the trend in the Market Natural Capital Index from 1980 to 2015 is downward. This reflects the fact that Canada has been using many of its natural assets faster than it has been replacing them. Clearly, this drawdown of natural capital cannot continue forever. At some point, simple physical depletion of stocks becomes a reality if production continues without reserves being replenished.

Beyond physical depletion, there is also the possibility of "economic" depletion of natural capital. Since Canada sells many of its natural resource commodities on international markets, the value of much of the nation's natural capital rests on demand and prices in international markets. If demand and/or prices for resources fall enough, Canada's natural capital could be depleted in economic terms even if it remains abundant in physical terms. Resources that are valuable assets when prices and demand are high can become "stranded" (that is, left physically in place with little or no economic value) if prices/demand fall significantly.

The asset most at risk of becoming stranded in Canada is the oil sands. The decline in oil prices since 2015 coupled with global trends limiting growth in demand for oil,[a] increasing competition from lower-cost producers in the U.S. and the Middle East and uncertainty regarding future access to global markets make for uncertain conditions for Canada's oil sands.

The oil sands remain enormous in physical terms, so physical depletion is not a substantial concern. Their value as an asset is at considerable risk of falling however. In fact, according to Statistics Canada, the value of oil sands asset did fall dramatically in the wake of the 2015 decline in oil prices, after having hit an historic high in 2014 (Figure 10).[b] The nominal value of the oil sands declined by $446 billion from 2014, or 83 per cent, to $89 billion in 2015.[c] The last time the oil sands' value as an asset was that low was in 2003 when the physical size of the reserves under development was less than half of what it was in 2015.[d]

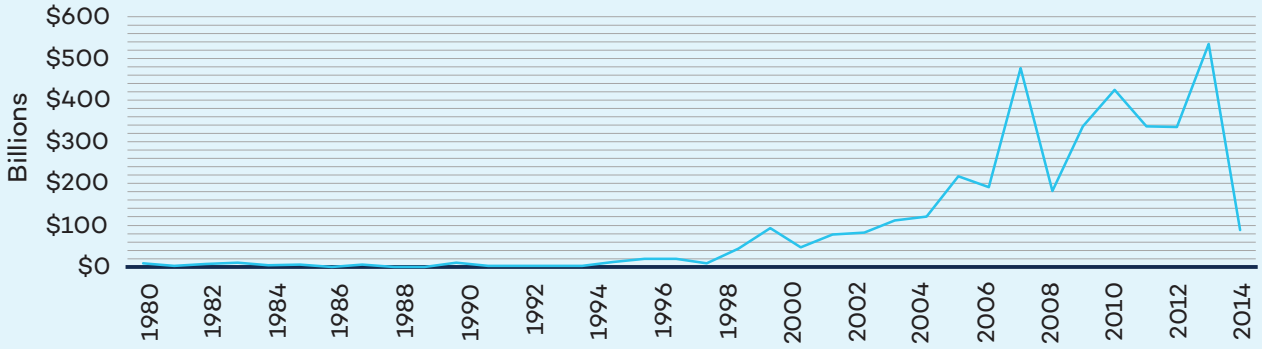

Figure 10. Oil sands asset value (nominal), 1980–2015

Source: Current study based on Statistics Canada data.

(continued)

[a] The International Energy Agency (2015) notes the following sources of downward pressure on global oil demand: declining use of oil relative to other sources of energy, including renewables; China's transition away from its initial, highly energy-intensive phase of development; the increasing prevalence of fuel-economy standards for road vehicles; and the disconnect between the falling global oil price and stable or rising consumer prices for refined petroleum products (due, in part, to governments choosing to capitalize on the fall in oil prices to reduce subsidies in oil markets).

[b] Not adjusted for inflation.

[c] The asset value fell even further in 2016 to $54.8 billion. Statistics Canada, Value of selected natural resource reserves, CANSIM Table 153-0121.

[d] Only the portion of oil sands proven reserves under active development is considered an asset for the purposes of estimating comprehensive wealth. In 2003, the reserves under active development amounted to 1.7 billion cubic metres. This figure had risen to 3.8 billion cubic metres by 2015. Total oil sands reserves are estimated to be greater than 26 billion cubic metres.

Text Box 8. Physical versus economic depletion of natural assets—the case of the oil sands (continued)

Of course, resource prices are well known to be volatile, so the 2015 decline in the oil sands value is not necessarily permanent. As Figure 11 shows, fossil fuel assets (oil sands plus other fossil fuels) have declined in value several times since 1980, tracking the declines in global oil prices closely. It is worth noting, however, that the decline in 2015 was the largest ever one-year decline in percentage terms (86 per cent) and the second largest, behind the drop in 2009 due to the global financial crisis, in absolute terms ($666 billion in 2015 prices).

Whether global oil prices will recover to the levels seen in 2014 is, of course, uncertain.[e] If they do, the natural wealth lost in 2015 could be regained. If not, some or all of the losses could become permanent.

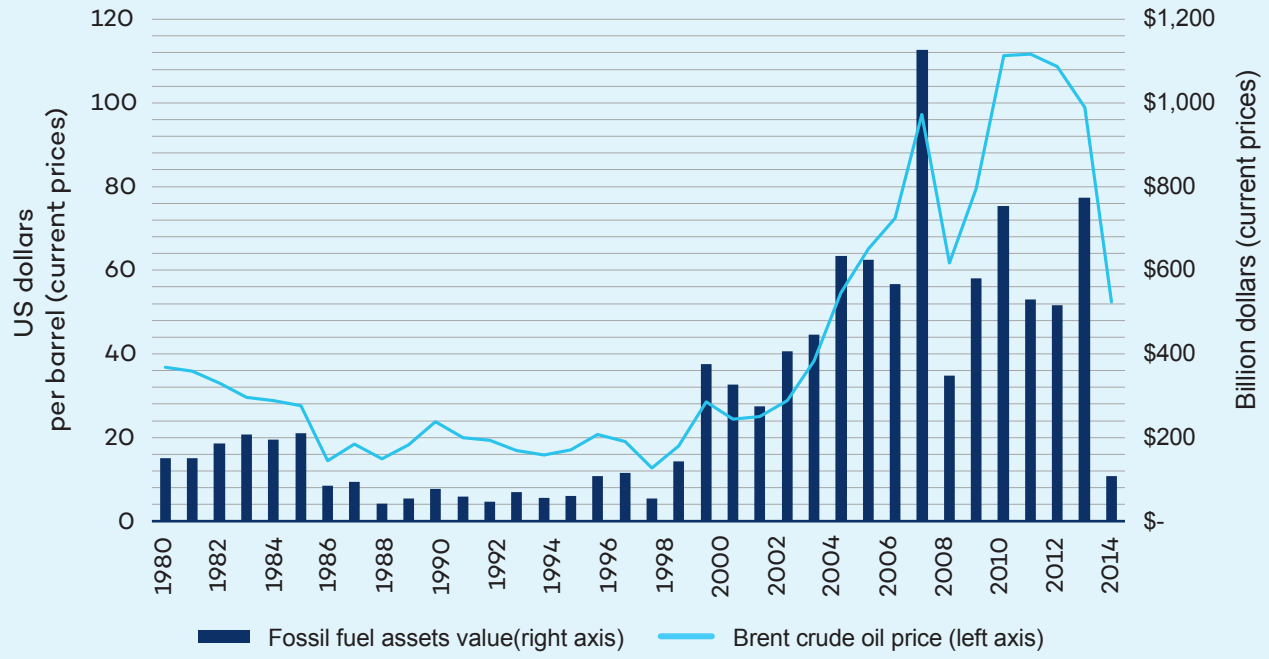

Figure 11. Fossil fuel asset values (nominal) and crude oil prices, 1980–2015

Source: Current study based on data from Statistics Canada and the British Petroleum Statistical Review of World Energy (https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/oil/oil-prices.html)

[e] As of October 2018, Brent crude was trading at about USD 80 per barrel, up from its average 2015 price of USD 52.

3.4.2 Ecosystems

If the trends and future prospects for Canada's market natural capital are disquieting, what about the country's ecosystems? Canada's land and forests, oceans, lakes and rivers all provide a variety of goods and services that contribute to Canadians' well-being: clean air; fish and game to harvest; water fit for drinking, irrigation, industrial use and electricity production; timber products; transportation routes and recreational opportunities.

Assessing the state of Canada's ecosystems is less straightforward, since ecosystems are not monitored nearly as often or thoroughly as market natural capital (and far less often or thoroughly than non-natural components of comprehensive wealth).

In this report, two indicators are used to assess the state of selected key ecosystems (forests, wetlands, waterbodies and grasslands). The first indicator considers changes in the extent (area) of ecosystems[49] between 2000 and 2011, the only two years for which nationally consistent data are available. The second looks at the degree of "development" of ecosystems in 2011 (data on development are only available for this one year). Ecosystems are considered "developed" if they are located within 1 kilometre of a linear feature like a road or a pipeline or within 10 kilometres of other types of human land uses (for example, mines, dams or inhabited areas).

Based on these indicators, all of Canada's key ecosystems are found to be under pressure from human development and other stresses.

- Forests (Indicator NC2) declined slightly in area between 2000 and 2011, mainly due to losses from pest infestations and fires. Despite the extent of Canada's forests, about 40 per cent of them were considered "developed" in 2011.
- Wetlands (Indicator NC3) also declined in area in most parts of the country, other than the Maritimes and the North. These losses, while relatively small, came on top of much larger declines in wetlands in earlier periods of the nation's development. Cumulatively, Canada has lost a large (but unknown) share of its original wetlands since European settlement. With most of the country's remaining wetlands being found in northern regions, only about one fifth (21 per cent) of those remaining were considered developed in 2011. Threats to remaining wetlands from human development may be small for the foreseeable future, then, with the exception of wetlands found in populated southern regions of the country, where threats from further development remain.
- Though no assessment of the change in Surface Water (Indicator NC4) extent or quality is possible, data indicate that 20 per cent of surface water areas were considered developed nationally in 2011. Regionally, about 40 per cent of surface water areas were considered developed in Newfoundland and Labrador, New Brunswick, Nova Scotia, PEI, Alberta and British Columbia.
- Grasslands (Indicator NC5) saw small declines in area from 2000 to 2011. As with wetlands, these declines came on top of large historical losses. Unlike wetlands, however, remaining grasslands are significantly threatened by further development. An estimated 95 per cent of remaining grasslands in Alberta and Manitoba were considered developed in 2011. In Saskatchewan, the corresponding figure was about 77 per cent.

3.4.3 Climate

An unknown with respect to ecosystems is what will happen to them and the goods and services they provide as the climate changes. How might Canada's water resources be affected by changes in precipitation and temperature? How will changes to forest ecosystems affect timber supplies? Will the Great Lakes become less reliable as transportation routes? Will Canada's wilderness become less attractive for recreation if winters are too warm to support consistent snowfall? Fully answering these questions is beyond the scope of this report. What is clear based on the findings, however, is that

[49] Waterbodies are not assessed by this indicator.

Canada's climate is changing in ways that are consistent with the predictions of the scientific community (Collins et al., 2013).

Six indicators are used here to evaluate trends in key climate variables. The indicators either compare variables against climate "normals"[50] or look at trends in the absolute values of the variables.

- Precipitation, measured as the annual departure from the 1961–1990 normal (Indicator NC6), generally increased in Canada between 1948 and 2015, with the greatest increases coming in the North. The national trend suggests that precipitation increased by 18 per cent on average compared with the normal between 1948 and 2015.[51] The trend in the North showed an even greater departure from normal (39 per cent).
- Temperature, as measured by annual departures from the 1961–1990 normal (Indicator NC7), showed a trend similar to that of precipitation, with an overall increase nationally from 1948–2015 and the greatest increases coming in the North. At the national level, the temperature trend suggests a 1.8 degree Celsius average departure from normal from 1948–2015. The trend for the Mackenzie climate district, which covers most of the Northwest Territories, suggests a departure of 2.6 degrees Celsius from normal.
- In spite of increased precipitation, annual average snow cover (Indicator NC8) declined across the country from 1972 to 2015 in the months of May and June (the data for the month of April do not show a statistically significant trend). The trend for May suggests an average reduction in snow cover of 0.86 million km^2 over the period, and the trend for June suggests a reduction of 1.67 million km^2.
- The mass of selected glaciers (Indicator NC9) in the Western Cordillera and High Arctic declined from 1960 to 2015, as measured by the cumulative loss in mass over the period. All six glaciers studied lost significant mass, with those in the Western Cordillera (southern Alberta and B.C.) losing more than those in the High Arctic.
- Water yield (Indicator NC10)—an estimate of the annual renewal of Canada's freshwater resources—showed no statistically significant trend 1971 to 2014.
- The extent of sea ice, as measured by average area covered by sea ice during the summer (Indicator NC11), declined from 1968 to 2015. Sea ice declined in all regions studied.

3.4.4 Summary of Natural Capital Trends

Canada's natural capital is facing more pressure than any other element of the nation's comprehensive wealth portfolio. The real per capita value of market natural capital declined by 17 per cent between 1980 and 2015 due to physical depletion of many resources; it would have declined further had it not been for growth in potash and, especially, oil sands. Oil sands are facing headwinds from various directions, however, and have already suffered substantial economic depletion (that is, loss in asset value) even if they remain large in physical terms.

Canada's ecosystems, while still vast and relatively intact compared with the rest of the world's, are nonetheless being slowly eroded in terms of extent and quality.

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[50] A climate normal is defined as the average value for a given variable over a specified period.

[51] The trends in the climate variables are all statistically significant at the 95 per cent confidence level or higher unless otherwise indicated.

Climate change and its impacts are evident in trends in, among others, temperature, precipitation and snow cover, raising further concerns about ecosystem sustainability.

Overall, the capacity of Canada's natural capital to provide its many well-being-enhancing goods and services has declined substantially since 1980 (Table 6).

Table 6. Trends in natural capital indicators

Theme	Indicator	Trend	
Market natural capital	Market Natural Capital Index (Indicator NC1)	Market Natural Capital Index (Indicator NC1)	
Ecosystems	Forests (Indicator NC2)	Forests (Indicator NC2)	
	Wetlands (Indicator NC3)	Wetlands (Indicator NC3)	
	Surface Water (Indicator NC4)	Surface Water (Indicator NC4)	No assessment of change possible
	Grasslands (Indicator NC5)	Grasslands (Indicator NC5)	
Climate	Precipitation (Indicator NC6)	Precipitation (Indicator NC6)	
	Temperature (Indicator NC7)	Temperature (Indicator NC7)	
	Snow Cover (Indicator NC8)	Snow Cover (Indicator NC8)	
	Glacier Mass (Indicator NC9)	Glacier Mass (Indicator NC9)	
	Water Yield (Indicator NC10)	Water Yield (Indicator NC10)	
	Sea Ice Extent (Indicator NC11)	Sea Ice Extent (Indicator NC11)	

Text Box 9. Green growth case study

This report is largely about assessing the status of the capital stocks that contribute to comprehensive wealth in Canada. However, these stocks are just part of the portrait. Changes in stocks are the result of *flows* to and from them; for example, the flow of timber out of forests and the flow of education and skills training into human capital. Understanding comprehensive wealth is, then, as much about measuring flows as it is about measuring stocks. An assessment of all the flows related to comprehensive wealth would be unmanageable in size and scope, however, so it has not been undertaken here.

As an example of what an assessment of flows might provide, this case study considers some of the flows relevant to natural capital. Specifically, the case study looks at the degree to which the Canadian economy makes effective use of the country's natural capital. Three dimensions are considered: the income Canada succeeds in generating per unit of natural capital used; the degree to which the management of natural capital drives innovation and the use of fiscal measures to help preserve natural capital.

Maintaining natural capital over time is vital for both current and future well-being. Excessive use of the goods and services natural capital provides can deplete individual natural assets, threatening comprehensive wealth and the sustainability of well-being. Finding means to effectively and efficiently use the goods and services offered by natural capital is essential to ensuring sustainability. Moreover, it represents an opportunity to generate sustainable economic growth through the development of new, resource-efficient technologies.

Measuring how Canada uses its natural capital requires a tailored suite of indicators. The OECD "green growth framework" provides a useful starting point (OECD, 2011). Green growth "is about fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies" (OECD, 2011, p. 9). Measuring green growth for Canada can help shed light on how our economy uses natural capital, where that use can be made more productive, and where opportunities to create more sustainable growth might lie.

The OECD's framework includes indicators in four categories:

- *Environmental and resource productivity*—These indicators measure the effectiveness of natural capital use by considering the economic output (GDP) produced per unit of a given natural capital input (for example, GDP per unit of energy consumed).
- *Maintaining the natural asset base*—These indicators measure the value and quality of natural assets themselves (they are similar to the natural capital indicators presented in this report).
- *Environmental quality of life*—These indicators measure the degree to which environmental degradation affects quality of life.
- *Economic opportunities and environmental policy*—These indicators measure the extent to which environmental protection can be harnessed as a source of growth, competitiveness, trade and jobs.

(continued)

Text Box 9. Green growth case study *(continued)*

For the purposes of this case study, three indicators[a] from the first and fourth categories have been chosen:

1. *Greenhouse gas productivity*—This indicator measures the income (GDP) generated per unit of greenhouse gas emissions. It is a measure of the effectiveness of Canada's use of the climate's weather regulation service.

2. *Environmental innovation*—This indicator measures the number of new technologies (patents) Canada produces that are related to environmental protection. It is a measure of the degree to which the Canadian economy profits from the need to find more effective ways of using natural capital.

3. *Environmental taxes*—This indicator measures the revenue earned by the federal/provincial/territorial governments from taxes intended to reduce reliance on natural capital. It is a measure of the extent to which Canadian governments are making use of fiscal policy measures to meet environmental goals. Fiscal policy measures are of interest because they can, in some cases, reduce the economic cost of achieving environmental goals in comparison to regulatory approaches.

Findings

Overall, the results of the case study suggest that Canada is making somewhat more effective use of its natural capital over time and is taking some measures to ensure that environmental protection and economic development are jointly pursued. At the same time, it is clear that more could be done, especially in comparison to the country's international peers.

The greenhouse gas productivity indicator shows improvements at the level of the total economy, meaning that Canada is generating more income per unit of greenhouse gas emissions over time. While this is encouraging, some sectors are lagging. The mining, quarrying and oil and gas extraction sectors, in particular, saw a decline in its greenhouse gas productivity between 1997 and 2014.

In terms of Canada's peers, the OECD ranked Canada 34th out of 35 member states in terms of carbon dioxide productivity in 2014.[b]

Changes to productivity can result from several effects, including substitution between natural capital and other inputs and changes in the composition of economic output (for example, an increasing emphasis on services versus manufactured goods). It was not possible to distinguish the effects of these effects on Canada's greenhouse gas productivity performance here. Further analysis would be useful in this regard.

[a] IISD's 2016 report on comprehensive wealth also included an indicator of water productivity that has not been included here because Statistics Canada had not yet released its water use data for 2015 by the time this update was completed.

[b] The OECD only measures productivity for energy-related carbon dioxide emissions and not for other greenhouse gases.

Text Box 9. Green growth case study *(continued)*

Canada fares somewhat better in regard to environmental innovation. Between 1990 and 2013, environmental technologies developed in Canada held constant as a share of all technologies developed and increased considerably per thousand persons. Canada's performance was good enough for it to rank, respectively, 15th and 13th in terms of these indicators among OECD countries in 2013.[c]

In terms of the use of taxes to achieve environmental goals, Canada fared poorly in comparison to its OECD peers. Of the 29 member states for which data were available in 2014, Canada ranked 28th, just ahead of the United States, in terms of environmentally related taxes as a share of total national tax revenue in 2014.[d]

[c] OECD.stat, *Green Growth Indicators*, *Development of environment-related technologies*.
[d] OECD.stat, *Green Growth Indicators*, *Environmentally related taxes, of total tax revenue*.

3.5 Detailed Trends in Human Capital

Human capital is assessed in this study on the basis of four indicators:

- Human Capital Index
- Education Spending
- Educational Attainment
- Adult Skills.

The Human Capital Index, which is the human capital sub-index of the overall NCWI, measures the real per capita value of the human capital stock embodied in the population aged 15–74. It is estimated by Statistics Canada[52] using the so-called lifetime-income approach. Annex 1 and Annex 6 provide additional details regarding the quality of Statistics Canada's human capital estimates and the details of the lifetime-income methodology respectively.

In addition to the Human Capital Index, the study also considered indicators related to:

- Real per-pupil spending on elementary, secondary and post-secondary education
- Educational attainment in terms of the highest certificate, diploma or degree held by the population at the federal and provincial/territorial levels
- Measures of adult literacy, numeracy and problem solving skills.

The trends in the human capital indicators and the factors driving them are discussed in detail in the remainder of this section. Technical details of the indicators as well of summaries of their trends are presented in Chapter 4 (see indicators HC1 through HC4).

[52] The estimates are based on an approach originally described in Gu and Wong (2010) and updated on special request by Statistics Canada for the purposes of this study.

3.5.1 Human Capital Index

The Human Capital Index—the largest component of national comprehensive wealth by far[53]— varied over the period 1980–2015 but trended generally upward until 2001 (with a dip from 1986 to 1991) and then downward afterward (Figure 12). In 2015, the average Canadian's human capital was valued at about $496,000, a slight decrease from its 1980 level of $498,000 (chained 2007 dollars). Evidence from the relatively few other national studies available suggests that Canada's peer nations were more successful in increasing their human capital in recent decades. The United Kingdom, Australia and New Zealand all had growing rates of human capital during periods overlapping with the period studied here, though the timeseries available for those countries are shorter. The United States, like Canada, did not show growth in human capital based on available data (Christian, 2014; Jones and Fender, 2011; Wei, 2008; Le et al., 2006).

The decline in Canada's Human Capital Index, even if slight, occurred in the context of substantial increases in the share of Canadians obtaining some kind of formal education certificate, diploma or degree (Figure 13). From 1986 to 2016, the share of the population aged 15 and older with a bachelor's degree or higher increased from 10 per cent to 23 per cent. The share with no formal educational designation of any sort fell from 48 per cent to 18 per cent. Most the increase in educational attainment (outside of secondary school) came in the form of graduates from colleges and universities; the share of the population graduating from trades schools did not change over the period.

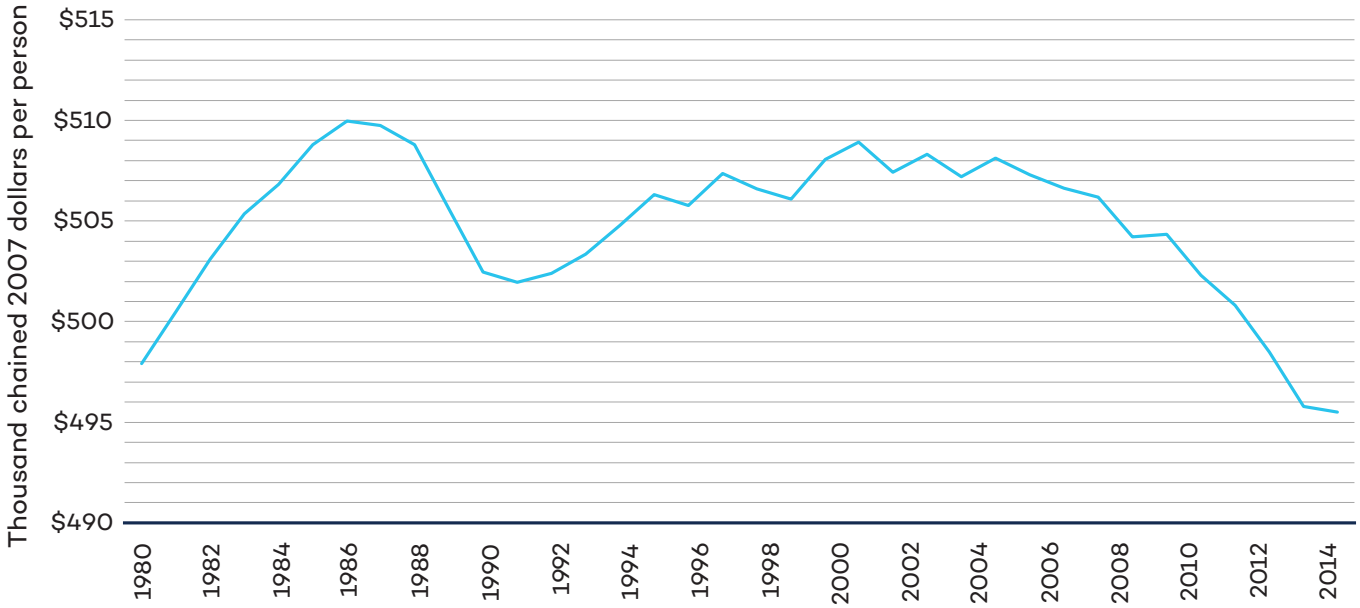

Figure 12. Human Capital Index, Canada, 1980–2015

Note: The scale on this figure has intentionally been set to permit the year-to-year changes in the index to be clear. The amplitude of the changes in the figure should not be taken as representative of the actual change in the index, which was quite small over time.

Source: Current study based on a special compilation from Statistics Canada.

[53] Human capital accounts for about 80 per cent of comprehensive wealth in Canada, a level similar to that in other developed countries.

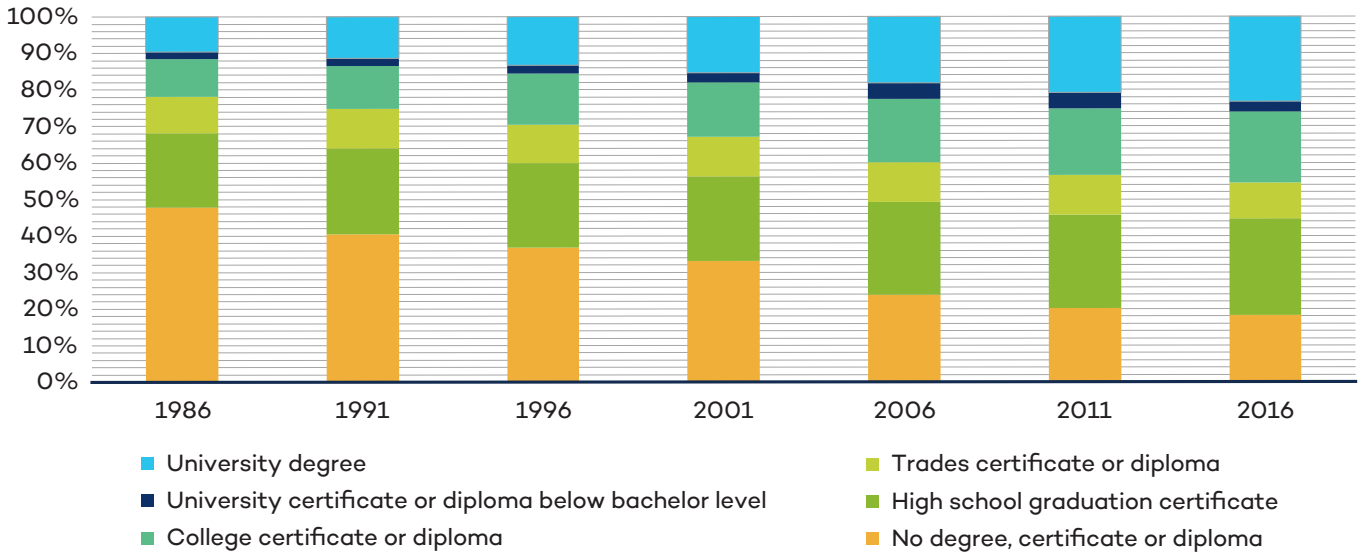

Figure 13. Educational attainment, Canada, 1986–2016

Source: Current study based on Statistics Canada data.

Given the strongly upward trend in educational attainment, the fact that the trend in human capital was worst for younger workers is all the more troubling (Figure 14). On average, human capital for younger workers (aged 15 to 34) grew at a rate of 0.25 per cent annually from 1980 to 2015 (total growth of 9 per cent). In contrast, human capital for prime-age (35 to 54) and older (55 to 74) workers grew on average by 0.62 per cent and 1.1 per cent annually respectively (total growth of 25 per cent and 46 per cent). This suggests that younger workers had difficulty translating their increased investments in education into returns in the workforce. Since younger workers eventually become older workers, this raises concern for future growth in human capital.

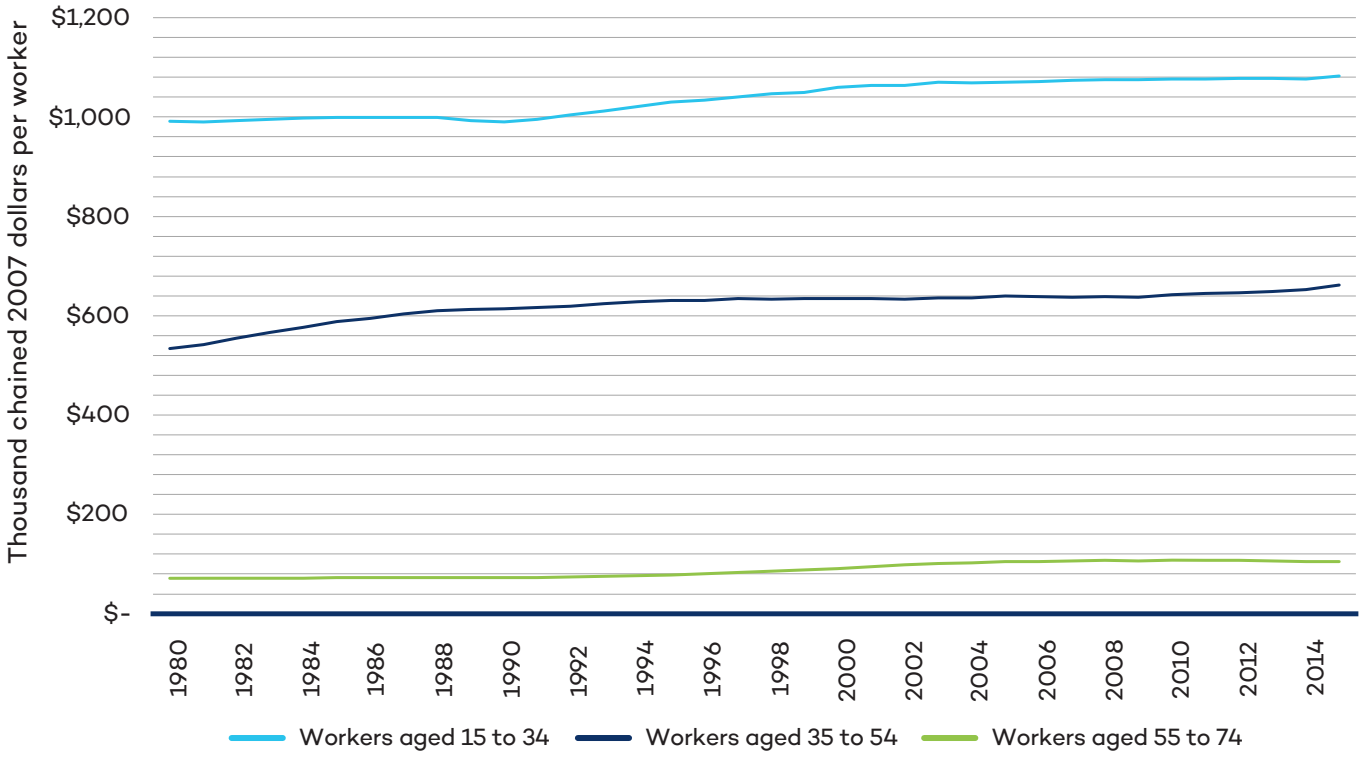

Figure 14. Human Capital Index by worker age group, Canada, 1980–2015

Notes:
1. The denominators used to calculate the indexes in this figure are the respective populations aged 15–34, 35–54 and 55–74 in each year of the time series. This differs from the denominator used to calculate the trend in the overall Human Capital Index (Figure 12), which is the total Canadian population in each year rather than the sum of the populations aged 15–74. Total population is used as the denominator in the overall index to ensure consistency with the other indexes compiled for this study, all of which use total population to adjust for population growth. This explains why the age-specific indexes in this figure show growth from 1980–2015 when the overall index shows a slight decline.
2. The scale in this figure differs significantly from that in Figure 12, so direct comparison of the amplitudes in the lines between the two figures is not meaningful.

Source: Current study based on Statistics Canada data.

The reasons for the lack of growth in the Human Capital Index are complex. One simple factor is at play, however: the aging of the population. As the average Canadian worker gets older, his/her remaining years in the work force drops. Fewer years left to work translates into less lifetime income and, other things equal, less human capital. There is more to explaining Canada's weak human capital performance than this, though.

It may be that increased education spending is necessary just to maintain a given level of human capital in today's competitive global economy. In Canada, real spending on education per student did increase substantially over the period, rising from $21,950 to $30,740 (chained 2007 dollars), for an average annual growth rate of 0.97 per cent (Figure 15). It is worth noting, however, that this growth rate lags that of real net national income per capita (1.28 per cent). It is also worth noting that the majority of the increase in spending occurred at the primary/secondary level rather than the university level. Given the emphasis on advanced knowledge and skills in today's economy, it could be argued that greater investment in post-secondary education is called for.

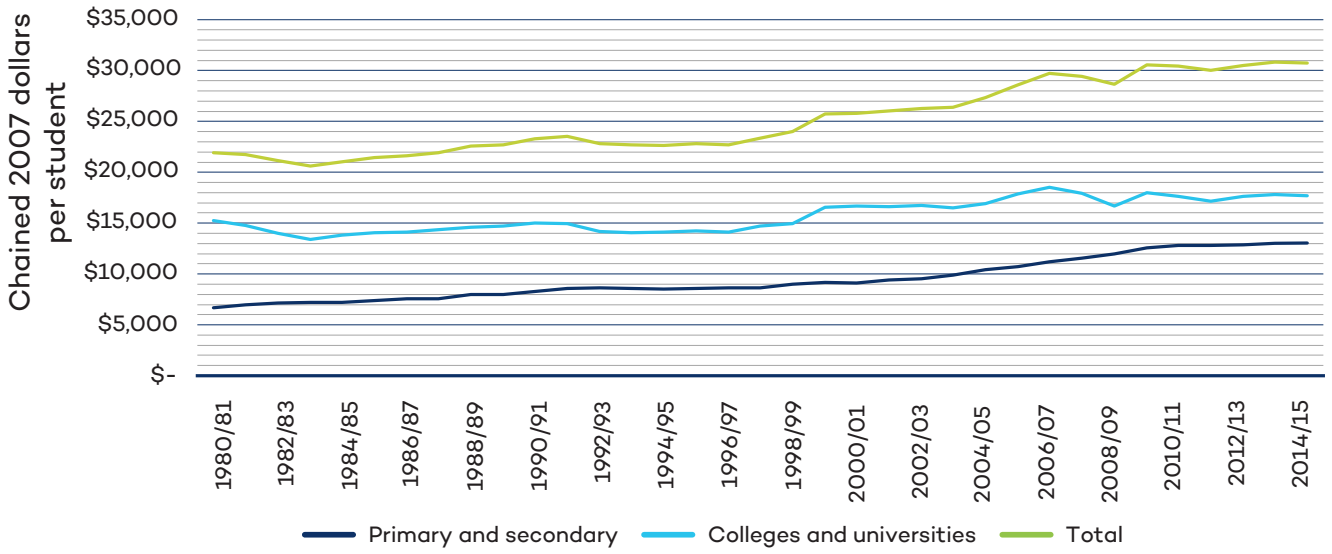

Figure 15. Education spending, Canada, 1980/81–2014/15

Note: Education spending data are not available on a calendar-year basis.

Source: Current study based on Statistics Canada data.

It could also be that the quality of education has declined over time, so that individuals are better qualified but are not necessarily better educated than in the past. It is also possible that Canadians truly are better educated than in the past but that for other reasons this did not translate into increased human capital in recent decades.

The quality of Canadian education can be partly explored by considering Canadians' performance on an international assessment of adult skills related to literacy, numeracy and problem solving in technological environments designed by the OECD and administered by Statistics Canada.[54] Unfortunately, the assessment has only been administered once in Canada, so it is not possible to determine whether adult skills have changed over time. However, Canadian results can be compared to OECD averages and provinces/territories can be compared with one another.

Canadians scored just above the OECD average for literacy in 2012 (Table 7). PEI, Nova Scotia, Ontario, Manitoba, Alberta, British Columbia and the Yukon all scored above the OECD average. Newfoundland and Labrador, New Brunswick, Quebec, Saskatchewan, the Northwest Territories and Nunavut all fell below the OECD average. Alberta was the highest-scoring jurisdiction in terms of literacy; Nunavut scored lowest.

Canada scored 265.5 in numeracy, below the OECD average of 269. All provinces and territories scored at or below the OECD average. Nationally, Alberta scored the highest in numeracy (269.1). Nunavut scored the lowest (200.5), well below the OECD average.

54 *Programme for the International Assessment of Adult Competencies.*

Table 7. Adult literacy and numeracy, Canada, provinces and territories, 2012

	Literacy		Numeracy	
	Average Score	Share of the population aged 16 to 65 scoring at or above literacy level 3[a]	Average Score	Share of the population aged 16 to 65 scoring at or above numeracy level 3[b]
Canada	273.5	51.5	265.5	45.3
Newfoundland and Labrador	265.4	45.3	251.9	34.5
Prince Edward Island	277.5	54.7	265.0	44.2
Nova Scotia	273.9	49.7	262.8	41.8
New Brunswick	268.3	46.5	255.7	36.9
Quebec	268.6	46.8	264.9	56.1
Ontario	275.5	53.2	266.3	46.2
Manitoba	273.9	51.7	264.2	45.2
Saskatchewan	271.6	50.1	262.8	43.5
Alberta	277.7	55.1	269.1	47.3
British Columbia	274.8	54.1	266.3	47.7
Yukon	277.2	55.7	263.1	44.2
Northwest Territories	253.3	36.1	239.4	30.3
Nunavut	219.1	16.9	200.5	12.5

[a] Level 3 literacy skills correspond to a score of at least 276 and imply the ability to comprehend texts that are dense or lengthy.
[b] Level 3 numeracy skills correspond to a score of at least 276 and imply the ability to understand mathematical information that may not be explicit, is sometimes embedded in unfamiliar contexts and is represented in complex ways.

Source: Current study based on Statistics Canada data.

Problem solving is assessed solely using proficiency levels. Thirty-seven per cent of Canadians scored at or above level 2 proficiency,[55] which was above the OECD average of 34 per cent. The share of inhabitants at level 2 was at least as high in all provinces/territories (other than Nunavut and Newfoundland and Labrador) as the OECD average.

Table 8. Trends in human capital indicator

Theme	Indicator	Trend
Human capital	*Human Capital Index*	↓
Education inputs	*Education Spending*	↑
Education outcomes	*Educational Attainment*	↑
	Adult Skills	No assessment of change possible

[55] Level 2 problem solving tasks typically require the use of both generic and specific technology applications. Some navigation across pages and applications is required and tasks may involve multiple steps and operators. Some integration and inferential reasoning may be needed.

3.6 Detailed Trends in Financial Capital

The treatment of financial capital within the context of comprehensive wealth is more complex than that of produced, natural or human capital. For this reason—and because financial capital was not treated in IISD's 2016 report on comprehensive wealth—the discussion in this section is somewhat more detailed than that in the preceding sections.

As explained earlier (Text Box 5), the complexity in the treatment of financial capital arises because, unlike other forms of capital, financial capital consists of assets and offsetting liabilities. The value of a personal savings account, an asset for an individual that owns it, is offset by the corresponding liability the account represents for the bank where it is held. Similarly, a mortgage on a residence is an asset for the lender but a liability for the household that took it out.

As a result of offsetting assets and liabilities, financial wealth sums to zero in cases where the assets and corresponding liabilities are both owned by Canadians (for example, a Canadian citizen's savings account held by a Canadian bank). The only financial assets that contribute to Canada's national comprehensive wealth, then, are those whose offsetting liabilities are owned by non-residents; for example, an ownership stake in a foreign firm by a Canadian resident or a foreign government bond held by a Canadian investment firm.

Since foreign financial assets can be held in either direction, it is the difference between the value of foreign financial assets (less foreign liabilities) owned by Canadians and Canadian financial assets (less liabilities) owned by non-residents that is relevant to national comprehensive wealth.

The name given to this difference is Canada's international investment position (IIPI), and it is this indicator that is the primary basis for assessing financial capital here. More specifically, financial capital is assessed on the basis of the International Investment Position Index, which measures the real per capita value of Canada's net holdings of foreign financial assets.

The trends in the International Investment Position Index are summarized below. Details of the methods and data sources used in its compilation are presented in Chapter 4 (see Indicator FC1).

This section also delves into aspects of Canada's financial capital beyond the IIPI. Although only the IIPI is relevant to comprehensive wealth at the national level, the financial capital held by individual sectors of the economy is relevant to the wealth of those sectors and therefore important to the discussion here. In what follows, particular attention is paid to the trends in household financial capital, as it is there that financial assets and liabilities most directly impact Canadians' wealth. Additional detail is also presented in Annex 7 in order to keep the discussion here to a manageable length.

3.6.1 Sources of Financial Statistics and Approach to Their Deflation

Before discussing the findings, a word is required on the data sources and deflation method used in this section.

Unless otherwise noted, all financial capital data have been taken from Statistics Canada; Text Box 10 lists the Statistics Canada data sources that have been referenced to compile the figures used in this section and in Annex 7.

It should be noted that the majority of Statistics Canada's data on financial capital are available on a consistent basis only back to 1990. Thus the discussion in this section focusses on the period 1990–2015, meaning it is not perfectly aligned with the discussion of natural, produced and human capital in the preceding sections where the timeframe also included the years 1980–1989. Where possible, financial data for periods prior to 1990 are presented (some as far back as 1961 or earlier). For the most part, though, the focus in this section is on trends during the period 1990–2015.

For the most part, Statistics Canada does not compile financial data in real (inflation-adjusted) terms, so it was necessary to deflate many of the financial data used here. To do this, we used the implicit price index for final domestic demand[56] as the price deflator. This was chosen because final domestic demand reflects the prices of a broad range of current and capital expenditure items.

Text Box 10. Statistics Canada financial capital data sources referenced

International investment position: *International Investment Position, Book and Market Values* (CANSIM Table 376-0142)

Stocks of financial assets and liabilities: *National Balance Sheet Account* (CANSIM Table 378-0121)

Investment and divestment of financial assets and liabilities; borrowing and lending by sector: *Financial Flow Account* (CANSIM Table 378-0119)

Revaluations of financial assets and liabilities: *Other Changes in Assets Account* (CANSIM Table 378-0126)

Corporate investment; saving; lending: *Current and Capital Accounts - Corporations* (CANSIM Table 380-0076)

Household disposable income; saving rate; lending; borrowing; adjustment for change in pension entitlements: *Current and Capital Accounts - Households* (CANSIM Table 380-0072)

Household financial ratios: *National Balance Sheet Accounts, Financial Indicators, Households and Non-profit Institutions Serving Households* (CANSIM Table 378-0123)

Household spending: *Gross Domestic Product, Expenditure-based* (CANSIM Table 380-0064)

Household debt payments: *Selected Indicators – Households* (CANSIM Table 380-0073)

Bank of Canada prime rate: *Financial Market Statistics, Last Wednesday Unless Otherwise Stated, Bank of Canada* (CANSIM Table 176-0043)

Housing prices: *New Housing Price Index* (CANSIM Table 327-0056)

Pension assets: P*ension Satellite Account, Pension Assets at Market Value* (CANSIM Table 378-0117)

Pension investment flows and revaluations: *Pension Satellite Account, Financial Flows* (CANSIM Table 378-0118)

[56] Statistics Canada, *Price indexes, gross domestic product*, CANSIM Table 380-0066.

3.6.2 Overall Financial Wealth: International Investment Position Index

For most of the period from 1990 to 2015, Canada's International Investment Position Index (IIPI) was consistently negative, meaning that non-residents owned more Canadian financial assets than Canadians owned foreign financial assets in real per capita terms. The trend in these years was varied but moved generally toward a diminishing gap between the two; that is, toward the net balance of foreign financial asset ownership being in Canada's favour.

In 2014, likely for the first time in Canada's history[57], the IIPI moved into positive territory, with Canadians owning more foreign financial assets than non-residents owned Canadian assets. In real per capita terms, Canadians owned about $9,000 in net foreign financial assets in 2015 compared with net foreign liabilities of about $13,800 in 1990 (Figure 16).

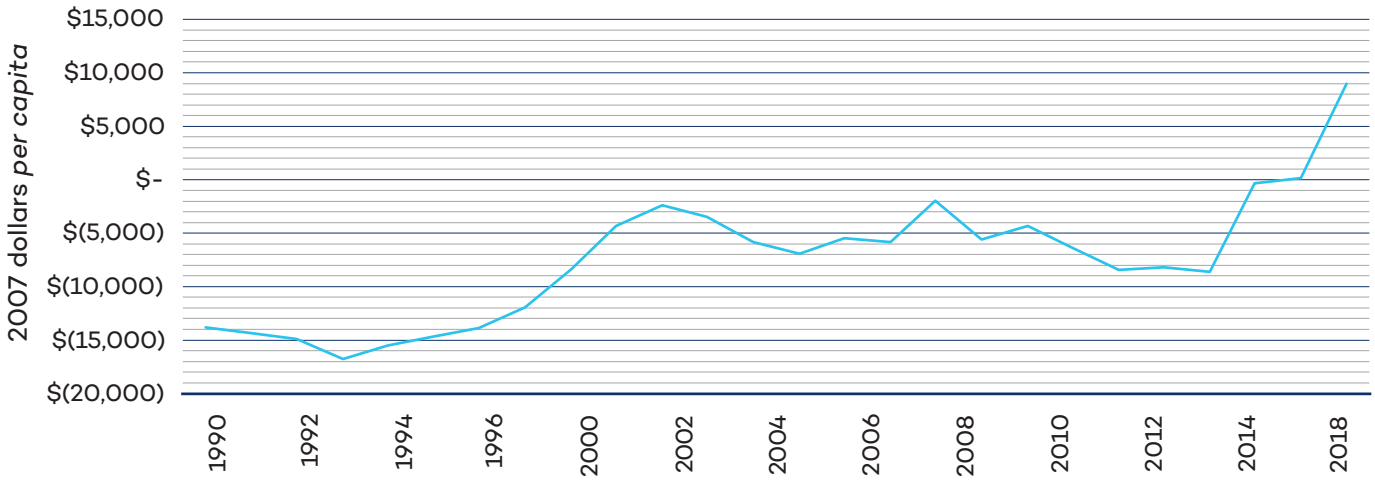

Figure 16. Canada's international investment position, market value, 1990–2015

Source: Current study based on Statistics Canada data.

It is important to note the historic move of the IIPI into positive territory in 2014 was not the outcome of increased Canadian external investment. Though Canadians did increase their holdings of foreign financial assets in 2014, foreign acquisition of Canadian financial assets outstripped Canadian acquisitions of foreign assets in that year, as it did in all years after the 2008 financial crisis up to 2015 and in most years prior to that as well.

Rather, the reason for Canada's shift into positive IIPI territory in 2014 was revaluations of Canada's financial assets due to the relatively better performance of the U.S. stock market and the decline in the value of the Canadian dollar, both of which tend to increase the Canadian-dollar value of Canada's foreign financial assets. The ongoing strong performance of the U.S. stock market and relatively low value of the Canadian dollar meant that the IIPI remained positive in 2015.[58]

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[57] It is not possible to be certain whether Canada had a positive IIP in any year prior to 2014. Certainly, it did not between 1990 and 2013. Prior to 1990, the way in which Statistics Canada estimated the IIP was different. Book values (that is, the value at which assets were acquired) rather than current market values were used as the basis for the estimates. Annual book-value estimates going all the way back to 1945 are available from Statistics Canada, with occasional estimates beginning in 1926. Over the entire period from 1926 to 2015 (and still in 2018), Canada's book-value IIP was negative in every year for which estimates are available. It is only the market-value estimate of the IIP that moved into positive territory after 2014. While there may have been a year prior to 2014 when the market-value IIP would also have been positive, there is no way of knowing this for sure.

[58] The IIPI remained positive after 2015, though it fell by nearly half in 2016 before nearly doubling again in 2017, reflecting the volatility of financial markets.

Canada's generally negative IIPI (recent years notwithstanding) reflects the country's traditional position as a net borrower of funds from the rest of the world. From 1961 to 2015, Canadian national saving was typically less than the demand for investment funds from Canadian governments, companies and households and the country has relied on lending by non-residents to make up the gap (Figure 17). The one exception to this was the period between 1999 and 2008, when Canada became a net lender to the rest of the world, borrowing nothing in net terms from foreign sources. This unique period reflected the success of governments in controlling spending, reducing their need to borrow during the late 1990s and most of the 2000s. The global financial crisis in 2008 brought this to an end, however, and governments began once again to borrow to underpin their efforts to support the economic recovery. As Figure 17 shows, foreign lending since 2009 has made up a higher share of net Canadian borrowing than average since 1961.

Although the reasons for the IIPI's likely historic move into positive territory after 2013 did not necessarily reflect underlying strength in the Canadian economy or in rates of net foreign asset acquisition, it was, nonetheless, positive from the point of view of national comprehensive wealth. Prior to 2014, when the IIPI was negative, non-residents had a claim on some of Canada's income. The flip from negative to positive in 2014 meant that Canadians were able to keep all of the income they generated in addition to having a claim on some of the income generated by other countries. This additional income and the consumption it supported represented an increase in Canadians' well-being, other things being equal. The same is true of the improvement in the IIPI that occurred earlier (1993–2000) in the time period; even though the IIPI remained negative in 2000, it was substantially less negative than it had been in 1993, meaning that other countries had less of a claim on Canadian income and leaving more of it to support Canadian consumption and well-being.

Overall, then, the trends in financial capital from 1990 to 2015 have generally been favourable for Canada.

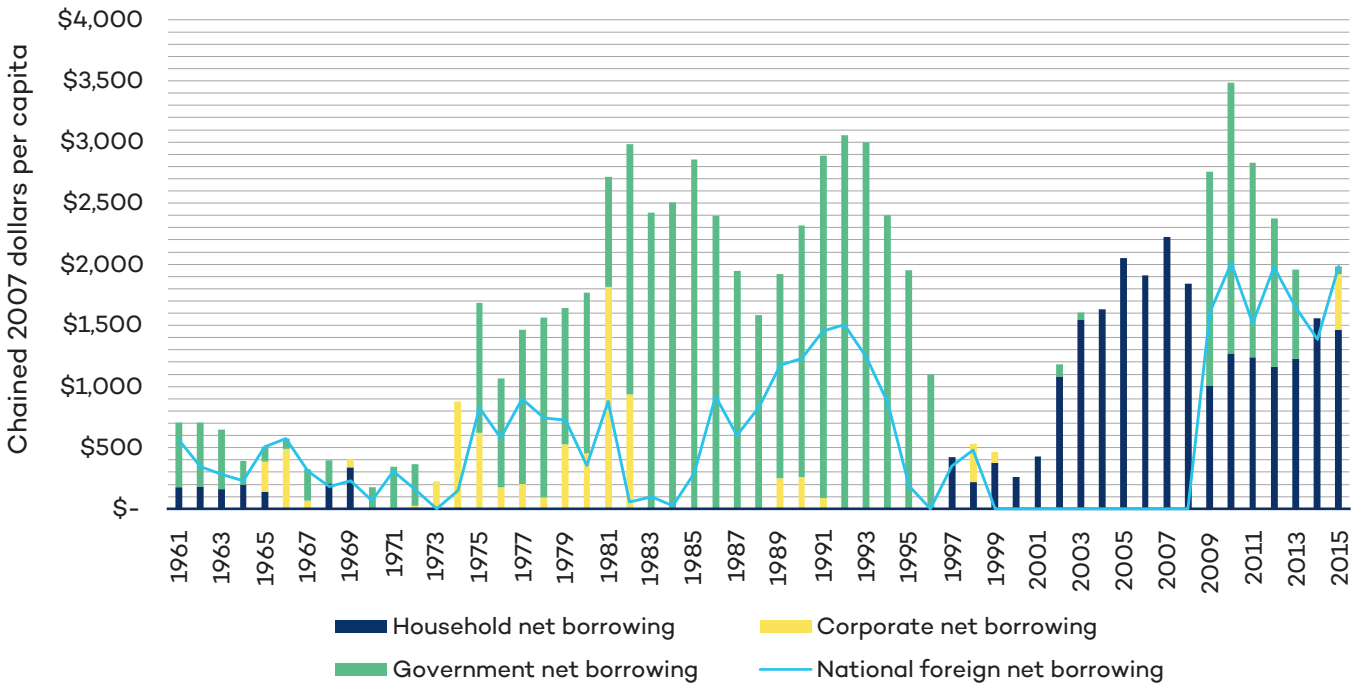

Figure 17. Borrowing by sector and total foreign borrowing, Canada, 1961–2015

Source: Current study based on Statistics Canada data.

3.6.3 Trends in Household Financial Capital

Any discussion of financial capital in Canada today has to pay attention to the household sector. Experts are increasingly focused on household trends—especially the sector's rapid accumulation of debt since the late 1990s—and their implications for financial stability. Trends in the household sector are therefore covered in considerable detail below, beginning with household spending.

3.6.3.1 Trends in Household Spending

Beginning in 1993, the household sector departed from what had been a fairly consistent pattern going back to the early 1970s of spending about 95 per cent of its total disposable income on goods and services and saving the rest. By 1997, total household expenditure on goods and services exceeded total household disposable income and did so (or nearly so) in every year from 1997 to 2015. The sector was able to do this by taking on debt to support its consumption. As a result, the sector as a whole nearly ceased saving, switching from its traditional role, dating back at least to the 1960s, as a net lender to the rest of the economy[59] and becoming a significant net borrower of funds. From the mid-2000s onward, household borrowing levels in real per capita terms were similar to the rates at which governments borrowed from the mid-1970s to the late-1990s and after 2008 (Figure 17).

This change in household behaviour coincided with the end of the period of steep declines in interest rates that began in 1981 and the beginning of a period of a slower, but steady, declines toward the historically low interest rates seen in recent years. As Figure 18 shows, this decline in interest rates coincided with a decline in the household saving rate, discussed further below, and with increases in new house prices.

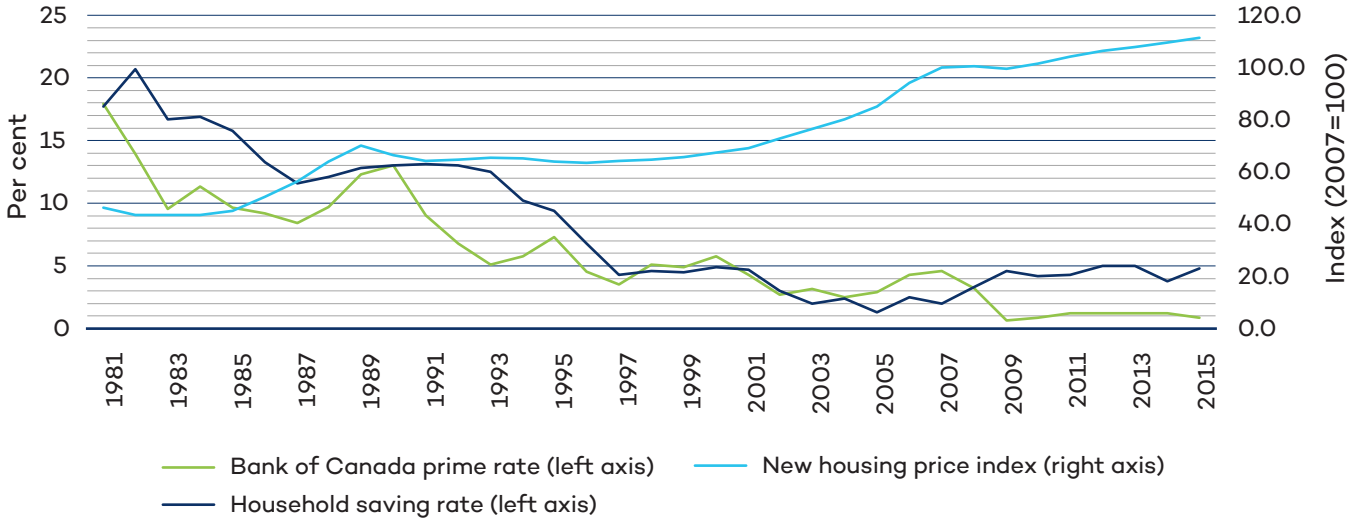

Figure 18. Bank of Canada prime rate, household savings rate and new housing price index, Canada, 1981–2015

Source: Source: Current study based on Statistics Canada data.

[59] As anecdotal evidence of how common the view of households as net lenders to the rest of the economy was prior to the turn of the millennium, the sixth Canadian edition of Samuelson, Nordhaus and McCallum's popular introductory textbook on economics stated (in bold-face, red text) that "households and other groups provide financial resources or 'funds' to those who want to purchase capital goods" (Samuelson et al., 1988, p. 664). The notion that households could be chronic net borrowers rather than net lenders of investment funds was not on the radar screen at the time.

3.6.3.2 Trends in Household Financial Assets

Almost inevitably, the low-interest-rate regime that began in 1997 resulted in households focusing on accumulation of real estate and consumer durables, as mortgage rates fell to historical lows. This accumulation came at the expense of financial assets. The share of household net worth[60] represented by real estate[61] and consumer durables rose from 44 per cent in 1999 to 57 per cent in 2015. This growth reversed three decades of household asset diversification, bringing the share of real estate and consumer durables in household net worth back to its level from the beginning of the 1970s.

Since selling homes and their contents is relatively difficult, the increasing share of household net worth tied up in real estate and consumer durables decreased the sector's liquidity. It also increased its exposure to a housing market that is witnessing historically high prices, as seen in Figure 18.

Looking at trends in financial assets more closely, the household sector steadily decreased its overall holdings of stocks and other equities as well as bonds. Households overall sold more equities than they bought in every year but one from 1999 to 2015 (Figure 19). Divestment in bonds was even more significant, with sales exceeding purchases in most years since 1990 (Figure 20).

As a result of the divestment in bonds, the total value of household bond holdings fell significantly from 1990 to 2015 (Figure 21). In contrast, even though equities also saw consistent divestment after 1997, the total value of equity holdings actually increased (Figure 22). This was the result of significant holding gains on equities in most years since 1997 due to stock market gains and, in the case of foreign financial assets, drops in the exchange rate of the Canadian dollar (Figure 23). Holding gains do, of course, represent real increases in household wealth. They are, however, at risk from market corrections and changes in exchange rates. The risk is greater when markets have been climbing for long periods of time, as was the case in North America in 2015.[62] See Section A7.1 in Annex 7 for further discussion of the importance of holding gains and other non-investment changes in household financial wealth between 1990 and 2015.

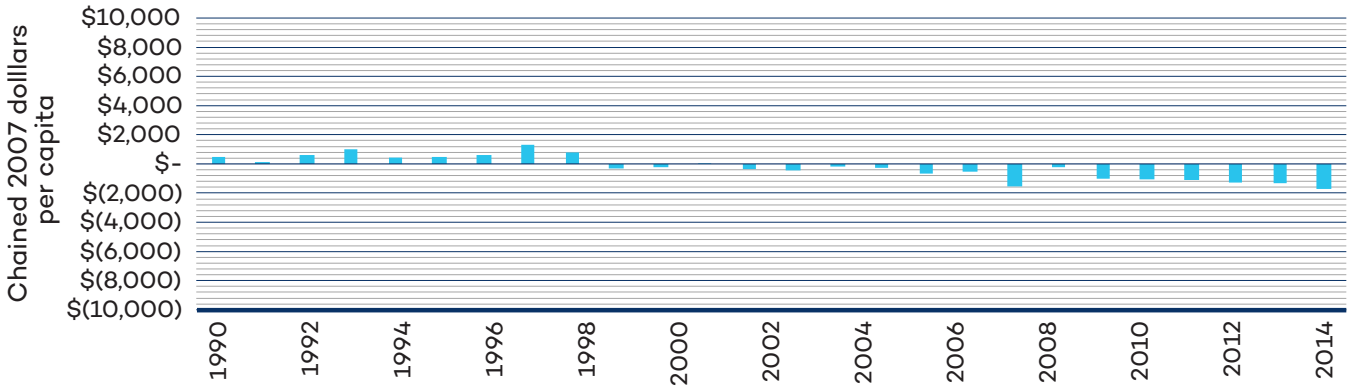

Figure 19. Net household acquisition of equities and investment funds, Canada, 1990–2015

Source: Current study based on Statistics Canada data.

[60] Household net worth is the difference between the value of total household sector assets (financial and non-financial) and the sector's financial liabilities.

[61] Residential and non-residential structures plus land.

[62] Market corrections were seen, especially in the U.S., in the winter of 2018 but it was too soon at the time of writing of this report to know what impact, if any, they might have on Canadian household financial assets.

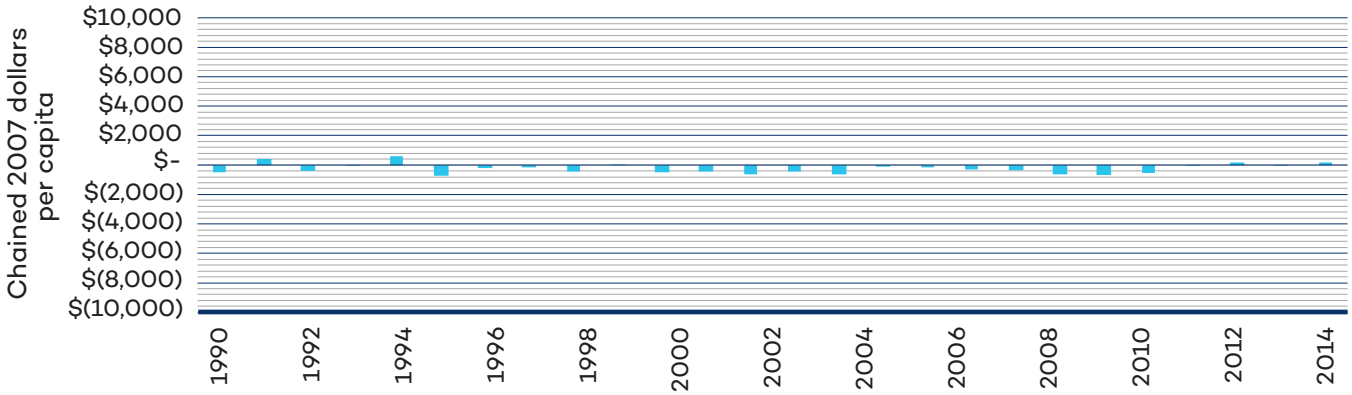

Figure 20. Net household acquisition of bonds and other debt securities, Canada, 1990–2015

Source: Current study based on Statistics Canada data.

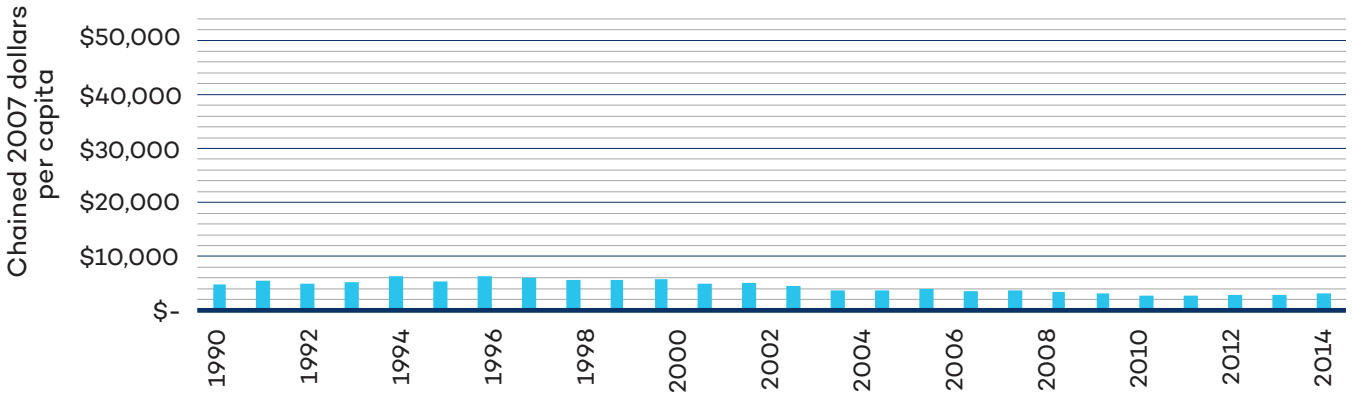

Figure 21. Household holdings of bonds and other debt securities, Canada, 1990–2015

Source: Current study based on Statistics Canada data.

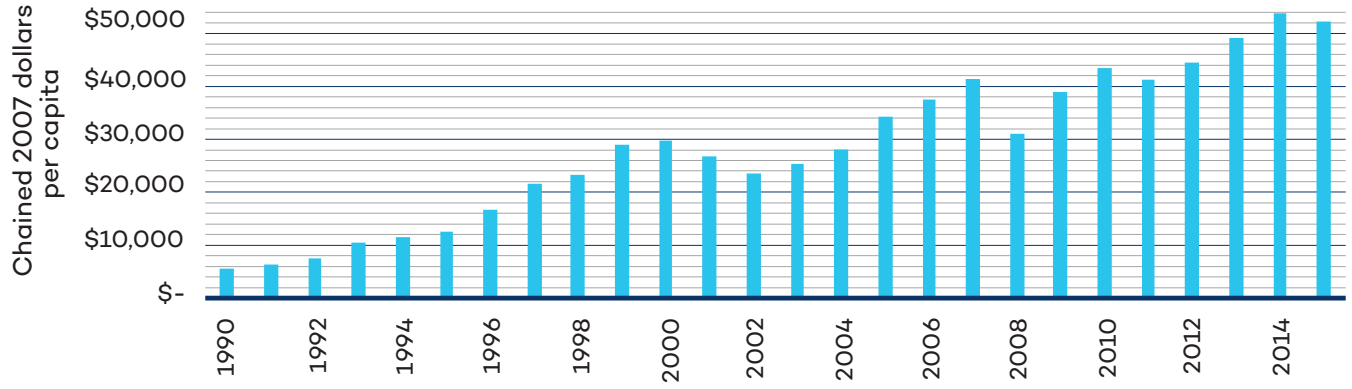

Figure 22. Household holdings of equities and investment funds, Canada, 1990–2015

Source: Current study based on Statistics Canada data.

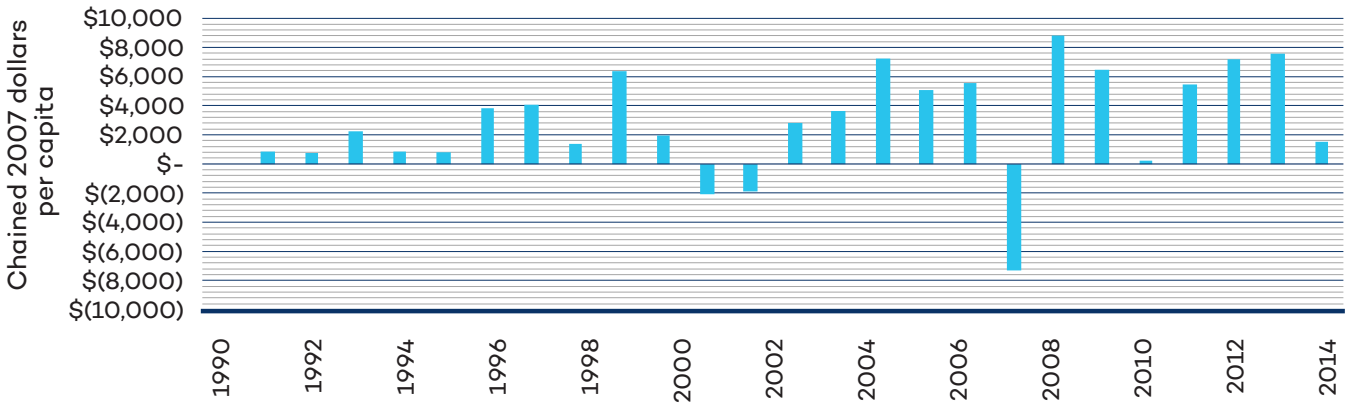

Figure 23. Holding gains on household equities and investment funds, Canada, 1990–2015

Source: Current study based on Statistics Canada data.

Beyond equities and bonds, households tended to increase their holdings of cash over the period, perhaps a sign that consumers preferred to have cash on hand to fund current expenditures as opposed to tying up savings by buying longer-term assets (like equities and bonds) to fund future consumption.

Pension assets also increased due to significant and increasing investments, especially in the categories of trusteed[63] and social security[64] pension plans that are mandatory for employees who belong to them. Discretionary investments in registered retirement pension plans (RRSP) were also significant over the period. However, unlike investments in mandatory pension plans, which grew steadily in real per capita terms, per capita investments in RRSP accounts were decreasing from 1997 onward. Section A7.2 in Annex 7 discusses changes in RRSP assets and their implications for Canadian households' readiness for retirement in more detail.

3.6.3.3 Trends in Household Financial Liabilities

As significant as the changes in household financial assets were between 1990 and 2015, the most important part of the household financial capital story played out on the liability side. Mortgages, consumer credit, lines of credit and other consumer loans all grew rapidly over the period, making the Canadian household sector the most indebted as a share of GDP among a broad group of advanced and emerging economies.[65] This growing debt load worries experts, including the governor of the Bank of Canada (Poloz, 2017), about the sustainability of household financial well-being. The buildup of debt is tightly coupled with the historically low interest-rate and rising home-price regimes that have been seen since 1997. As mentioned earlier, many households would find themselves in difficult financial straits if financial conditions were to change quickly.

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63 Trusteed pension plans are those offered by employers to their employees and include both public and private plans. Unlike non-trusteed plans such as the RRSP, participation in trusteed pension plans is not optional and employees do not determine how much of their income is invested in the plans.

64 Social security pension plans are those offered by the federal (Canada Pension Plan) and Quebec (Quebec Pension Plan) governments.

65 See Figure 2.7 (Panel A) in OECD, 2017.

When looking at financial liabilities, ratios are commonly used to assess a sector's ability to manage its debt load without undue levels of risk. Among the more important of these ratios for the household sector are:

- The ratio of household debt to disposable income
- The debt service ratio, or the amount households are obliged to pay in principal and interest each year as a share of disposable income
- The debt to net worth ratio, or the ratio of debt to the difference between total household assets and liabilities.

The trends in these indicators, which are discussed further in Section A7.3 in Annex 7, suggest that the risk associated with household sector's debt increased from 1990 to 2015:

- The ratio of debt to disposable income rose continually from 87 per cent in 1990 to 166 per cent in 2015, meaning that households were faced with much higher levels of debt relative to their incomes as time went by.
- The cost of servicing debt remained stable in spite of rising debt levels because of the historically low interest rates that have prevailed in recent years, meaning that households are vulnerable to interest rate rises.
- Debt to net worth remained stable in spite of rising debt levels because of holding gains on financial assets and heavy investment in homes, meaning that households are vulnerable to corrections in the prices of equities and/or homes, both of which are at historic highs in recent years.

These trends point out how tightly linked the financial stability of households is to low interest rates and growth in the stock and housing markets. The housing boom, which is driven in part by the historically low interest-rate regime seen since 1997, is the main investment flow driving net worth. Rising interest rates could slow housing investment and price growth, dragging net worth growth down with it. Similarly, a slowing in the stock market would dampen the contribution to net worth growth from holding gains on equities. Annex 7 (Section A7.4) discusses the risks associated with one particular form of household debt—home equity lines of credit—in more detail.

3.6.3.4 Trends in Household Saving

As noted above, household aggregate spending on goods and services exceeded disposable income (or nearly so) in every year from 1997 to 2015, breaking a pattern of the sector spending about 95 per cent of disposable income going back to the 1960s (Figure 24). On average, spending exceeded disposable income by 1.3 per cent from 1997 to 2015. Such spending is, by definition, unsustainable in the long run, as it relies on mounting levels of household debt. To the extent that it contributes to GDP growth, that growth is also unsustainable (see Annex 3 for further discussion). This is important, as household expenditure is by far the largest contributor to GDP growth; on average from 1990 to 2015, the annual increase in household expenditures accounted for 84 per cent of the annual increase in GDP.

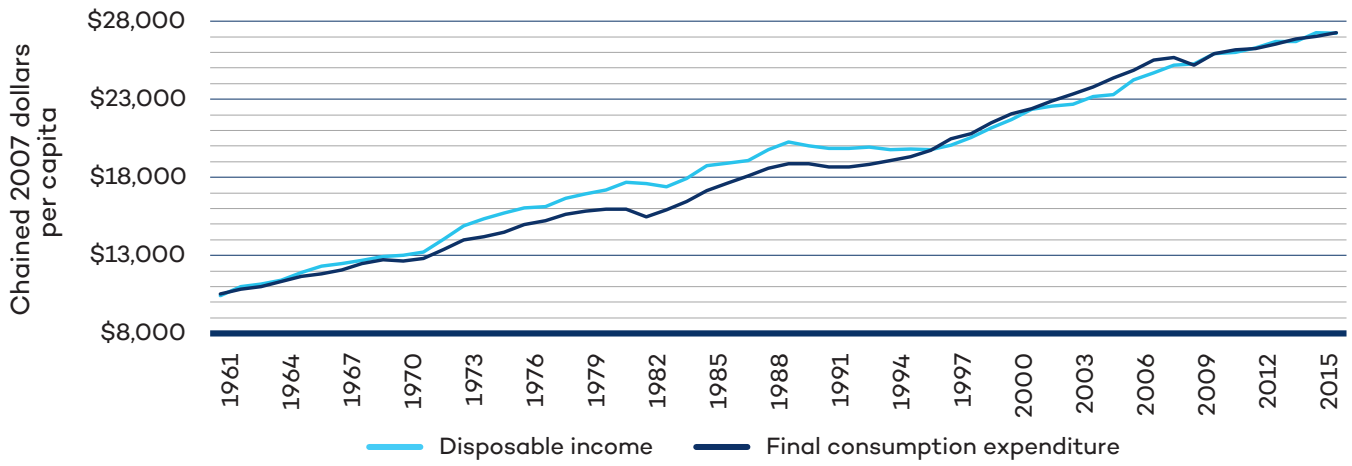

Figure 24. Household disposable income and final consumption expenditure, Canada, 1961–2015

Source: Current study based on Statistics Canada data.

Even though the household sector routinely spent more than it actually had to spend between 1997 and 2015, using consumer credit and other debt to do so, it was still saving.[66] This is because of an adjustment made to the official saving rate for the "change in pension entitlements" to account for contributions made to trusteed pension plans administered by employers on behalf of their workers. If not for this adjustment, aggregate household savings would have been negative in most years since 1997. As it was, the sector saved less than 4 per cent of disposable income on average from 1997 to 2015, compared with an average of 10.5 per cent from 1961 to 1996.

As the aggregate household saving rate fell, the sector's discretionary saving ceased entirely.[67] From 1961 to 1996, the adjustment for saving in trusteed pensions made up about 58 per cent of annual household saving on average, meaning that discretionary saving outside of mandatory pensions accounted for about 42 per cent of the sector's aggregate saving during that period. From 1997 to 2015, the pension adjustment accounted for, on average, 155 per cent of sector saving. In other words, discretionary saving (saving other than that through mandatory pension plans) made up almost half of aggregate household saving prior to 1997 and none afterward.

It must be noted that the fact that the household sector saved little in aggregate during the period from 1997 to 2015 does not mean that some individual households were not choosing to save substantially. As the discussion in Section A7.2 in Annex 7 shows, many households were indeed making RRSP, TFSA and other financial investments.

Whether Canadians household overall were saving too much or too little during this period is a complex question that is beyond the scope of this report. What does seem clear based on available data is that household saving behaviour was changing as time went by. The implications of this for long-term financial wealth deserve further analysis.

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66 The household saving rate is defined as the ratio of overall household sector savings to overall disposable income.

67 This is consistent with the discussion in Section A7.2 in Annex 7 that those under the age of 55 are holding less financial assets outside of mandatory pension assets as time goes by.

3.6.3.5 Trends in Household Lending

The declining rate of household saving meant, as noted earlier, that the household sector no longer played its traditional role as a source of investment funds for the rest of the economy after 1997. Prior to 1997, households lent a substantial portion of their annual savings to other sectors of the economy as investment capital, either directly by buying stocks and other forms of corporate debt or by lending their money to banks and other financial intermediaries to invest on their behalf. The average share of annual household aggregate saving that was lent to other sectors from 1961 to 1996 was 17.3 per cent, peaking at 80 per cent at the time of the 1981–82 recession. From 1997 to 2015, this share fell to -182 per cent; in other words, even though household aggregate saving remained positive (just) after 1997, the sector ceased to lend any funds to the rest of the economy and became a net borrower in every year to 2015 (Figure 25).[68]

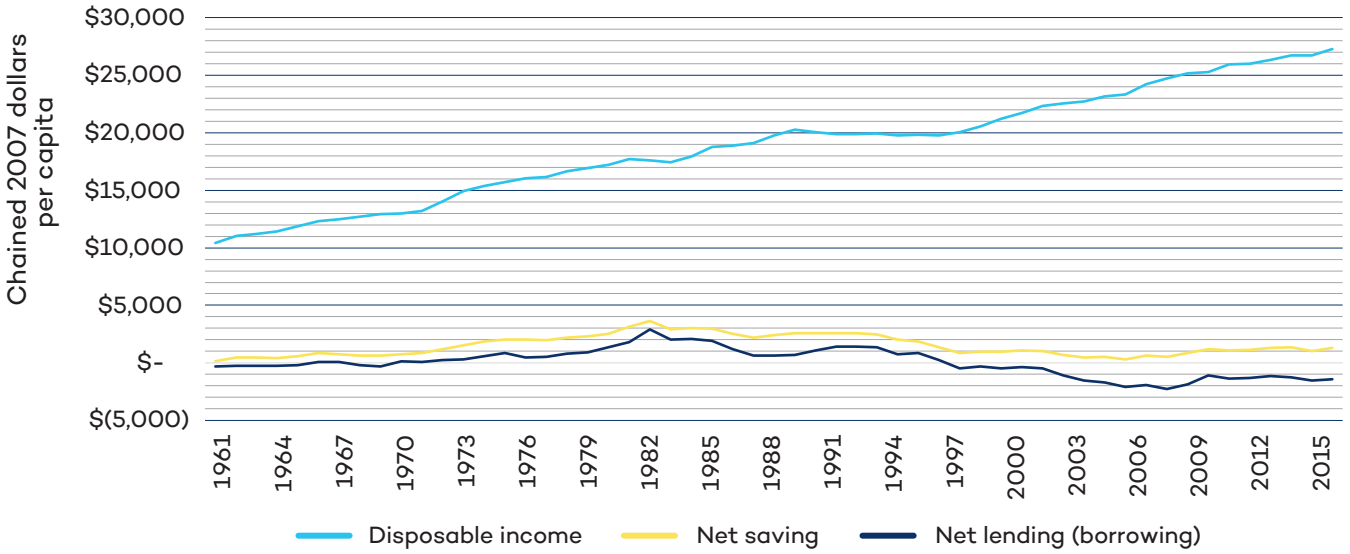

Figure 25. Household disposable income, net saving and net lending, Canada, 1961–2015

Source: Current study based on Statistics Canada data.

With households regularly borrowing after 1997, investment funds for the rest of the economy had to come from elsewhere. Until the financial crisis in 2008, governments met some of the need, as they had reversed their traditional role as net borrowers and become net lenders during that period.[69] Following the financial crisis, however, they began borrowing again in an effort to support the flagging economy. This left financial corporations (banks and other lenders) as the only Canadian sector lending money after 2011. They were able to pick up some of the slack in the supply of investment funds but could not meet it all. This left foreign lenders to provide the majority of investment funds in Canada after 2011—the first time this had been the case since the mid-1960s. Of Canadian borrowing between 2012 and 2015, foreign lenders provided 71 per cent on average compared with 28 per cent on average from 1961 to 2011. This added considerably to net foreign ownership of Canadian financial assets and, other things being equal, worsened Canada's international investment position in relative terms.

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[68] This result was inevitable because, as already noted, the only thing preventing the household saving rate from falling below zero after 1990 was the pension entitlement adjustment. This adjustment is for contributions that employees and employers make to trusteed pension plans, which are funds that households never actually have in their hands—the funds are deducted directly from paychecks. Since households cannot lend money they don't have, the dynamics of saving after 1997 inevitably meant that the household sector would be forced into an overall net borrowing position.

[69] From 1961 to 2015, 1997–2008 was the only period of any length when Canadian governments were consistently net lenders. These were the years when the federal government was focused on reducing its spending and bringing the deficit under control.

Trends in sectoral lending during this period, including the atypical role of non-financial corporations as net lenders and their accumulation of a "cash mountain," are discussed further in Section A7.5 of Annex 7.

3.6.4 Summary of Financial Capital Trends

To summarize, the well-being derived from financial capital in Canada shows both signs of strength and fragility. In terms of strengths, the country's IIPI made an historical shift into positive territory in 2014 and remained there through 2015 and beyond.[70] This meant, likely for the first time ever, that the value of the foreign financial assets owned by Canadians outstripped the value of Canadian assets owned by foreigners. This meant that Canadians finally had a net claim on some of the income generated in other countries rather than those in other countries regularly having a net claim on some of Canada's income. While undoubtedly positive from a wealth perspective, it is important to note that this trend was not actually the result of increased acquisition of foreign financial assets by Canadians. Rather, it was the result rather of favourable stock and currency market conditions that drove holding gains in the value of Canada's net foreign assets. Such gains are particularly vulnerable to changes in market conditions, as the volatility of the IIPI mentioned in the footnote below reflects.

In terms of weaknesses, a major concern is the use of debt by households to fund their overall spending over and above a sustainable level since the late 1990s. Experts are increasingly focused on the risk the historic accumulation of household debt poses to the sector and to financial wealth in general. Though some argue the risk is not significant,[71] many believe it is.[72] As the CEO of the Royal Bank put it, Canada's economy is being "driven maybe too much by the consumer," and spending, particularly on housing, "is over-driving the economy" (Bradshaw, 2018). David Dodge, former deputy minister of the federal Department of Finance and former governor of the Bank of Canada, has noted that "Canadians… are going to have to expect more normal interest rates. And that means domestic consumption really ought to [fall] off a bit. So, the economy will slow down" (Calleja, 2018). International organizations are also voicing concern, particularly around the risk associated with Canadian house prices. In a recent report on the risk of banking crises, the Bank for International Settlements[73] noted that Canada was the only major country to fall in the warning zone for financial crises based on four early-warning indicators: debt-to-GDP gap;[74] overall debt service ratio; household sector debt service ratio and the ratio of cross-border claims-to-GDP (Aldasoro, Borio & Drehmann, 2018).[75] The risk was particular high when these ratios were combined with rising house prices. The OECD has similarly noted that Canadian house prices present an elevated risk compared to other advanced economies (Figure 26). According to a recent OECD report, "a disorderly correction [in Canadian housing prices] would adversely impact growth and could threaten financial stability" (OECD, 2017, p. 114). "Housing booms," the report went on, "often lead to busts which cause severe economic downturns and banking difficulties" (OECD, 2017, p. 72).

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70 It has been quite volatile, however, falling by nearly 50 per cent in 2016 and then almost doubling again in 2017.

71 See, for example, Marion and Arseneau (2018).

72 See, for example, Carrick (2016), Curren (2017) and Bradshaw (2018).

73 The Bank for International Settlements is, effectively, the central bank of central banks.

74 The departure of the debt-to-GDP ratio from its long-term average.

75 Cross-border claims are outstanding financial liabilities of Canadian households, companies and governments to foreign banks.

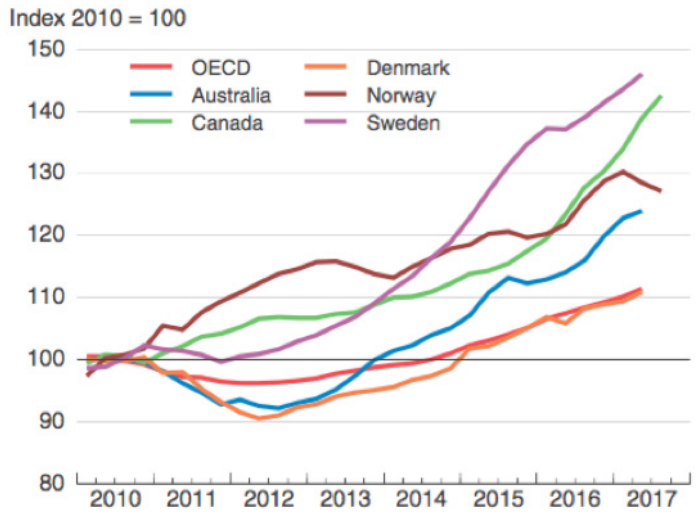

Figure 26. Index of real housing prices, Canada and selected OECD countries, 2010–2017

Source: OECD, 2017, p. 114.

The run-up in house prices has been just one result of the low-interest-rate regime that began in the late 1990s. In addition to investing heavily in real estate, the household sector departed from patterns of financial behaviour that date back several decades. In particular, since 1997 the sector has:

- Used credit to routinely spend beyond its means.
- Increased its holdings of relatively illiquid real estate and consumer durables as a share of net worth to levels not seen since the 1960s.
- Reduced its holdings of relatively liquid—and economically productive—assets such as bonds and equities.
- Amassed historically high levels of mortgage and other kinds of debt.
- Relied on favourable stock, housing and currency market gains as primary sources of growth in financial assets rather than on actual investments.
- Reduced annual levels of retirement saving through RRSP accounts and, for those under 55, reduced overall savings outside of mandatory pension plans.
- Reduced the overall saving rate to levels not seen since the early 1960s—levels that are too low to allow the sector to play its traditional role as a lender of funds to the rest of the economy—forcing Canada to borrow from foreign lenders at a level also not seen for half a century and harming (other things being equal) the country's international investment position.

The extent to which this situation represents a risk to Canadians' financial wealth is a subject of debate, with some seeing the risks as manageable and others expressing concern. Whichever side one falls on, the risks are certainly real and careful management will be required to prevent the household sector's highly leveraged position from resulting in wealth losses. Policy action to reduce the risk, particularly to cool the over-heated housing market, has already been taken.[76] Interest rates began to rise in 2017, so financial pressure is already being felt. Domestic and global political and economic uncertainty coupled with the

[76] For example, so-called "stress tests" on new mortgages from federally regulated lenders to ensure that households can manage their payments not only at their negotiated interest rates but at rates at least 2 per cent higher.

stagnation of human capital, declining natural capital and investment in produced capital discussed in earlier sections, makes the situation even more complex to handle.

3.7 Detailed Trends in Social Capital

Social capital, the remaining element of the comprehensive wealth portfolio, is the most complex of all to assess. The concepts, methods and data necessary to value it are still being developed, so no social capital index could be compiled for this study; social capital does not figure in the National Comprehensive Wealth Index presented here as a result. Instead, social capital is assessed on the basis of a suite of non-monetary indicators grouped into two themes (Table 9):

- **Civic engagement**—trends in key variables reflecting the actions and behaviours that can be seen as contributing positively to the collective life of a community or society
- **Trust and cooperative norms**—trends in key variables reflecting how people behave and expect others to behave.

The trends in the social capital indicators are summarized in the remainder of this section. Details of the methods and data sources used in their compilation are presented in Chapter 4 (see indicators SC1 through SC9). It should be noted that the frequency and time periods of the indicators differ from one to another and, for the most part, they are available less frequently and for shorter periods than is the case for the indicators of produced, natural, human and financial capital discussed above.

Table 9. Social capital indicators

Theme	Indicator
Civic engagement	• Participation in Group Activities (SC1) • Volunteering (SC2) • Diversity in Social Networks (SC3) • Control Over Public Decisions (SC4) • Voter Turnout (SC5)
Trust and cooperative norms	• Generalized Trust (SC6) • Trust in Neighbours and Strangers (SC7) • Trust that a Lost Wallet Will Be Returned (SC8) • Trust in Institutions (SC9)

Note: Bracketed text refers to the indicator number used in Chapter 4 of this report.

3.7.1 Civic Engagement

Indicators of civic engagement in Canada have largely remained stable.

Participation in group activities (Indicator SC1) rose slightly from 2003 to 2008 but then remained steady until 2013. In total, 65 per cent of Canadians participated in a group activity in 2013. Quebec had the lowest levels of participation among provinces in 2013 (57 per cent) and British Columbia had the highest (71 per cent). However, with uneven results across time and regions, there is no clear trend for this indicator.

Volunteering rates (Indicator SC2) also had no clear trend due to uneven results across time and regions. The indicator rose slightly from 2004 (45 per cent) to 2010 (47 per cent), before falling to 43.6 per cent

in 2013. Quebec again had the lowest rates among the provinces and territories, with 32.1 per cent of people volunteering in 2013. Saskatchewan had the highest volunteer rate in 2013 (56.2 per cent) (Figure 27).

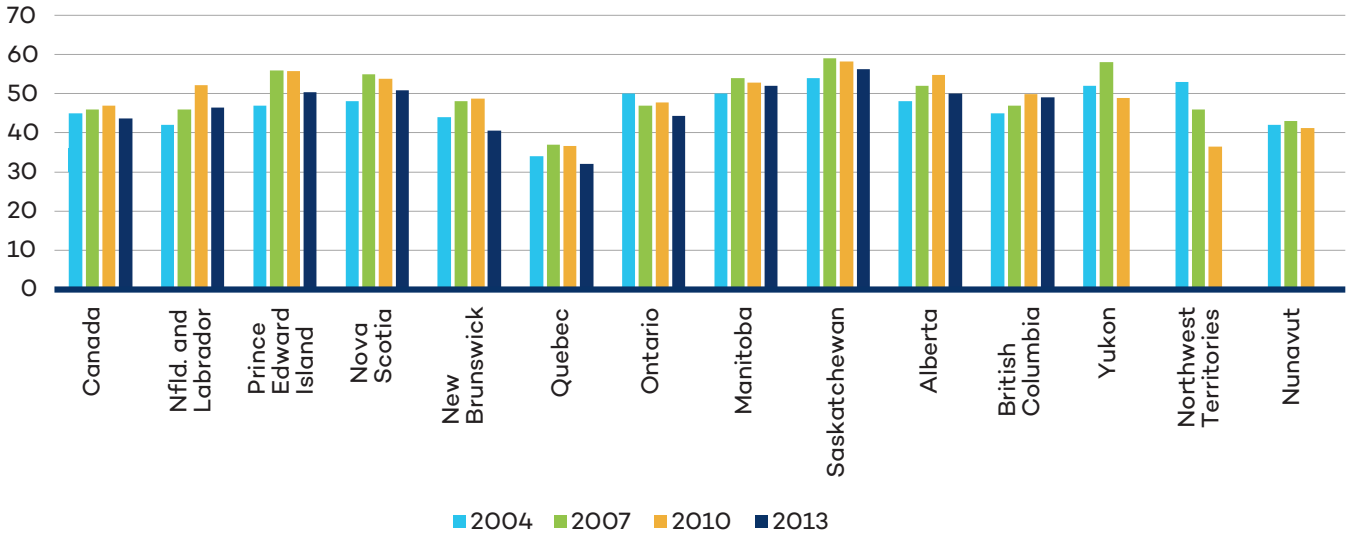

Figure 27. Volunteering rates, Canada and provinces/territories, 2004, 2007, 2010 and 2013

Note: Data are not available for the Territories for 2013.

Source: Current study based on Hall, Lasby, Gumulka, & Tryon, 2006; Turcotte, 2015b; Vezina & Crompton, 2012.

Unlike the previous two indicators, diversity in social networks (Indicator SC 3) had a clear upward trend. The indicator increased from 54 per cent in 2003 to 59 per cent in 2013 for Canada as a whole. All provinces saw an increase from 2003 to 2013. Newfoundland and Labrador, Prince Edward Island, Nova Scotia and Alberta all saw a 7 per cent increase over the period (Figure 28).

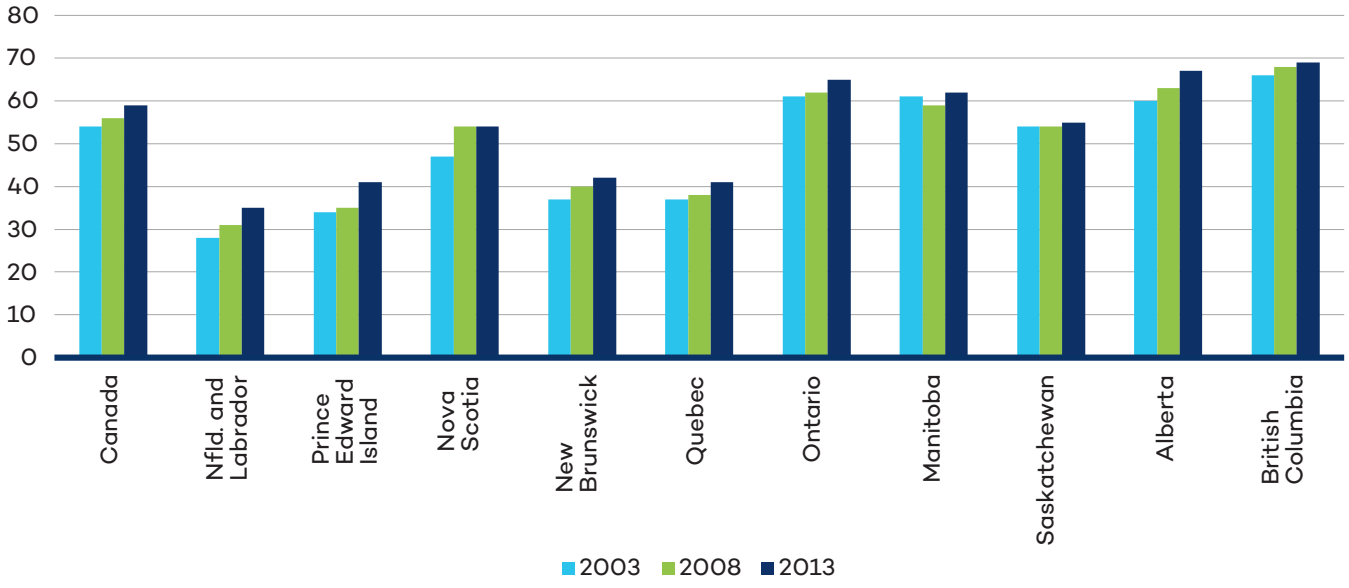

Figure 28. Share of people who in the past month were in contact with at least a few friends from an ethnic group visibly different than their own, Canada and provinces, 2003, 2008 and 2013

Source: Current study based on Statistics Canada data.

The increase in the diversity of social networks may reflect the growing diversity of Canada, as the provinces with relatively high levels of visible minorities tended to have higher levels of diversity in social networks. However, Quebec is an outlier, as it has a relatively high proportion of visible minorities but a low diversity of social networks.

After a substantial increase from 1993 to 2000, the share of people feeling that they had some degree of control over public decision (Indicator SC4) has remained more or less stable. Between 56 and 62 per cent of people have disagreed with the statement "people like me don't have any say about what the government does" since 2000.

Voter turnout (Indicator SC5) is generally highest in provincial/territorial elections, averaging 67.5 per cent in elections held between 1990 and 2015. Municipal election turnout is generally quite low, averaging only 40.3 per cent in elections over the same time period. Turnout in federal elections trended generally downward from 1980 to 2008, when it hit an historical low of 58.8 per cent but rose again in the last two federal elections (Figure 29).

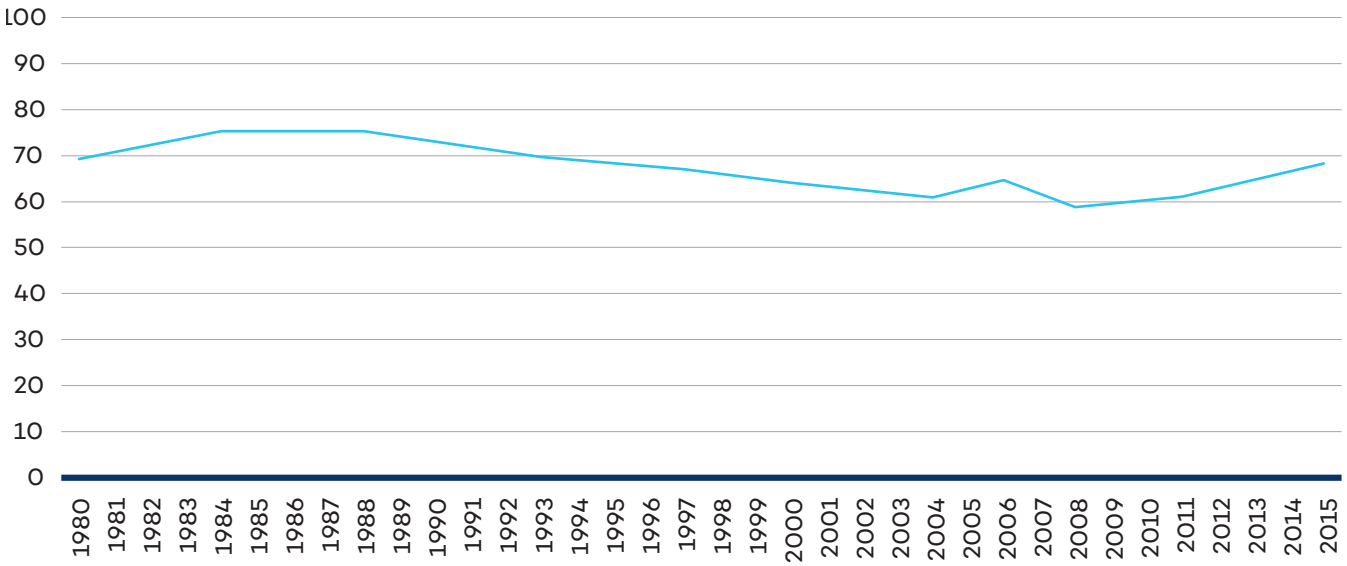

Figure 29. Voter turnout, federal elections from 1980 to 2015 (per cent)

Source: Current study based on data from Elections Canada.

3.7.2 Trust and Cooperative Norms

As with the indicators of civic engagement, indicators of trust and cooperative norms remained stable.

Generalized trust (Indicator SC6) showed essentially no change from 2003 (55 per cent) to 2013 (54 per cent). Quebec again had the lowest levels among provinces, at 36 per cent in 2013. Prince Edward Island and British Columbia had the highest levels in 2013 (63 per cent) (Figure 30). Due to uneven results across time and regions, there is no clear trend for this indicator.

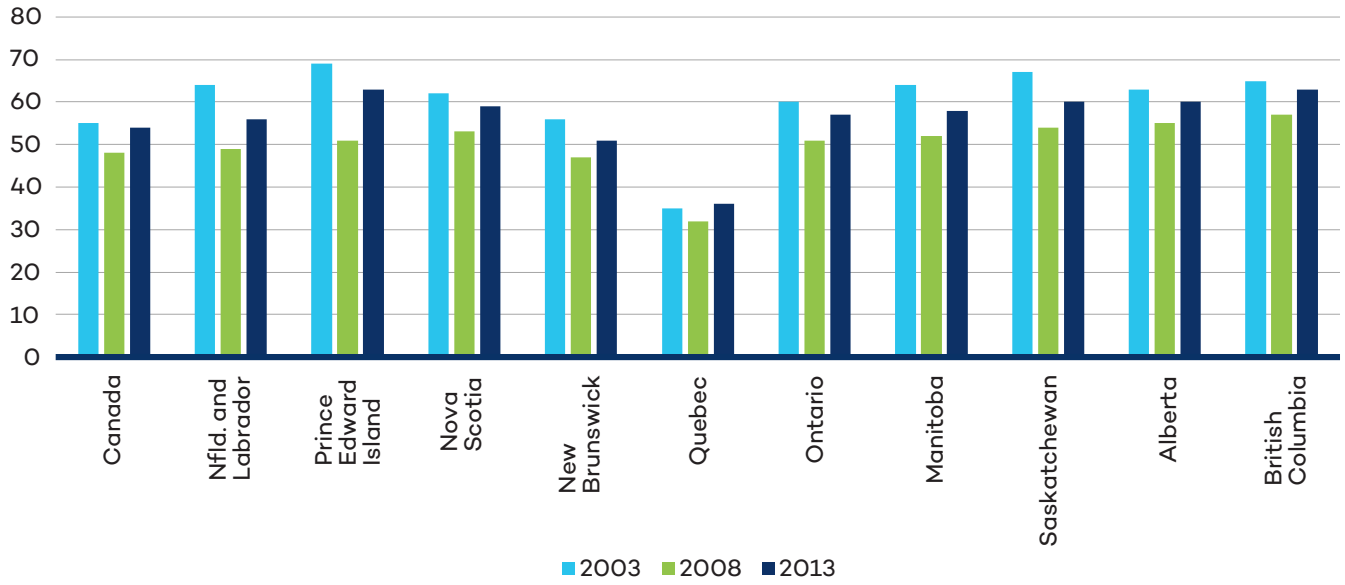

Figure 30. Share of Canadians who feel that most people can be trusted, Canada and provinces, 2003, 2008 and 2013

Source: Current study based on data from Statistics Canada.

Trust in Neighbours and Strangers (Indicator SC7) was also largely unchanged from 2003 to 2013. Trust in Neighbours was 3.7 on a scale of 1 to 5 (with 1 being the lowest) in 2013, the same as it was in 2003. Trust in strangers was 2.4 in 2013, up slightly from 2.2 in 2003. Again, Quebec scored the lowest in this indicator, with a 3.5 in 2013 for trust in neighbours and a 2.1 in 2013 for trust in strangers. In both cases Quebec was the only province below the national figure.

As with the above indicators, trust that a lost wallet will be returned (Indicator SC8) remained relatively unchanged from 2003 (46 per cent) to 2013 (45 per cent). Quebec scored the lowest, at 42 per cent in 2013.

Trust in institutions (Indicator SC9), measured as confidence in the federal government, showed a general upward trend (though it varied considerably between 1993 and 2011). In 1993, only 31.1 per cent of people reported having some degree of confidence in 1993. By 2011, more than half (55.2 per cent) of people had some degree of confidence. There has also been a shift toward trust in the governments on the extremes. The share of people expressing a great deal of confidence in the government has remained low but peaked at 6.1 per cent in 2011. The share of people with no confidence at all, on the other hand, has fallen steadily from 15.3 per cent in 1993 to 7.1 per cent in 2011 (Figure 31).

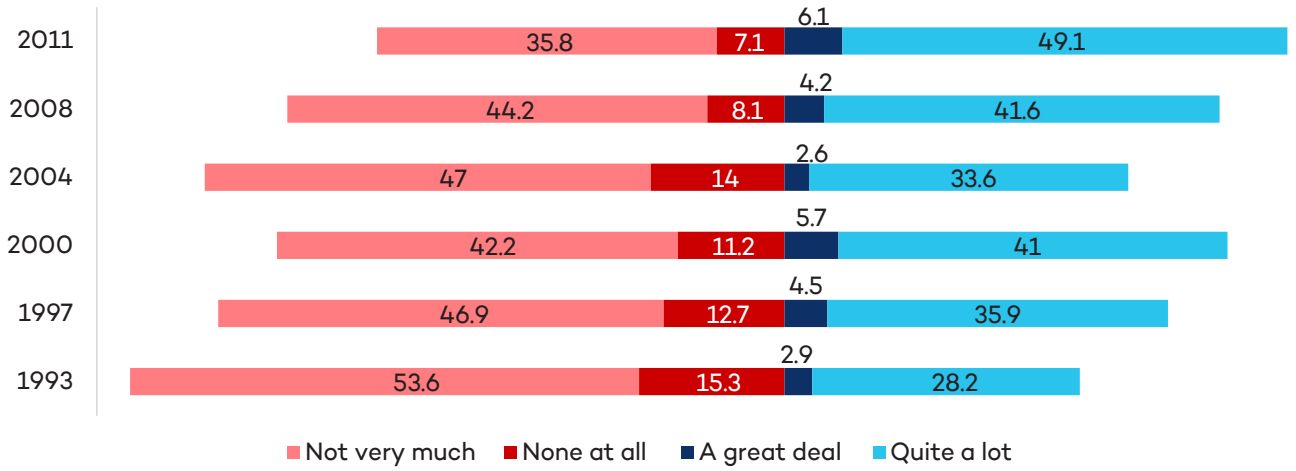

Figure 31. Share of Canadians expressing confidence in the federal government, Canada, 1993, 1997, 2000, 2004, 2008 and 2011

Source: Current study, based on Fournier et al., 2011.

3.7.3 Summary of Social Capital Trends

Overall, the above indicators paint a picture of stability, but not growth, in social capital. It must be emphasized, however, that the available time series are shorter than for the other forms of capital and several them are approaching a decade since they were last updated. Further, there is no way to look at social capital on a per capita basis. That Quebec scored lowest on a number of indicators may indicate a relatively lower level of social capital there than in other provinces.

Table 10. Trends in social capital indicators

Theme	Indicator	Trend
Civic engagement	Participation in Group Activities	↔
	Volunteering	↔
	Diversity in Social Networks	↑
	Control Over Public Decisions	↔
	Voter Turnout	↔
Trust and cooperative norms	Generalized Trust	↔
	Trust in Neighbours and Strangers	↔
	Trust that a Lost Wallet Will Be Returned	↔
	Trust in Institutions	↑

3.8 Applying a Comprehensive Wealth Lens to Decision Making

Though the main purpose of this report is to demonstrate why comprehensive wealth is a valuable lens to use in assessing national progress (that is, as a tool to evaluate whether the country is headed in the right direction on the basis of *ex post*—or historical—analysis), we also want to show how comprehensive wealth measures could lead to improved *ex ante*—or forward-looking—decision making. To that end, we discuss in this section how a comprehensive wealth lens could be applied in the decision-making process, illustrating our proposed approach with a case studies focused on a major natural resource policy decision, the proposed development of Ontario's Ring of Fire chromite deposit.

3.8.1 The Comprehensive Wealth Lens

As a lens on decision making, comprehensive wealth measures offer the possibility of focusing decision-makers' attention on issues that might otherwise not receive the attention they deserve. Most obviously, the framework draws attention to the impact of policies and projects on the assets that make up the comprehensive wealth portfolio. This alone is a significant strength since wealth, in spite of its importance in assessing sustainability, receives far less attention today than measures such as GDP.

By focusing on assets, which are by definition long-lived, the framework also draws attention to the long-term impacts of policies and projects, which can often be overshadowed by short-term benefits. Job opportunities, for example, can be both short- and long-lived and the impacts of each on human capital formation are quite different. Creation of short-term, relatively low-wage jobs in construction, for example, is not as advantageous to human capital formation as creation of longer-term, higher-wage jobs in, say, advanced manufacturing. Investments in capital-intensive projects, to take another example, may have large and positive impacts on GDP in the short term but can lock economic development into a specific path for many years to come. This may be fine if the long-term prospects for that path look good but less so if the investments are in a mature industry facing competition from rapidly emerging technologies.

Another significant benefit of comprehensive wealth as a lens on decision making is the coherent framework it offers for assessing the diverse issues that can be associated with policies and projects. Issues ranging from job creation to natural resource revenues, ecosystem health, investment flows, debt and social development can be assessed within a single framework by considering their impacts on the various elements of the comprehensive wealth portfolio. Assessing trade-offs among them is facilitated by the use of monetary measures for most elements of the portfolio. Trade-offs involving critical assets that should not be substituted by others (such as key ecosystems) are avoided by the use of separate, non-monetary measures for those.

The main focus the comprehensive wealth lens brings is, of course, on the *value* of the assets that make up the comprehensive wealth portfolio or, in the case of critical assets, on non-monetary measures of asset quantity and quality. For the sake of simplicity, we refer below to an asset's value or quantity/quality as its "size."

The basic sustainability criterion of the comprehensive wealth framework is that the size of the assets that make up the portfolio (and, therefore, the size of the portfolio itself) must be stable or increasing in per capita terms for development to be sustainable. Applied in the context of *ex ante* decision making, this means that a policy or project should be evaluated based on its projected effect on the per capita size of the comprehensive wealth portfolio. Projects/policies that maintain or increase per capita comprehensive wealth should be considered desirable and those that do not should be considered undesirable.

Note that it is not essential that that each element of the comprehensive wealth portfolio be maintained or increased in size as a result of a policy/project for it to be considered desirable. It is acceptable for some assets to be reduced in size if others are increased by an equal or greater amount, such that the overall portfolio size remains the same or grows. The assumption here is that assets are substitutable; in other words, that the goods and services produced by one asset can be replaced either with 1) the same goods and services produced by another asset (e.g., transportation services while on vacation can be provided by car or bus) or 2) by a different set of goods and services that are equally valued by consumers (e.g., consumers choose to vacation at home rather than away), such that the overall consumption of goods and services is not reduced when one asset is replaced by another. For many assets, this is a reasonable assumption. There are many possible ways to produce goods and services and many goods and services for consumers to choose from in meeting their needs. It is not, however, valid in the case of critical assets. As discussed earlier (see Section 2.3), critical assets produce goods and services that are essential to well-being and therefore any loss of a critical asset inevitably results in a loss in well-being. Thus, for a policy to be considered *ex ante* desirable through the lens of comprehensive wealth, it must not only be projected to maintain or increase the per capita size of non-critical assets but also to maintain or increase the size of critical assets.

Beyond the effect on asset size, applying the comprehensive wealth lens leads to a focus on two other dimensions of assets: their *diversity* and their *distribution*.

Diversity refers to the relative shares of different categories of assets within the overall comprehensive wealth portfolio; for example, the share of human capital in overall comprehensive wealth. It can also refer to the relative shares of different assets within a category; for example, the share of residential housing within produced capital or the share of timber within market natural capital. Asset diversity is important for the resilience of wealth and, ultimately, well-being. Just as financial advisors counsel individuals to diversify their stock and bond holdings (that is, to not have "all their eggs in one basket") as a hedge against collapse in one part of their portfolios, nations also require asset diversification. Concentration of assets in one category of capital can lead to fragility and risks to sustainability (as, we argue, is the case for Canada today due to the concentration of produced and natural assets in oil and gas).

There are several dimensions to asset **distribution**. It can refer to the relative shares of overall comprehensive wealth owned by different sectors of the economy; that is, the shares of wealth owned by households, businesses, governments and non-residents. It can also refer to the relative shares of the wealth of a given sector owned by different groups within the sector; for example, the share of total household wealth owned by households headed by individuals over the age of 65. It can also refer to the geographic distribution of assets within a country; for example, the share of wealth held by a given province.

Distribution of assets matters for reasons beyond diversity. Whereas diversification is the classic hedge against wealth losses from having "all your eggs in one basket," concern about the distribution of wealth has more to do with ensuring fairness in economic and social opportunities across groups or regions. Wealth inequality within the household sector, in particular, has received considerable attention in recent years, partly due to the work of the French economist, Thomas Piketty (2014).[77]

Given the above, a simple matrix for the *ex ante* evaluation of policy/project decisions through the lens of comprehensive wealth (Table 11) can be drawn up. In the case study that follows, this matrix is applied to show how the comprehensive wealth lens could be used in a real-world example—evaluation of the proposed development of Ontario's Ring of Fire chromite deposit.

Table 11. Simple comprehensive wealth evaluation matrix

	Impact on asset size	Impact on asset diversification	Impact on asset distribution
Produced capital			
Natural capital			
Human capital			
Financial capital			
Social capital			
Overall comprehensive wealth			

3.8.2 Case Study—Development of Ontario's Ring of Fire

In this case study, we apply the comprehensive wealth lens to the proposed development of Ontario's Ring of Fire chromite deposit. This project has been discussed for at least a decade but remains at the planning stage, with no substantial work beyond exploration undertaken to date. It would see mining and smelting of chromite ore occur within northern Ontario's James Bay lowlands, currently home to a number of Indigenous communities and largely pristine wilderness. Though the investments associated with the project have significant potential for short-term economic growth, the project also carries risks of ecological and social disruption in the longer term. Longer-term economic benefits of the project depend on demand for chromium, the metal that is refined from the ore.

In the table below, we present a highly simplified assessment of the Ring of Fire project using the comprehensive wealth lens. It should be noted that our assessment is not meant to be taken as a serious effort at evaluating the project, but as an example the kind of assessment that would be done from a comprehensive wealth perspective. Though we have provided only highly qualified qualitative assessments (all that is possible within the resources available for this study), a real assessment would replace these with robust quantitative assessments; that is, rather than saying that produced capital would "likely" increase in size, a real assessment would give a dollar figure of the amount by which it would increase. Reflecting the long-term focus of the comprehensive wealth framework, a real assessment would provide

[77] Piketty, who finds that household wealth is more concentrated globally today than any time since the First World War, argues that wealth will further concentrate in the absence of rapid economic growth or another force acting to redistribute it. On the grounds that the days of rapid economic growth in developed nations are largely past, he concludes (not without controversy) that government intervention through taxation of household wealth is necessary to avoid ever-greater concentration of wealth in the hands of the rich and the concomitant negative social and economic implications.

such figures for each year of the project's expected life (likely 30+ years), taking into account the best predictions available regarding the evolution in chromium demand. In our simplistic assessment, we have tacitly assumed this demand will remain high enough over the life the project to justify continued operation until the end of its life.

Emphasizing again that our assessment is meant only as an illustration and is not to be taken as a serious effort, it is interesting to see that the project does not pass with flying colours from a comprehensive wealth perspective. While we feel it is likely to increase the size of most non-critical assets, there are concerns about its impacts on social capital. It impacts on Indigenous communities' social capital in particular could be negative if the terms of the project are negotiated without due consideration for their concerns. Looking at critical assets, the project inevitably leads to the loss of some pristine wilderness and the opening up of that wilderness to the cumulative effects of possible future development. Though the framework cannot help resolve the trade-off between non-critical and critical assets (this may only be amenable to political resolution), it does at least lay bare the fact that the conflict exists.

As for asset diversification and distribution, the project may have relatively little to offer. It will do little to diversify Canada's economy away from its already heavy reliance on extractive industries. It may improve the distribution of some assets, increasing the share of them held in relatively underdeveloped northern Ontario, but this depends very much on whether social capital is improved or undermined by the project. Given Canada's recent record on this front, it remains an open question whether the Ring of Fire project can be assumed to be positive from this perspective.

Table 12. Comprehensive wealth assessment of the Ring of Fire chromite project

	Impact on asset size	Impact on asset diversification	Impact on asset distribution
Produced capital	**Likely positive –** Significant investments would be required in transportation infrastructure, mining and smelting machinery and equipment; and residential and non-residential buildings.	**Likely neutral to negative –** While the project would aid in diversifying Canada's produced capital away from its concentration in oil and gas extraction, it would deepen the concentration in the broader category of resource extraction industries.	**Sectoral distribution: Likely neutral –** All three sectors would likely see increases in produced capital as a result of the project. Businesses would own more mining/smelting equipment; governments would own more transportation infrastructure and households would own more residential buildings. The net effect would likely be not to change the distribution of produced capital. **Regional distribution:** Likely neutral to negative – Would improve the regional distribution of produced capital within Ontario but worsen the distribution of produced capital nationally, as Ontario already has substantial holdings relative to most other provinces.

Table 12. Comprehensive wealth assessment of the Ring of Fire chromite project

	Impact on asset size	Impact on asset diversification	Impact on asset distribution
Natural capital	**Market natural capital: Positive –** Development of the deposit would add a new mineral asset to Canada's natural capital portfolio. **Non-market natural capital: Negative –** Development of the deposit would disturb currently pristine boreal forest, with loss of the associated ecological goods and services.	**Market natural capital: Positive –** Would help diversify Canada's market natural capital portfolio away from its reliance on oil and gas and potash. **Non-market natural capital: Negative –** Would decrease ecological diversity in northern Ontario.	**Market natural capital:** **Sectoral distribution:** Likely positive – Assuming the Ontario government receives reasonable royalty payments, the value of market natural assets held by the government sector would increase. Regional distribution: Likely positive – Would improve the regional distribution of market natural assets, rebalancing wealth between oil-rich provinces and Ontario. Non-market natural capital: Negative – Would increase the share of disturbed ecosystems in northern Ontario, an area that remains largely pristine today.
Human capital	**Likely positive –** Would offer employment in an area where jobs are scarce, likely reducing unemployment.	**Likely neutral to negative –** Would increase the share of human capital devoted to resource extraction, which is already a major employer of human capital in Canada.	**Likely neutral to positive –** Nationally, would increase Ontario's human capital, which is already high relative to other provinces. Within Ontario, would shift human capital to the north, where it is low relative to other parts of the province.
Financial capital	**Likely negative to neutral –** Would require significant government funding to build infrastructure, which would likely be financed by debt from non-residents. Business sector investment could be financed domestically from corporate cash reserves and debt issuance.	**Likely neutral to positive –** Would provide an opportunity for Canadian businesses to invest some of their cash to purchase the debt needed to finance the project. Would also provide an opportunity for both households and large investors (pension funds, etc.) to invest in a new domestic project.	**Likely neutral –** Could increase the share of financial capital held by businesses and residents of Ontario, which is already high relative to other provinces. Could improve the distribution of financial assets within Ontario, shifting holdings more toward the north.

Table 12. Comprehensive wealth assessment of the Ring of Fire chromite project

	Impact on asset size	Impact on asset diversification	Impact on asset distribution
Social capital	**Difficult to predict –** Impact depends very much on how the project unfolds. Meaningful Indigenous consultations could result in positive outcomes for those communities. Those in the Indigenous and non-Indigenous populations opposed on principle to resource development are likely to be unhappy if the project proceeds. The broader Canadian population may also be dissatisfied if the project proceeds poorly (e.g., is delayed by protests, legitimate or otherwise).	**Likely neutral –** Could improve or worsen both civic engagement and trust/community norms, so social capital diversity is unlikely to change.	**Difficult to predict –** If Indigenous communities are broadly supportive of the project, could increase social capital among those communities. However, failure to negotiate in good faith could lower social capital for these same groups.
Overall comprehensive wealth	**Non-critical assets: Likely positive –** Overall, the size of most non-critical assets would likely increase or remain the same. **Critical assets: Likely negative –** Unavoidable losses of pristine wilderness. Opening up of formerly remote areas to further development, possibly creating further losses.	**Non-critical assets: Likely neutral –** Diversity of some assets would increase while others would decrease. **Critical assets: Likely negative –** Unavoidable losses of pristine wilderness. Opening up of formerly remote areas to further development, possibly creating further losses.	**Non-critical assets: Difficult to predict, but likely neutral to positive –** Impact depends very much on how the project unfolds. If social capital impacts turn out to be positive, asset distribution will likely improve overall. If not, it would likely remain unchanged, with improvements in the distribution of some assets and worsening in others. **Critical assets: Likely negative –** Unavoidable losses of pristine wilderness. Opening up of formerly remote areas to further development, possibly creating further losses.

Comprehensive Wealth

4

COMPREHENSIVE WEALTH INDICATORS IN DETAIL

In this chapter, we present the individual indicators used to assess comprehensive wealth in this study. The indicators are presented in six sections, one for overall comprehensive wealth and one each for the five elements of the comprehensive wealth portfolio.

For each indicator, the following is discussed:

- The geographic scope of the indicator
- The time series for which the indicator has been compiled
- The frequency with which the indicator can be compiled
- A description of the indicator
- The relevance of the indicator to comprehensive wealth
- The methods and data sources (and their limitations) used to compile the indicator
- The statistical reliability of indicator[78]
- An analysis of the trends in the indicator.

[78] Statistical reliability is a qualitative assessment made on the basis of the report's authors' knowledge of data quality and conceptual and methodological soundness. Indicators are rated as either "very reliable," "reliable" or "acceptable." Indicators are considered to be "very reliable" (Class 1) when they are characterized by source data that are mainly derived from highly reliable sources like Statistics Canada surveys or from other sources that are considered to be highly reliable and by concepts and methods that are based on accepted environmental, economic or statistical theory and do not require arbitrary or subjective decisions regarding important parameters. Indicators that meet all but one of the above criteria are deemed to be "reliable" (Class 2). Those that fail to meet two or more of the criteria are deemed to be "acceptable" (Class 3).

4.1
Overall Comprehensive Wealth Indicator

Indicator CW1 – Comprehensive Wealth Index

Theme: Overall Comprehensive Wealth

Geographic scope: Canada

Time series: 1980–2015

Frequency: Annual

Description: The Comprehensive Wealth Index has two variants: national and domestic. The National Comprehensive Wealth Index measures the aggregate value of real (inflation-adjusted) per capita produced, natural, human and financial capital, with financial capital measured as Canada's net foreign financial asset holdings. The Domestic Comprehensive Wealth Index measures the aggregate value of real per capita produced, natural and human capital. It is not possible at the moment to include social capital in either variant of the index—see Limitations below. Both indexes are measured in chained 2007 dollars.

Relevance to comprehensive wealth: The National Comprehensive Wealth Index (NCWI) is the broadest measure of comprehensive wealth available. By combining the values of produced, natural, human and financial capital into a single index, it offers the possibility of readily monitoring and communicating the overall trend in comprehensive wealth, just as GDP does for the overall trend in income.

The Domestic Comprehensive Wealth Index (DCWI), which excludes financial capital, reflects the productive capacity of the Canadian economy more closely than the national index. By measuring just those assets that exist within the borders of the country, the DCWI measures the wealth that is most closely tied to well-being for the majority of Canadians.

In theory, the NCWI is a nearly ideal indicator of the sustainability of well-being (Dasgupta 2001 and 2014; Dasgupta & Mäler, 2000; Hamilton & Clemens, 1999; Managi & Kumar, 2018; Stiglitz et al., 2009; UNU–IHDP & UNEP, 2012; World Bank, 2011 and 2018). This is because the assets measured by the index are the basis for producing all the "goods and services" that are "consumed" by individual Canadians. This consumption serves, in turn, as the basis for a great deal of well-being.[79] "Goods and services" and "consumption" are placed within quotation marks to indicate that the terms are used differently here from their everyday understanding. The "goods and services" produced by the assets comprising comprehensive wealth include the market goods and services that are traditionally associated with the term. They extend far beyond that, however, to include a wide range of goods and services produced and consumed outside of the market. These include tangible goods (such as subsistence food derived from the environment), that are very much like market goods, as well as services that contribute to market production but for which no payment is made (such as pollination of crops freely provided by wild insects). They also include services that contribute directly to well-being: recreational opportunities, provision of clean air and water, aesthetic enjoyment, cultural and spiritual experiences and a variety of human skills and abilities (parenting skills, for example).[80] The broad coverage of the NCWI in terms

[79] Some well-being obviously comes from within individuals themselves (such as pure spirituality) and is not provided by the assets that are included in comprehensive wealth

[80] In its ideal form the Comprehensive Wealth Index would include social capital and all of the well-being-enhancing "services" associated with civic engagement and trust; for example, security, a sense of belonging and support in times of need. With social capital included, the Comprehensive Wealth Index becomes a very complete measure of the basis of well-being.

of well-being enhancing assets is what makes it such a valuable indicator of sustainability. If the real per capita value of comprehensive wealth is increasing over time, development (that is, increasing well-being) is likely sustainable. If it is falling over time, development is unambiguously unsustainable and well-being will fall at some point in the future.

Method of calculation and data sources: The national and domestic comprehensive wealth indexes are calculated as quantity indexes of per capita produced, natural, human and, in the case of the national index, financial capital stocks.[81] Data were obtained from Statistics Canada and the index was compiled the authors of this report (Annex 8 provides details of the methods and data sources used in the compilation of the indexes).

Limitations: The major limitation of the national and domestic comprehensive wealth indexes is their exclusion of social capital, which cannot be included because the concepts, methods and data sources required to value it are not yet available. Also significant is the exclusion of a number of natural assets that cannot (or should not[82]) be valued: commercial fish stocks, surface and groundwater resources, non-commercial forests, wetlands and other ecosystems.

Inclusion of commercial timber assets in the indexes required extension of the timber volume estimate from Statistics Canada's Physical Timber Stock Account[83], which has not been updated since 2003 (see Annex 9 for details).

Statistics Canada's human capital estimates are published by the agency only in research studies and not as official national statistics. As a result, they may be less reliable than the estimates of produced and natural capital, both of which are official statistics (see Annex 1 for further discussion of the quality of human capital data).

Reliability: The national and domestic comprehensive wealth indexes are considered reliable (Class 2) rather than very reliable because the estimates of human capital are based on research results rather than official statistics.[84]

Analysis: The most comprehensive measure of wealth that can be compiled for Canada today—the NCWI—grew 8.4 per cent in total over the 35 years from 1980 to 2015. In 1980, the NCWI stood at $647,000 per Canadian (chained 2007 dollars). By 2015, it had risen to $701,000, for an annual average growth rate of 0.23 per cent (Figure 32).

Looking at the individual components of the NCWI, human capital—the largest of Canada's assets by far—was essentially flat over the period. The average Canadian held just slightly less human capital in real terms in 2015 ($496,000) than in 1980 ($498,000). Market natural capital declined at a relatively steady rate of 0.50 per cent annually, from $103,000 to $86,000 in real per capita terms (a total decline of 16.5 per cent). Produced capital increased 1.47 per cent annually, also relatively steadily, from $67,200 to $112,000 in real per capita terms (a total increase of 66.7 per cent). Financial capital increased sharply over the period, rising from -$12,300 to $9000 in real per capita terms.

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81 Specifically, the Comprehensive Wealth Index is a chained Törnqvist volume index with 2007 used as the base year to calculate annual levels ("chained dollar" quantities) of comprehensive wealth from 1980 to 2013.

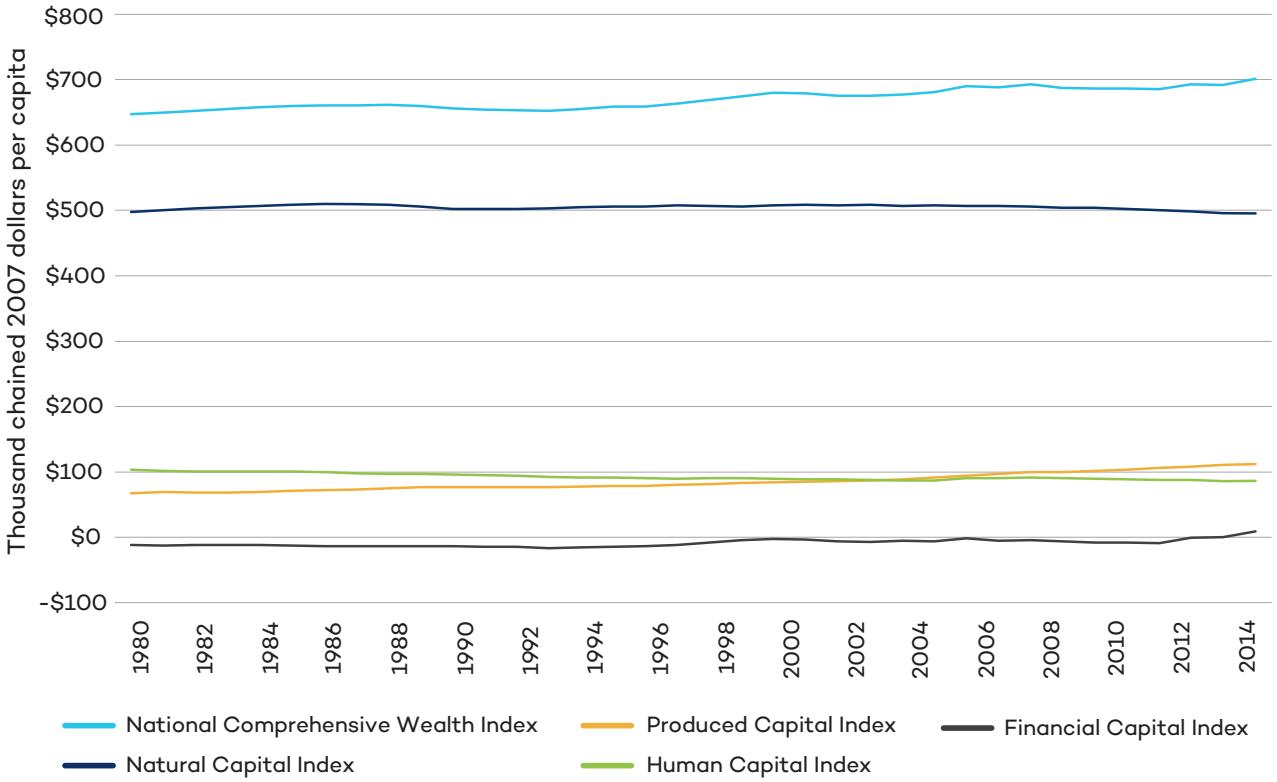
82 Some of these can be considered "critical" natural capital and are not amenable to valuation or inclusion in the Comprehensive Wealth Index. See the discussion of critical natural capital in Section 3.1 for further details.

83 Statistics Canada, *Timber Assets* (Volume), CANSIM Table 153-0030.

84 See Footnote 78 for details of the reliability scale used in this report.

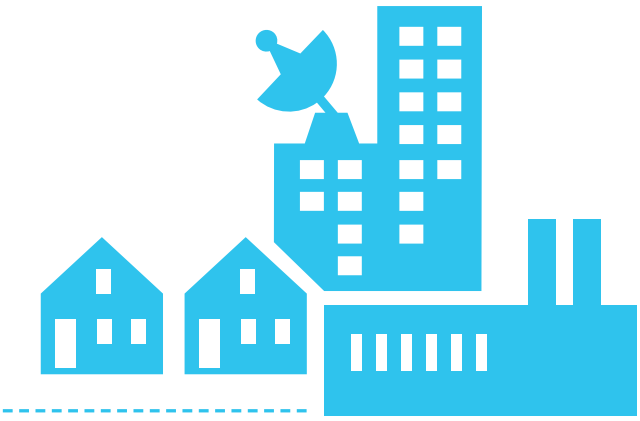
For its part, the DCWI grew 5 per cent in total over the 35 years from 1980 to 2015. In 1980, the DCWI stood at $660,000 per Canadian (chained 2007 dollars). By 2015, it had risen to $693,000, for an annual average growth rate of 0.14 per cent. The fact that the DCWI grew less and more slowly than the NCWI reflects the fact that financial capital was the most strongly growing element of Canada's comprehensive wealth portfolio over the period.

Figure 32. National Comprehensive Wealth Index and component sub-indexes, Canada, 1980–2015



Source: Current study based on Statistics Canada and other data sources (see Annex 1).

4.2
Produced Capital Indicators



Indicator PC1 – Fixed Capital Index

Theme: Produced Capital

Geographic scope: Canada

Time series: 1980–2015

Frequency: Annual

Description: The Fixed Capital Index measures the aggregate value of real (inflation-adjusted) per capita fixed capital owned by Canadian households, businesses and governments (residential buildings; non-residential buildings; roads, dams and other infrastructure; machinery and equipment; and intangible assets such as patents).

Relevance to comprehensive wealth: Fixed capital is a main factor of production in the business sector. It is a key part of the productive base upon which market output is created and therefore plays a key role in the provision of well-being-enhancing market goods and services.

Method of calculation and data sources: The index is created by combining Statistics Canada's estimates of real non-residential[85] and residential[86] fixed capital stocks (divided by population[87] to convert them to a per capita basis) into an annual volume index for 1980 to 2015.[88] It is measured in chained 2007 dollars.

Limitations: The Fixed Capital Index has no notable limitations.

Reliability: The Fixed Capital Index is considered very reliable.[89]

Analysis: The Fixed Capital Index grew at an average annual rate of 1.70 per cent between 1980 and 2015 (Figure 33). The majority of the growth in the Fixed Capital Index is explained by what happened in two areas of the economy: residential buildings and the oil and gas industry.[90] If the values of the housing stock and oil and gas extraction assets are removed from the analysis, produced capital grew at a more modest 0.98 per cent on average between 1980 and 2015.

In absolute terms, with housing and oil and gas included, fixed capital increased by about $46,500 per capita (chained 2007 dollars) over the period. When housing and oil and gas extraction assets are taken out of the analysis, the absolute increase drops to $11,900 per person and the overall level available per capita drops significantly.

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85 Statistics Canada, *Flows and Stocks of Fixed Non-Residential Capital, by Industry and Asset*, CANSIM Table 031-0005).

86 Statistics Canada, *Flows and Stocks of Fixed Residential Capital*, CANSIM Table 031-0008.

87 Statistics Canada, *Estimates of population for July* 1, CANSIM Table 051-0001.

88 Specifically, the Produced Capital Index is a chained Törnqvist volume index with 2007 used as the base year to calculate annual levels ("chained dollar" quantities) from 1980 to 2015. See Annex 8 for further details.

89 See Footnote 78 for details of the reliability scale used in this report.

90 Strictly speaking, the industry in question is the mining, quarrying and oil and gas extraction industry. The majority of capital growth in this industry is, however, related to increased investment in just the oil and gas extraction sub-industry.

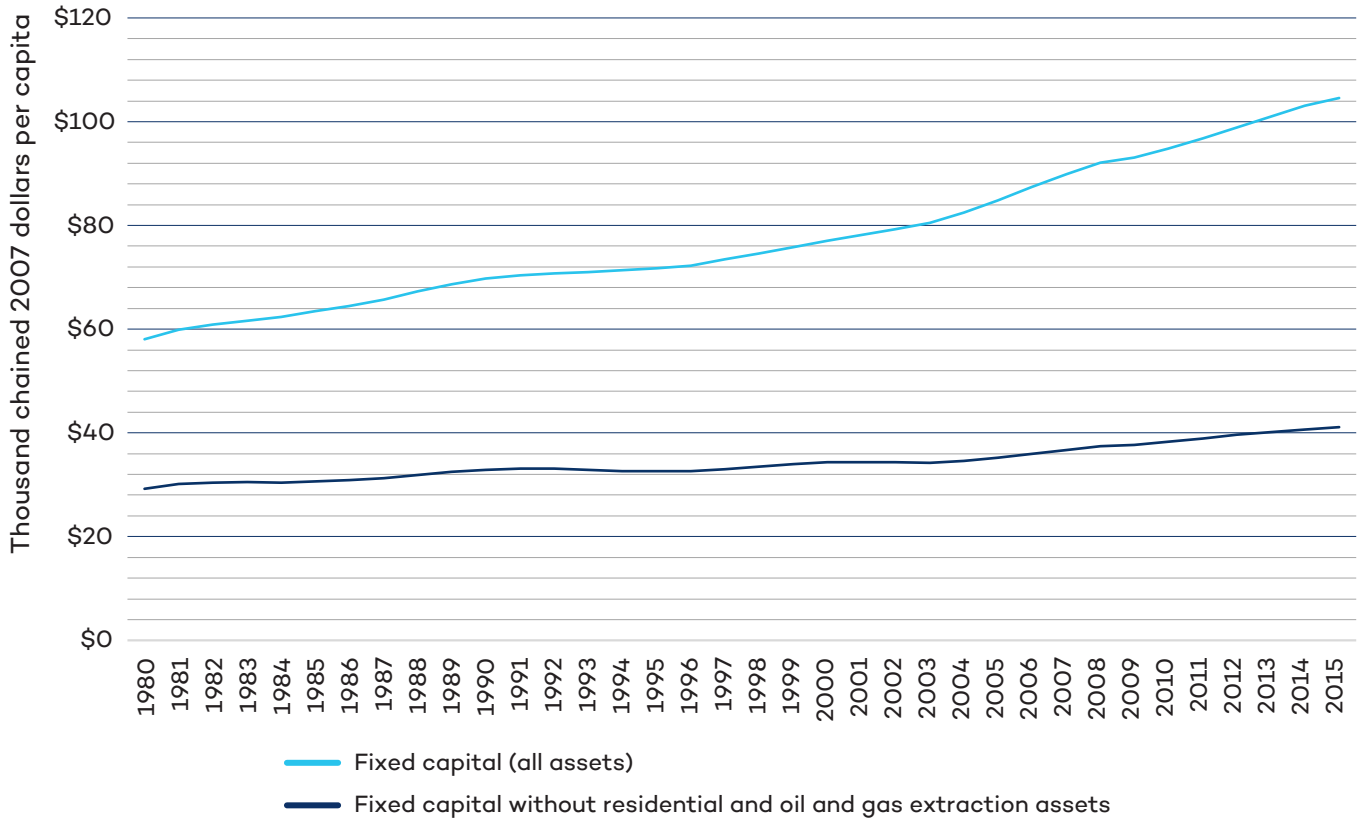

Figure 33. Fixed Capital Index, Canada, 1980–2013

Source: Current study based on Statistics Canada data.

Indicator PC2 – Inventory Index

Theme: Produced Capital

Geographic scope: Canada

Time series: 1980–2015

Frequency: Annual

Description: The Inventory Index measures the aggregate value of real (inflation-adjusted) per capita business and government inventories of materials and supplies; work-in-progress;[91] finished goods; single-use military materials and goods for resale.

Relevance to comprehensive wealth: Inventories represent a store of wealth for their owners and, therefore, are a part of the nation's comprehensive wealth. Unlike fixed capital, inventories do not generally have long lives (they are normally sold or transformed into other products by their owners over relatively short timespans) and do not figure directly in the production of other goods (other than, in some cases, being incorporated into those goods, as in the incorporation of tires from an automotive manufacturer's inventory of tires into finished vehicles). For these reasons, inventories are measured separately from fixed capital in this study.

Method of calculation and data sources: For the period 1990–2015, the Inventory Index is created by dividing Statistics Canada's annual estimate of the market value of inventories in nominal terms[92] by the implicit price index for final domestic demand[93] to adjust for inflation and by population[94] to account for population growth. The Index is measured in chained 2007 dollars per capita.

For the period 1980–1989, it is necessary to adopt a slightly more complex method, as Statistics Canada's *National Balance Sheet Accounts* are available only back to 1990 based on the most recent (2008) version of the international standard for national accounting (European Commission et al., 2009). A version of the *National Balance Sheet Accounts* based on an earlier (1993) standard is available for years before 1990[95] but it is not fully consistent with that based on the 2008 standard. In order to create a consistent time series of nominal inventory values for 1980–2015, it was necessary to blend these two time series. This was accomplished by applying the average ratio of the 2008-based estimates to 1993-based estimates for the period 1990–1996 to the 1993-based estimate for each year from 1980 to 1989.

Limitations: As Statistics Canada does not publish estimates of the value of inventories in real terms, it is necessary to prepare one for the purposes of this study. The use of the implicit price index for final domestic demand to do so, while acceptable, may result in less accurate estimates than would be available if Statistics Canada were to publish official estimates in real terms.

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91 Work-in-progress covers large, complex semi-finished goods whose production lasts more than one accounting period such as bridges or ships.

92 Statistics Canada, *National Balance Sheet Accounts,* CANSIM Table 378-0121.

93 Statistics Canada, *Price Indexes, Gross Domestic Product*, CANSIM Table 380-0066.

94 Statistics Canada, *Estimates of Population for July 1*, CANSIM Table 051-0001.

95 Statistics Canada, *National Balance Sheet Accounts,* CANSIM Table 378-0049.

The method used to blend the *National Balance Sheet Accounts* time series for 1980–1989 and 1990–2015 to create a consistent time series for 1980–2015 introduces additional error into the estimates.

Reliability: The Inventory Index is considered reliable.[96]

Analysis: After declining from 1980 to 1984, the Inventory Index remained largely unchanged at about $7,000 (chained 2007 dollars per capita) from the mid-1980s to 2015 (Figure 34).

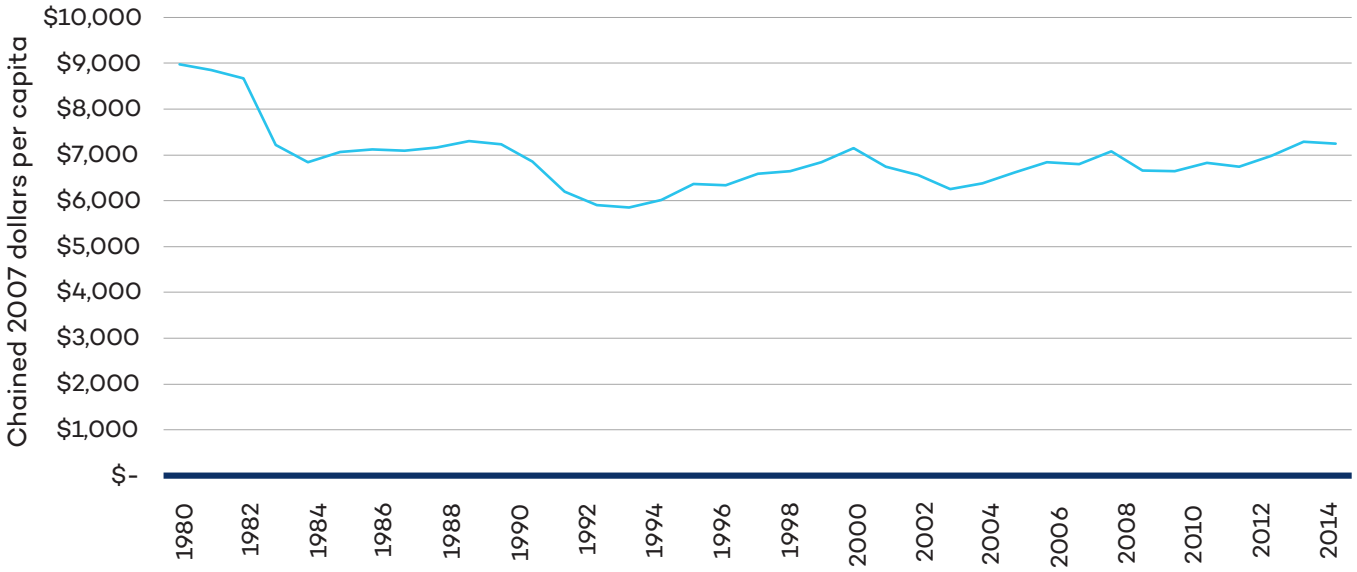

Figure 34. Inventory Index, Canada, 1980–2015

Source: Current study based on Statistics Canada data.

[96] See Footnote 78 for details of the reliability scale used in this report.

4.3
Natural Capital Indicators

Indicator NC1 – Market Natural Capital Index

Theme: Natural Capital – Market natural capital

Geographic Scope: National

Time series: 1980–2015

Frequency: Annual

Description: The Market Natural Capital Index measures the aggregate value of real (inflation-adjusted) per capita market natural capital.[97] It is measured in chained 2007 dollars per capita.

Relevance to comprehensive wealth: Natural capital is one of the four components of comprehensive wealth and a main factor of production in the business sector (along with human capital, produced capital and financial capital). It is a key part of the productive base upon which market output is created and therefore plays a key role in the provision of well-being enhancing market goods and services.

Use of the Market Natural Capital Index to measure natural capital is essential for overcoming one of the key challenges in measuring comprehensive wealth: the fact that natural assets are generally measured in physical units and that different units are used for different assets. Potash, for example, is measured in tonnes where crude oil is measured in cubic metres. As a result, their quantities cannot simply be summed, unlike produced and human capital, for which quantities are measured in dollars. Overall sustainability is difficult to assess in physical terms. For example, if the quantity of potash declines while the quantity of crude bitumen increases, is the country more or less sustainable? An aggregate index allows for the total natural asset base to be assessed and integrated with similar measures of produced and human capital to assess comprehensive wealth.

Method of calculation and data sources: The index is created by combining a Statistics Canada quantity index of fossil fuels, minerals and agricultural land[98] with estimates of commercial timber volumes and built-up land compiled by the authors[99] into an annual quantity index for 1980 to 2015.[100]

Limitations: A few important market natural resources (primarily commercial fish stocks and water resources such as hydroelectric, drinking and irrigation reservoirs) are not included in the Market Natural Capital Index due to gaps in data and methods. As a result, the value of market natural capital is somewhat underestimated by the index (see the discussion of missing assets in Annex 1 for further details). There are also non-market natural assets that contribute indirectly to market production (such as forest-based insects that provide pollination services freely to farmers and aquatic ecosystems that

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97 Market natural capital comprises fossil fuels (conventional oil, oil sands, natural gas and coal), mineral reserves (copper, diamonds, gold, iron, lead, molybdenum, nickel, potash, silver, uranium and zinc), timber stocks, agricultural land and built-up land (land under buildings and other infrastructure). Other market natural capital assets—including commercial fish stocks; the water in hydroelectric and irrigation reservoirs; aquifers used to supply drinking water; and wildlife stocks used for hunting and fishing—cannot currently be included in the index because data on their physical extent and value do not exist.

98 This index is an update of the one that appeared in a 2007 Statistics Canada article on natural resource wealth (Islam, 2007). The index was updated to 2015 by Statistics Canada at the request of the authors of this report (Islam, personal communication).

99 Until 2003, Statistics Canada made annual estimates of the volume of commercial timber assets in its *Physical Timber Stock Account*. Following the loss of the main data source, this account was suspended. The authors of this study extended this time series to 2015 for the purposes of compiling the Market Natural Capital Index. See Annex 9 for further details.

100 Specifically, the Market Natural Capital Index is a chained Törnqvist quantity index with 2007 used as the base year to calculate annual levels ("chained dollar" quantities) from 1980 to 2015. See Annex 8 for further details

regulate water quality and prevent floods) that could be valued and combined into a separate index of non-market natural capital.

Reliability: The Market Natural Capital Index is considered very reliable, with the exception of the extended estimates of commercial timber volumes and built-up land areas compiled by the authors of this study, which can be considered only acceptable. Overall, the Market Natural Capital Index is considered reliable.[101]

Analysis: The Market Natural Capital Index fell significantly from 1980 to 2015 (Figure 35). The real per capita value of Canada's market natural capital fell by from $103,000 in 1980 to $86,000 in 2015, a total decline of 17 per cent and an average annual decline of 0.5 per cent. The rate of decline was steady over the period with the exception of the mid-2000s, when significant additions to physical reserves of oil sands and, to a lesser extent, potash drove the value temporarily upward.

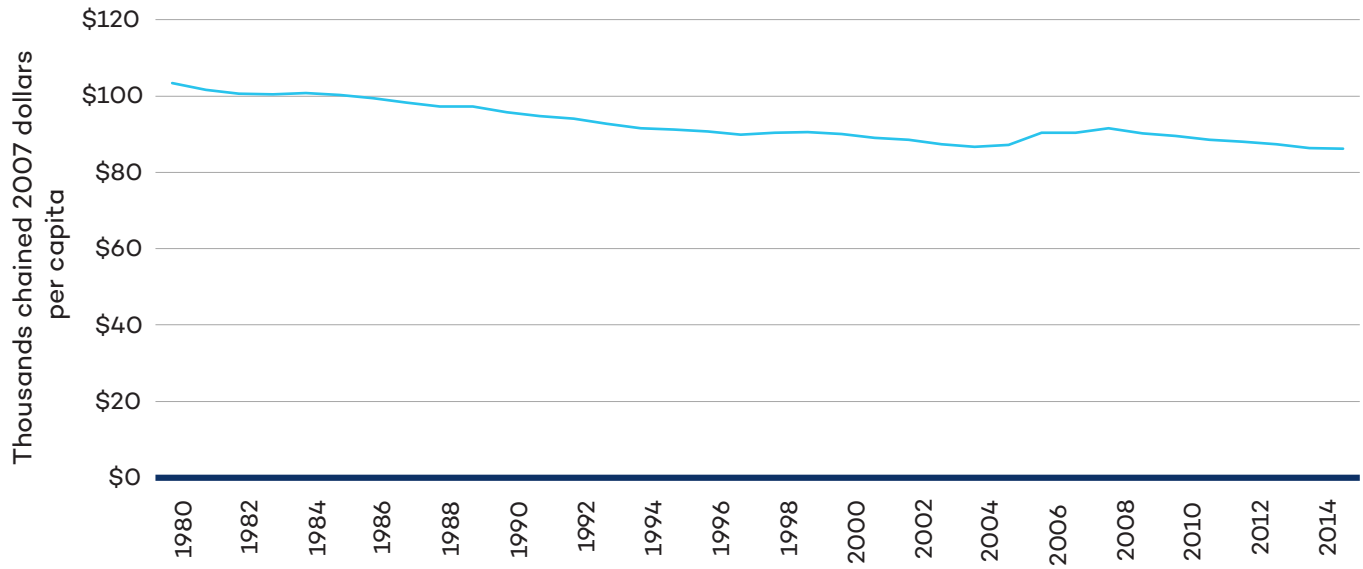

Figure 35. Market Natural Capital Index, Canada, 1980–2015
Source: Current study based on Statistics Canada and other data sources (see Annex 1).

[101] See Footnote 78 for details of the reliability scale used in this report.

Indicator NC2 – Forests[102]

Theme: Natural Capital – *Ecosystems*

Geographic Scope: National by province and territory

Time Series: 2000 and 2011

Frequency: Intermittent

Description: This indicator presents changes in the area of Canada's forest ecosystems at the level of provinces/territories between 2000 and 2011 and an assessment of the quality-adjusted extent of forest ecosystems in 2011 taking into consideration pressures on forest ecosystems as a result of cumulative human development of the landscape (roads, buildings, infrastructure and inhabited areas).

Relevance to comprehensive wealth: Canada has more than 3.4 million square kilometres of forest cover, amounting to about 38 per cent of its land area. Forests provide ecosystem goods services such as timber, water purification, climate stabilization and recreational/cultural experiences that contribute very significantly to Canada's wealth. They are also important habitat for various wildlife species.

Method of calculation and data sources: The estimates of forest ecosystem extent are derived from the *Land Cover Time Series* (LCTS) spatial dataset compiled by the Canada Centre for Remote Sensing (2012). This is the most current, publicly available land-cover dataset that provides complete coverage of Canada. To determine the impact of cumulative human development on forests, a spatial dataset of human land use was created by Global Forest Watch Canada (GFWC). This dataset was intersected with the LCTS to determine where forests are "developed" (that is, under pressure from immediately surrounding human land uses) and "undeveloped" (that is, far enough from any human land use to be considered free from direct human influence). Forest is considered "developed" if it is within 1 kilometre of a linear feature like a road or a pipeline or within 10 kilometres of other types of human land uses (for example, mines, dams or inhabited areas).

Limitations: This indicator has no major limitations aside from the irregularity of the underlying data required for its compilation.

Reliability: Forests is considered reliable.[103]

Analysis: The area of forest ecosystems declined by 164,170 km^2 between 2000 and 2011 (Figure 36). The most significant changes occurred in Saskatchewan, with a decrease of over 14 per cent in forest area, and the Yukon, where forest area decreased by 7 per cent. The area of land classified as "post-disturbance" (that is, burned forests and shrubland/low vegetation cover) increased from 642,650 km^2 to 811,480 km^2 over the period, indicating that most of the forest loss was due to fire or pest infestations.

Despite the immense area of forests in Canada, cumulative human development exerted a significant impact on the quality of forest ecosystems in 2011. Over 1.5 million km^2 (39 per cent) of all forests were found within 1 kilometre of a linear development feature such as a road or a pipeline or within 10 kilometres of a mine, dam, inhabitation or other human land use (Figure 37). The Maritime provinces, Alberta and British Columbia all had greater than 50 per cent developed forests.

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[102] Further details on the methods used in the compilation of the ecosystem indicators are available in Annex 10.

[103] See Footnote 78 for details of the reliability scale used in this report.

Unsurprisingly, the least impacted (or most intact) forest ecosystems were those found in the northern portions of Canada (Map 1).

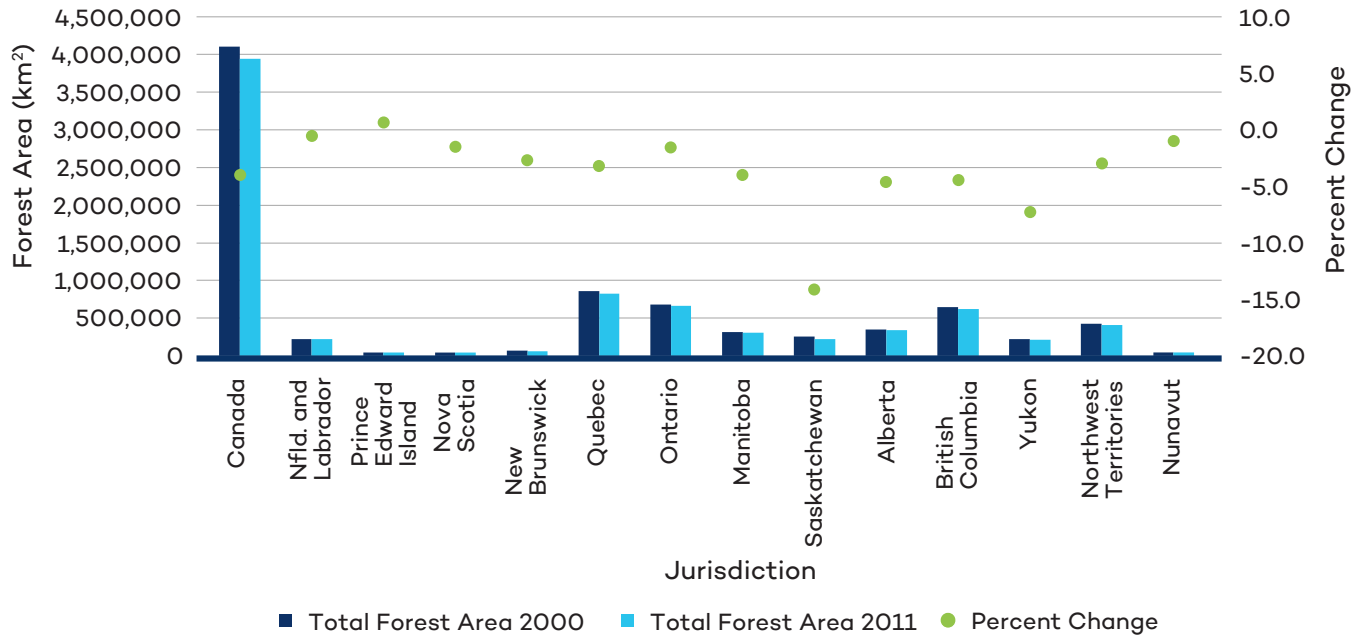


Figure 36. Forest ecosystem area and percentage change, Canada and provinces/territories, 2000–2011

Source: Global Forest Watch Canada.

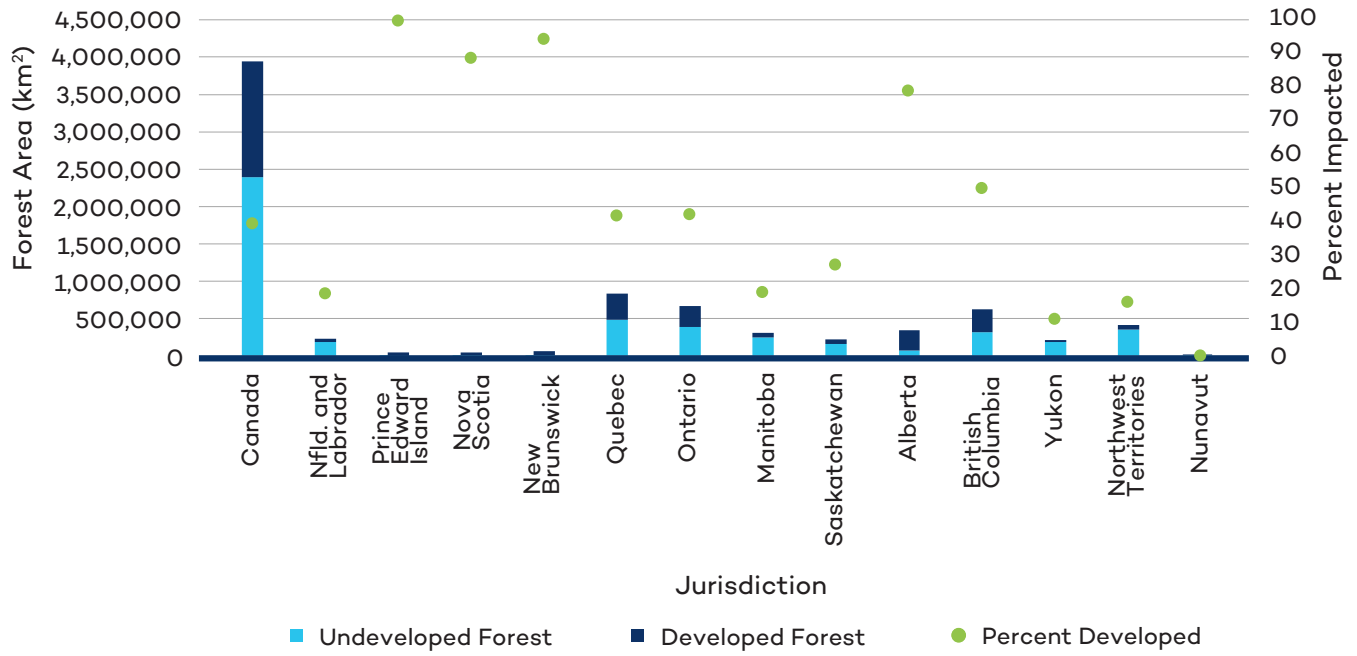
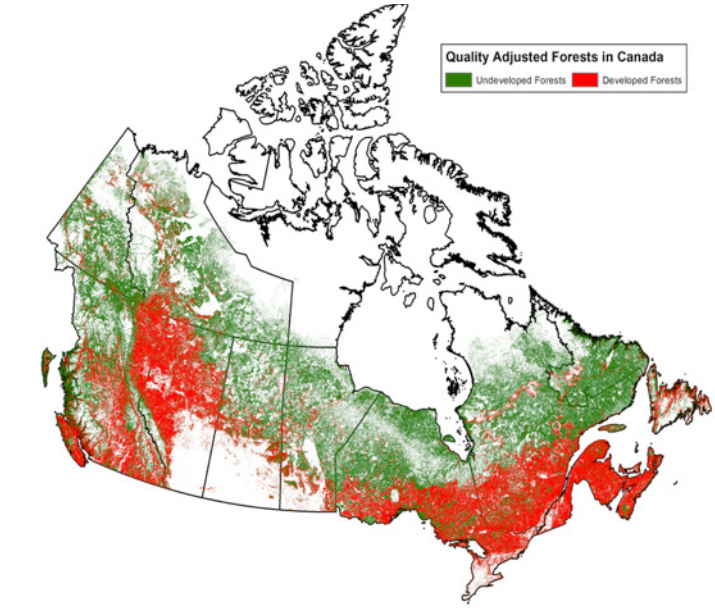


Figure 37. Quality-adjusted forest ecosystem extent, Canada and provinces/territories, 2011

Source: Global Forest Watch Canada.



Map 1. Quality-adjusted forest ecosystems, Canada, 2011

Source: Global Forest Watch Canada.

Indicator NC3 – Wetlands[104]

Theme: Natural Capital – *Ecosystems*

Geographic Scope: National by province and territory

Time Series: 2000 and 2011

Frequency: Intermittent

Description: This indicator presents changes in the area of Canada's wetland ecosystems at the level of provinces/territories between 2000 and 2011 and an assessment of the quality-adjusted extent of wetland ecosystems in 2011 taking into consideration pressure on wetlands as a result of cumulative human development of the landscape (roads, buildings, infrastructure and inhabited areas).

Relevance to comprehensive wealth: Wetlands cover 14 per cent of Canada's landmass. They provide essential ecosystem services such as flood regulation, water purification, carbon storage and recreational opportunities but are rapidly changing. Saskatchewan, for example, may have lost as much as 70 per cent of its wetlands since European settlement (Statistics Canada, 2013a).

Method of calculation and data sources: The estimates of wetland ecosystem extent are derived from the *Land Cover Time Series* (LCTS) spatial dataset compiled by the Canada Centre for Remote Sensing (2012). This is the most current, publicly available land-cover dataset that provides complete coverage of Canada. To determine the impact of cumulative human development on wetlands, a spatial dataset of human land use was created by Global Forest Watch Canada (GFWC). This dataset was intersected with the LCTS to determine where wetlands are "developed" (that is, under pressure from immediately surrounding human land uses) and "undeveloped" (that is, far enough from any human land use to be considered free from direct human influence). Wetlands are considered "developed" if they are within 1 kilometre of a linear feature like a road or a pipeline or within 10 kilometres of other types of human land uses (for example, mines, dams or inhabited areas).

Limitations: This indicator has no major limitations aside from the irregularity of the underlying data required for its compilation.

Reliability: Wetlands is considered reliable.[105]

Analysis: Nationally, wetland area decreased by 3 per cent from 411,653 km^2 in 2000 to 399,893 km^2 in 2011. Wetlands declined in area in most provinces, the exceptions being the Maritime provinces, the Yukon and Nunavut. The largest decreases in absolute terms were in Manitoba, with a loss of 2,888 km^2 (3 per cent), followed by Quebec (2,173 km^2; 6 per cent), Alberta (1,898 km^2; 5 per cent), Saskatchewan (1,809 km^2; 9 per cent) and Ontario (1,607 km^2; 1 per cent) (Figure 38).

Cumulative human development exerted considerable pressure on wetlands in 2011 (Figure 39 and Map 2). Nationally, 21 per cent of all wetlands (over 85,000 km^2) were found within 1 kilometre of a linear development feature such as a road or a pipeline or within 10 kilometres of a mine, dam, inhabitation or other human land use. Regionally, levels of wetland development were especially high in the Maritimes, where over 90 per cent of wetlands could be considered developed.

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104 Further details on the methods used in the compilation of the ecosystem indicators are available in Annex 10.

105 See Footnote 78 for details of the reliability scale used in this report.

Ontario had the largest extent of wetlands in 2011 (129,840 km^2, mostly in the northern part of the province), most of which was undeveloped. Manitoba had the second greatest area (88,366 km^2), of which almost 11 per cent was affected by cumulative development.

Alberta was unique in a number of regards. It was the only province that had a large absolute area of wetlands (35,940 km^2), a high level of development (74 per cent), and a high absolute loss (1,900 km^2). It was also the only province in which northern wetlands were highly developed. All of this reflects the impact of the dense network of linear development features (such as roads, pipelines and seismic lines) in the northern part of the province.

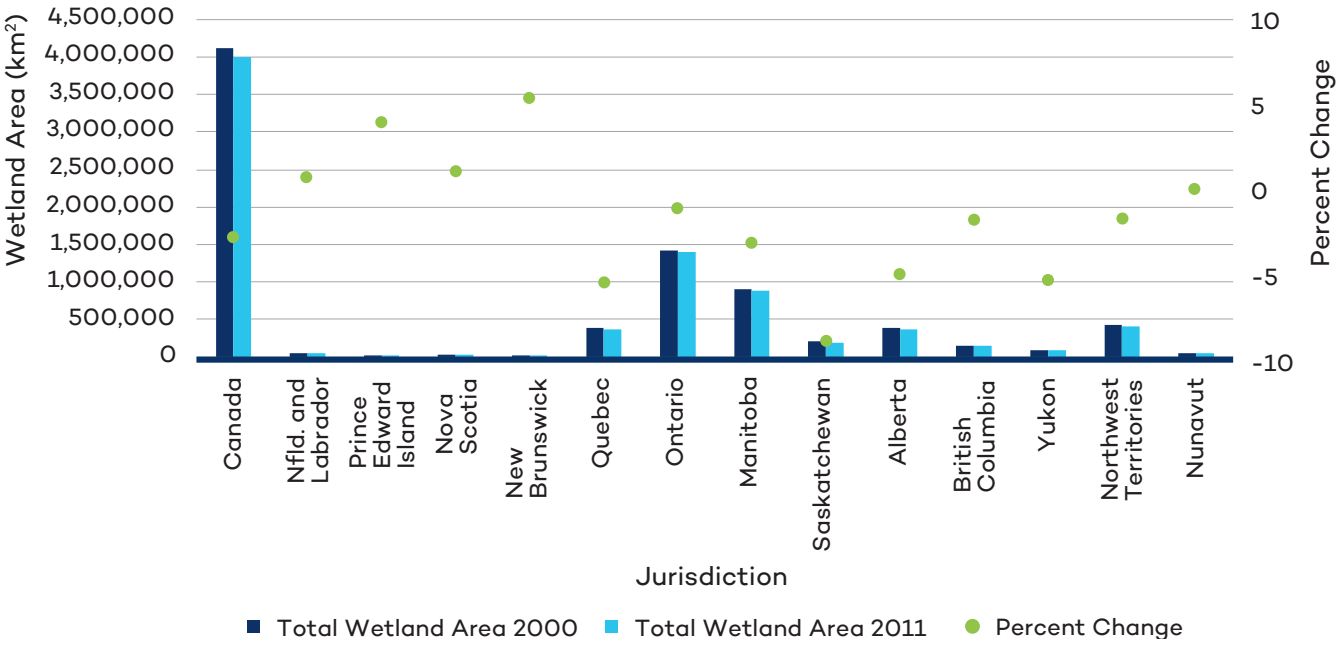


Figure 38. Wetland ecosystem extent and per cent change, Canada and provinces/territories, 2000–2011

Source: Global Forest Watch Canada.

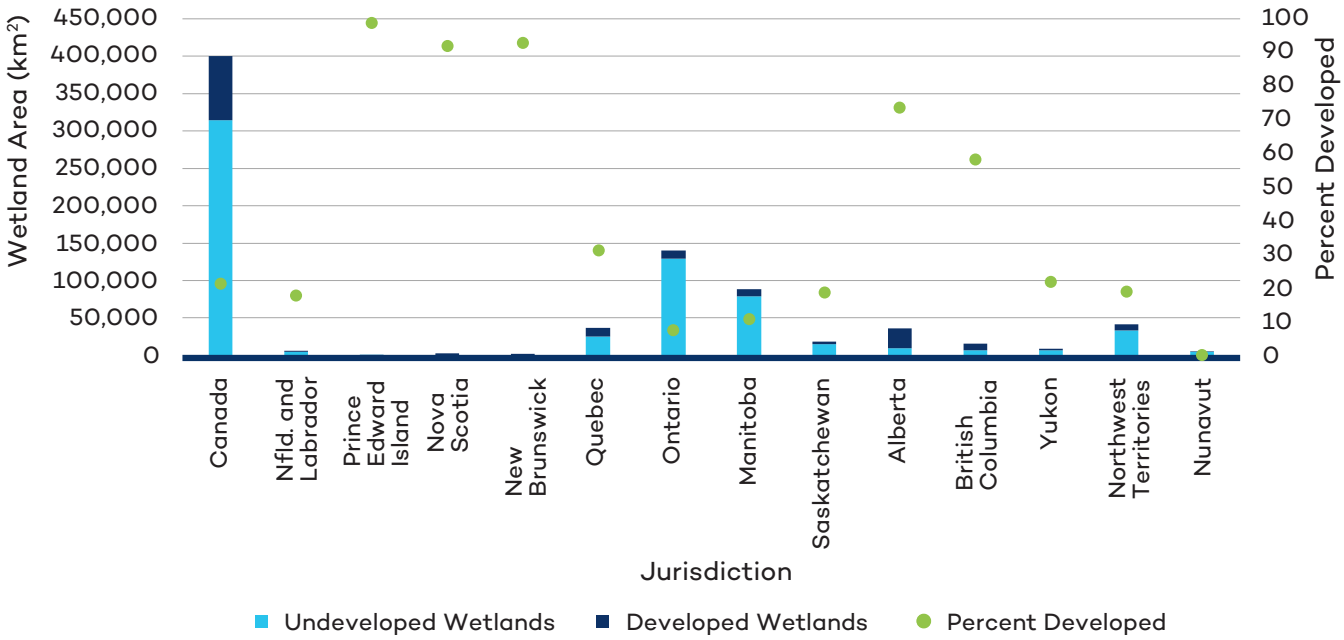
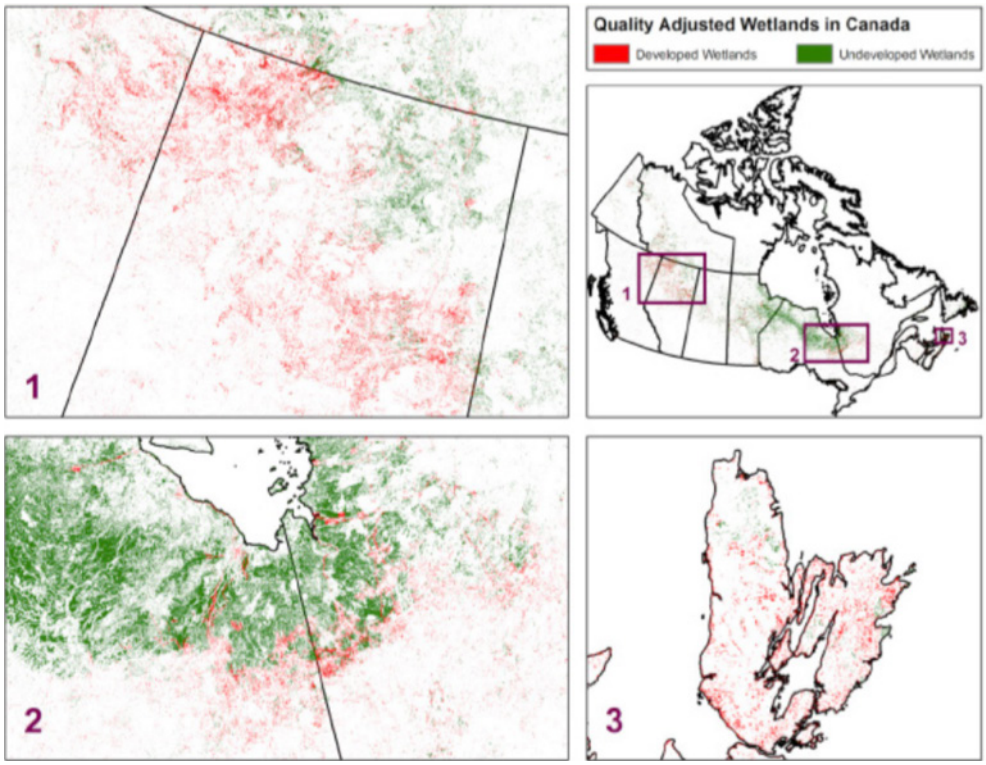


Figure 39. Quality-adjusted wetland ecosystem extent, Canada and provinces/territories, 2011

Source: Global Forest Watch Canada.



Map 2. Quality-adjusted wetland ecosystems, selected regions, 2011

Source: Global Forest Watch Canada.

Indicator NC4 – Surface Freshwater[106]

Theme: Natural Capital – *Ecosystems*

Geographic Scope: National by province and territory

Time Series: 2011

Frequency: Intermittent

Description: This indicator presents an assessment of the quality-adjusted extent of surface freshwater ecosystems in 2011 taking into consideration pressure on lakes and rivers as a result of cumulative human development of the landscape (roads, buildings, infrastructure and inhabited areas).

Relevance to comprehensive wealth: Canada has 8,500 named rivers and more lake area than any other country in the world. These lakes and rivers are the source of many ecosystem goods and services that contribute greatly to comprehensive wealth: fresh water for drinking, industrial use and hydropower production; fish for subsistence and recreation; flood control; and cultural benefits.

Method of calculation and data sources: To determine the impact of cumulative human development on lakes and rivers, a spatial dataset of human land use was created by Global Forest Watch Canada (GFWC). This dataset was intersected with the hydrographic boundaries to determine where lakes and rivers are "developed" (that is, under pressure from immediately surrounding human land uses) and "undeveloped" (that is, far enough from any human land use to be considered free from direct human influence). Lakes and rivers are considered "developed" if they are within 1 kilometre of a linear feature like a road or a pipeline or within 10 kilometres of other types of human land uses (for example, mines, dams or inhabited areas).

Limitations: This indicator has no major limitations aside from the irregularity of the underlying data required for its compilation.

Reliability: Surface Freshwater is considered reliable.[107]

Analysis: In terms of cumulative development, rivers in the Maritimes and Alberta were the most highly developed in 2011. Over 80 per cent of rivers (by length) were developed in these regions (Figure 40).

Development of overall surface water area (Figure 41) was greatest in the Maritimes (over 70 per cent). It was also high in Alberta, British Columbia and Newfoundland and Labrador.

[106] Further details on the methods used in the compilation of the ecosystem indicators are available in Annex 10.

[107] See Footnote 78 for details of the reliability scale used in this report.

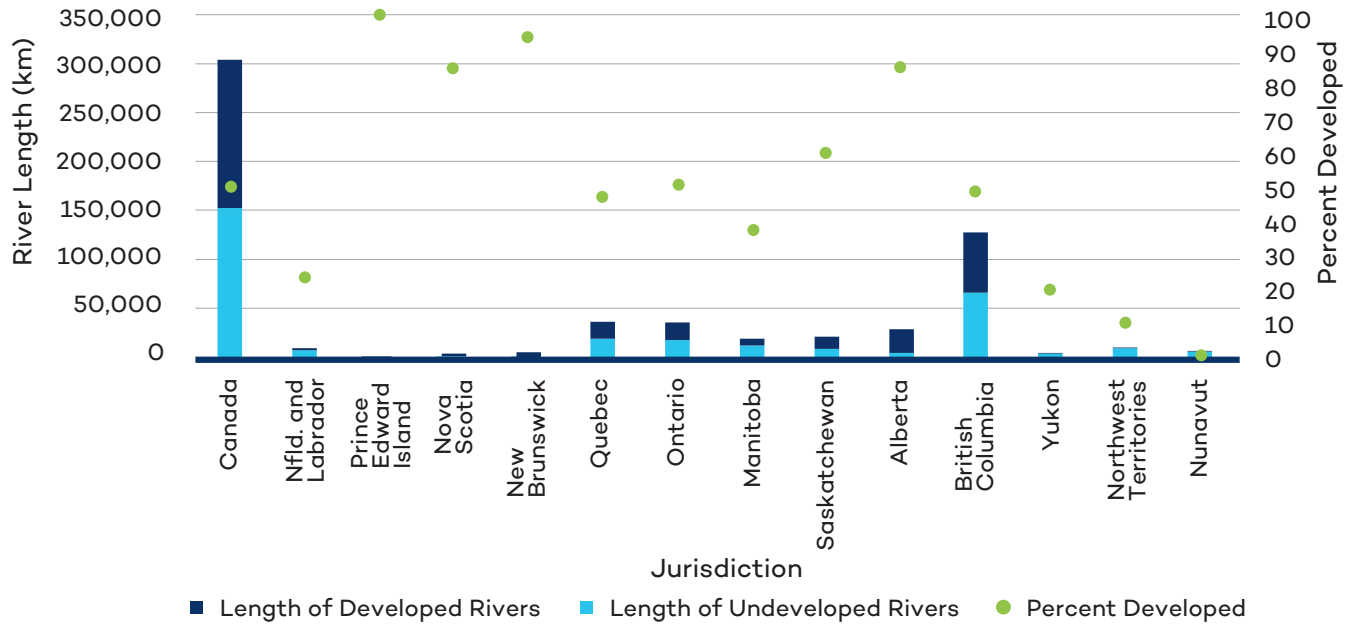


Figure 40. Quality-adjusted river length, Canada and provinces/territories, 2011

Source: Global Forest Watch Canada.

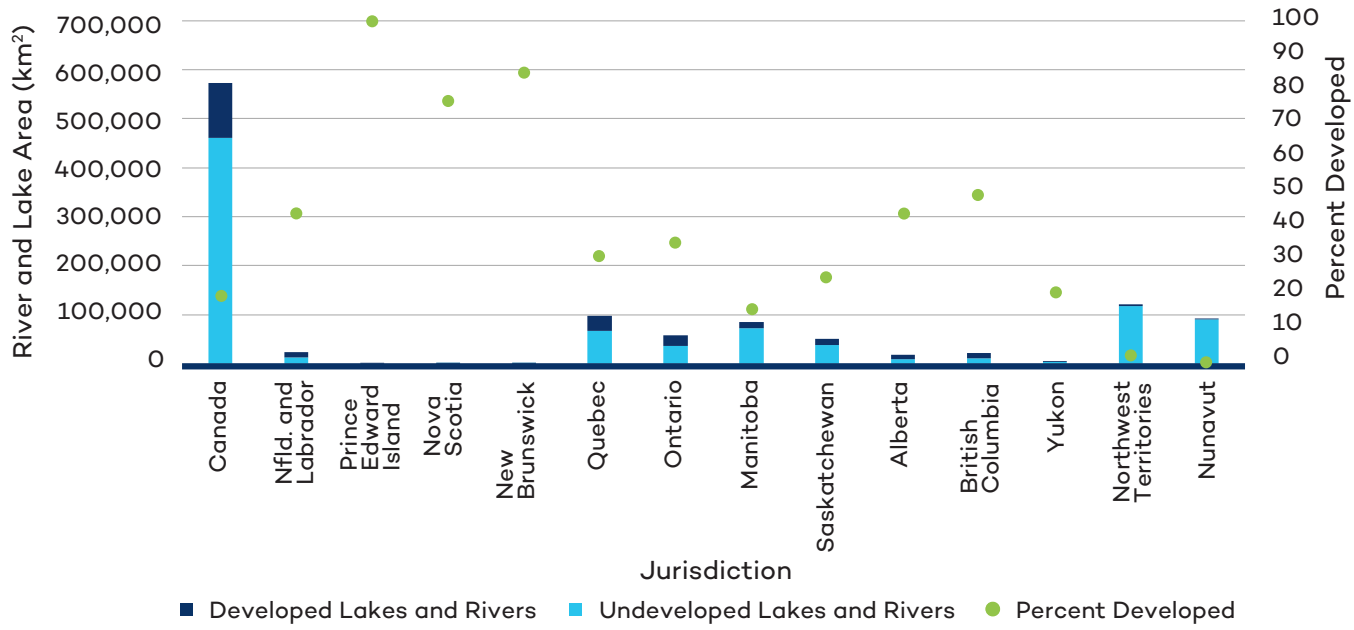


Figure 41. Quality-adjusted surface water extent, Canada and provinces/territories, 2011

Source: Global Forest Watch Canada.

Indicator NC5 – Grasslands[108]

Theme: Natural Capital – *Ecosystems*

Geographic Scope: National by province and territory

Time Series: 2000 and 2011

Frequency: Intermittent

Description: This indicator presents changes in the extent of Canada's grassland ecosystems at the level of provinces/territories between 2000 and 2011, and an assessment of the quality-adjusted extent of grassland ecosystems in 2011 taking into consideration pressure on grasslands as a result of cumulative human development of the landscape (roads, buildings, infrastructure and inhabited areas).

Relevance to comprehensive wealth: Grasslands are the ecosystems under the greatest pressure from development in Canada. Their extent has diminished considerably since European settlement, with 70 per cent of prairie grasslands (Federal, Provincial and Territorial Governments of Canada, 2010) and 97 per cent of southern Ontario grasslands (Ontario Tallgrass Prairie and Savanna Association, 2004) having disappeared in the past two hundred years. They cover only 0.5 per cent of Canada today and the vast majority of those remaining are impacted by development. They contribute to wealth through the provision of important cultural and recreational benefits, genetic diversity and increasingly rare habitat for plants and wildlife.

Method of calculation and data sources: The estimates of grassland ecosystem extent are derived from the Land Cover Time Series (LCTS) spatial dataset compiled by the Canada Centre for Remote Sensing (2012). This is the most current, publicly available land-cover dataset that provides complete coverage of Canada. To determine the impact of cumulative human development on grasslands, a spatial dataset of human land use was created by Global Forest Watch Canada (GFWC). This dataset was intersected with the LCTS to determine where grasslands are "developed" (that is, under pressure from immediately surrounding human land uses) and "undeveloped" (that is, far enough from any human land use to be considered free from direct human influence). Grasslands are considered "developed" if they are within 1 kilometre of a linear feature like a road or a pipeline or within 10 kilometres of other types of human land uses (for example, mines, dams or inhabited areas).

Limitations: This indicator has no major limitations aside from the irregularity of the underlying data required for its compilation.

Reliability: Grasslands is considered reliable.[109]

Analysis: Between 2000 and 2011, Canada lost 1,410 km^2 of its remaining grasslands (2 per cent). Alberta, Manitoba, Saskatchewan, British Columbia and Ontario are the only provinces where grassland ecosystems are found, with the vast majority located in Alberta, Saskatchewan and Manitoba. The greatest decrease was in Saskatchewan, which lost 764 km^2 over the period (Figure 42).

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[108] Further details on the methods used in the compilation of the ecosystem indicators are available in Annex 10.

[109] See Footnote 78 for details of the reliability scale used in this report.

Cumulative human development exerted very significant pressure on the grassland ecosystems in 2011. Grasslands in both Alberta and Manitoba were nearly 95 per cent developed and those in Saskatchewan were over 77 per cent developed (Figure 43 and Map 3).

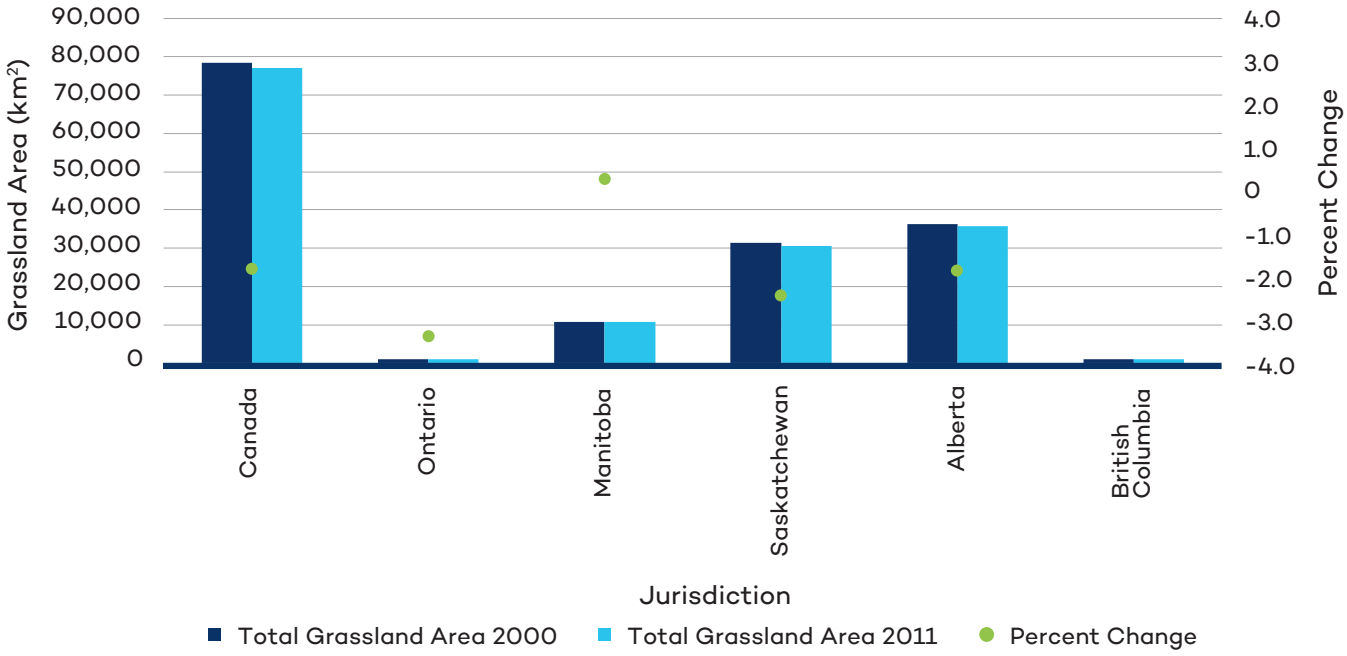


Figure 42. Grassland ecosystem extent and per cent change, Canada and selected provinces, 2000–2011

Source: Global Forest Watch Canada.

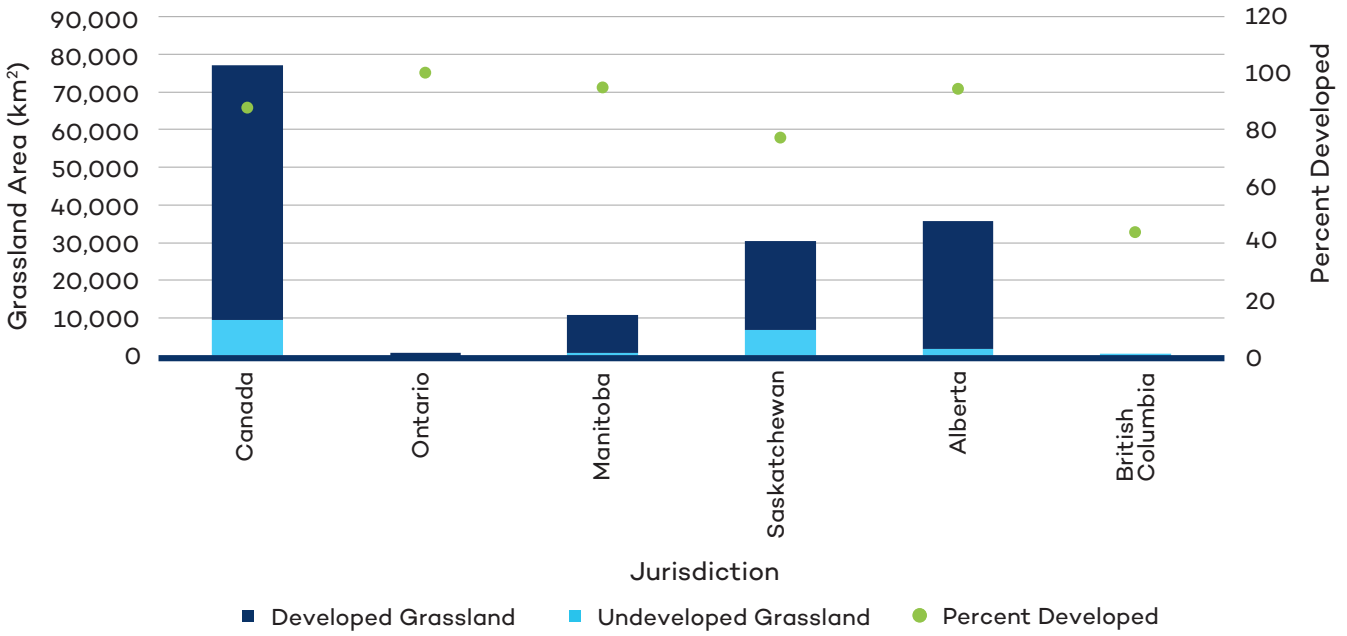
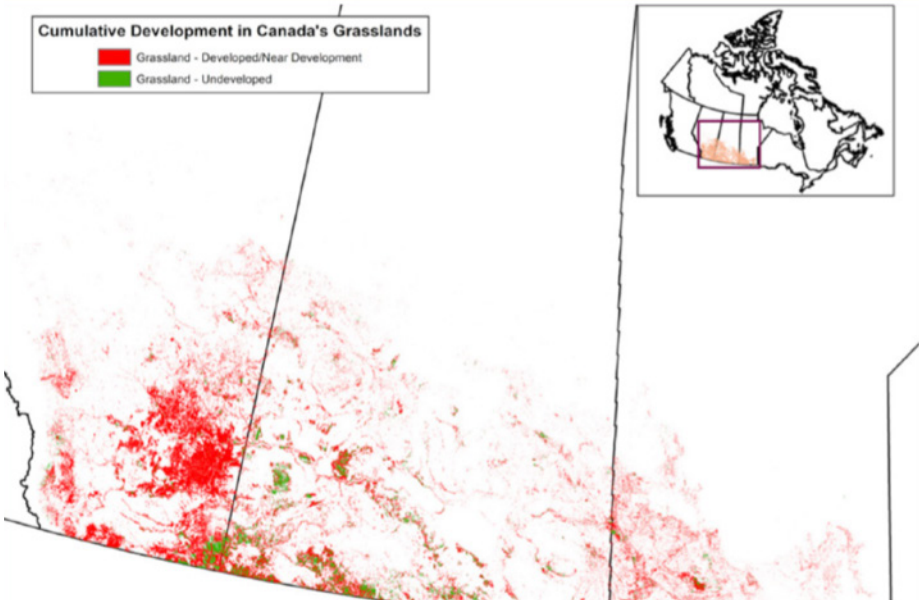


Figure 43. Quality-adjusted grassland ecosystem extent, Canada and selected provinces, 2011

Source: Global Forest Watch Canada.



Map 3. Quality-adjusted grassland ecosystems, southern Prairies, 2011

Source: Global Forest Watch Canada.

Indicator NC6 – Precipitation

Theme: Natural Capital – *Climate*

Geographic scope: National, regional

Time series: 1948 to 2015

Frequency: Annual

Description: This indicator presents an annual time series of precipitation departures from normal over the period 1948 to 2015 for 11 climatic regions and at the national level. The 11 climatic regions are presented in Figure 45 (Environment Canada, 2015). These same climatic regions are used in Indicator NC7 – *Temperature*. The indicator presents the annual departure from the precipitation "normal" for the period 1961 to 1990.[110]

Relevance to comprehensive wealth: Precipitation is an important indicator of climatic conditions and is considered an essential climate variable by the World Meteorological Organization-Global Climate Observing System. The United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) also use precipitation in their work.

Changing precipitation patterns affect water levels and can change the timing of peak stream flows. Increased precipitation can result in increased flooding and soil loss. Decreased precipitation can threaten drinking water supply and result in droughts. Changes in precipitation have a particularly large impact on agricultural land and productivity, as both droughts and flooding result in crop losses.

Figure 44. Climatic Regions of Canada
Source: Fritzsche, 2011a.

Method of calculation and data sources: The indicator is based on a method developed by Statistics Canada (Fritzsche, 2011a). Precipitation departure data are taken from the *Climate Trends and Variations Bulletin* produced by Environment and Climate Change Canada[111], which is, in turn, based on the *Adjusted and Homogenized Canadian Climate Database* (AHCCD)[112]. The AHCCD combines data from 470 stations across the country. Precipitation departures are calculated by subtracting the normal value for 1961 to 1990 from the annual value at

110 A precipitation normal is defined as the average annual precipitation over a given 30-year period for a given region.

111 See https://www.canada.ca/en/environment-climate-change/services/climate-change/science-research-data/climate-trends-variability/trends-variations.html

112 See http://ec.gc.ca/dccha-ahccd/Default.asp?lang=En&n=B1F8423A-1

each station. Values from the stations are interpolated to evenly spaced 50 km grid boxes, which are then averaged within each climatic region and the country as a whole (Environment Canada, n.d.).

Limitations: As the data are presented as percentage departures from normal, they must be interpreted carefully. The same percentage departure in different climatic regions can represent a very different absolute change in precipitation, particularly in the North, where there are lower levels of precipitation.

Precipitation varies significantly annually. As a result, trends in precipitation are sensitive to start and end periods of analysis.

Reliability: Precipitation is considered very reliable.[113]

Analysis: There has been an upward trend in precipitation at the national level, although there is a high degree of variability year to year (Figure 45). Compared to the 1961 to 1990 average, there has been a shift from drier to wetter between 1948 and 2015, with the trend increasing 18 per cent over that period.[114] The wettest year took place in 2005, at 15.6 per cent above average. The driest year was 1956, at 12.2 per cent below average. The precipitation departure was 1.7 per cent below average in 2015. Precipitation fell below average in 2014 (-2.2 per cent) for the first time since 1998 (-1.0 per cent).

The majority of Canada's climatic regions showed an upward trend in precipitation departures from 1948 to 2015. This was particularly true in the northern regions of the country. The greatest increase was in the Arctic Mountains and Fiords region, where the trend increased by 39 per cent from 1948 to 2015 (Figure 46).[115] As with national precipitation, the Arctic Mountains and Fiords region saw a drop in precipitation for the first time in 2014 after more than two decades of above-average precipitation.

Not all regions showed significant trends, particularly the Pacific Coast (Figure 47).

No climatic region in Canada showed a downward trend in precipitation departure from normal.

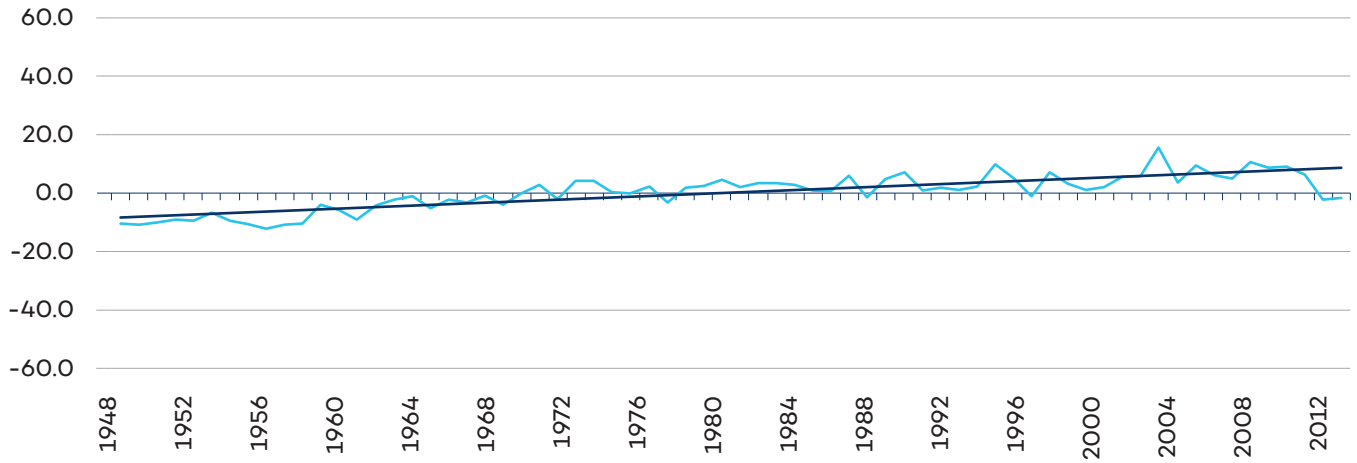


Figure 45. Precipitation departure from 1961–1990 normal (per cent), Canada, 1948–2015

Source: Environment and Climate Change Canada, Climate Trends and Variations Bulletin, 2018.

113 See Footnote 78 for details of the reliability scale used in this report.

114 Significant at the 99 per cent confidence level.

115 Significant at the 99 per cent confidence level.

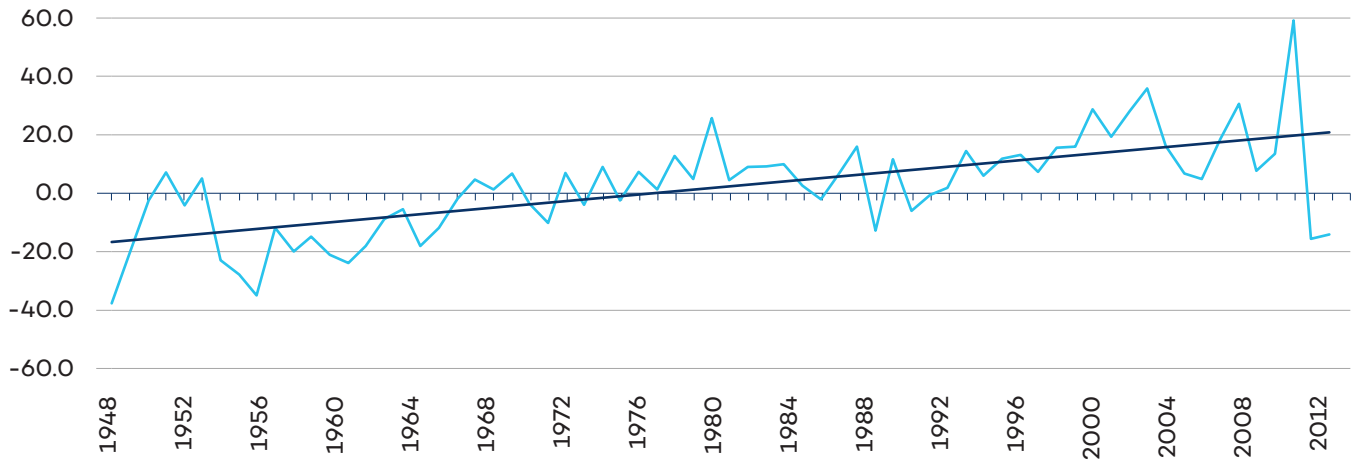


Figure 46. Precipitation departure from 1961–1990 normal (per cent), Arctic Mountains and Fiords Climate Region, 1948–2015

Source: Environment and Climate Change Canada, Climate Trends and Variations Bulletin, 2018.

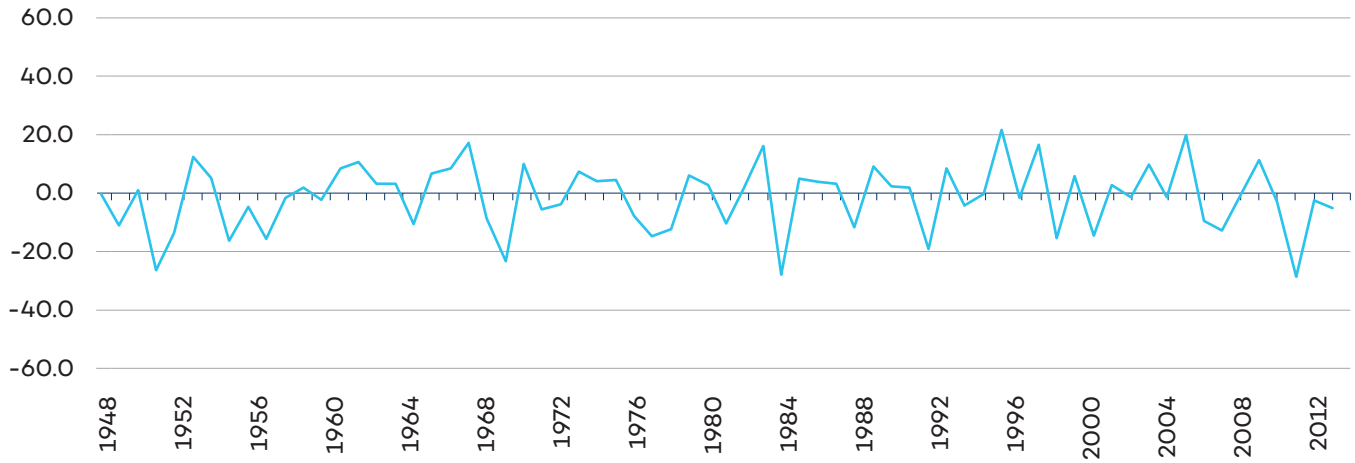


Figure 47. Precipitation departure from 1961–1990 normal (per cent), Pacific Coast Climate Region, 1948–2015

Source: Environment and Climate Change Canada, Climate Trends and Variations Bulletin, 2018.

Indicator NC7 –Temperature

Theme: Natural Capital – *Climate*

Geographic scope: National, regional

Time series: 1948 to 2015

Frequency: Annual

Description: This indicator presents an annual time series of temperature departures from normal over the period 1948 to 2015 for 11 climatic regions and at the national level. The 11 climatic regions are presented in Figure 45 on page 118 (Environment Canada, 2015). These same climatic regions are used in Indicator NC6 – Precipitation. The indicator presents the annual departure from the temperature "normal" for the period 1961 to 1990.[116]

Relevance to comprehensive wealth: Surface air temperature is an important indicator of climatic conditions and is considered an essential climate variable by the World Meteorological Organization-Global Climate Observing System. The United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) also use surface air temperature in their work.

Air temperature is of primary importance as an indicator of global climate change. Changes in climate and temperature have a long-term impact on stocks of natural capital including the value and productivity of agricultural land, the extent of forest and timber stocks, the functioning of ecosystems and the availability of ecosystem services.

Method of calculation and data sources: The indicator is based on a method developed by Statistics Canada (Fritzsche, 2011b). Temperature data are taken from the *Climate Trends and Variations Bulletin* produced by Environment and Climate Change Canada, which is, in turn, based on the Adjusted and Homogenized Canadian Climate Database (AHCCD). The AHCCD combines data from 470 stations across the country. Temperature departures are calculated by subtracting the normal value for 1961 to 1990 from the annual value at each station. Values from the stations are interpolated to evenly spaced 50 km grid boxes, which are then averaged within each climatic region and the country as a whole (Environment Canada, n.d.).

Limitations: Average temperatures undergo substantial fluctuations year to year, and over decades. As a result, trends based on short time periods are more sensitive to beginning and end dates, which may be affected by phenomena such as El Niño (IPCC, 2014).

Reliability: Temperature is considered very reliable.[117]

Analysis: Though there was a high degree of variability year to year, a clear upward trend in temperature can be seen at the national level from 1948 to 2015. Compared to the 1961–1990 normal, the trend in average temperatures across the country increased by 1.8 degrees Celsius (Figure 48).[118] The warmest

[116] A temperature normal is defined as the average annual temperature over a given 30-year period for a given region.

[117] See Footnote 78 details of the reliability scale used in this report

[118] Significant at the 99 per cent confidence level.

year was 2010 (3 degrees Celsius above the normal) and the coldest year was 1972 (2 degrees Celsius below the normal). The temperature departure was 1.3 degrees Celsius above average in 2015.

All climatic regions in Canada showed an upward trend, with the largest increase happening in the North. The trend in the Mackenzie District increased 2.6 degrees Celsius over the period (Figure 49).[119] The smallest increase took place in Atlantic Canada, where the trend increased 0.9 degrees Celsius (Figure 50).[120]

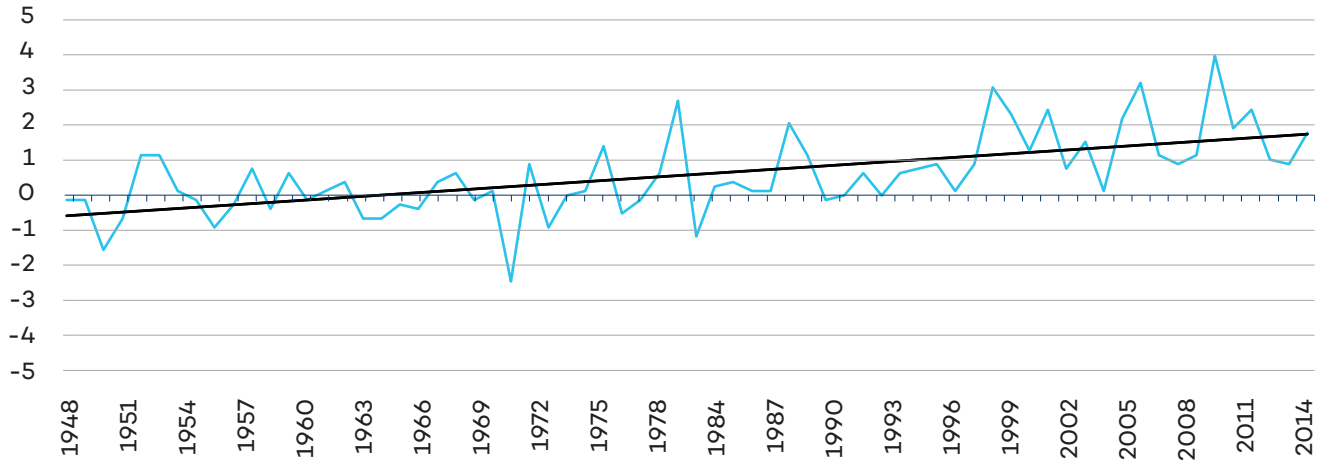


Figure 48. Temperature departure from 1961–1990 normal (degrees Celsius), Canada, 1948–2015

Source: Environment and Climate Change Canada, Climate Trends and Variations Bulletin, 2018.

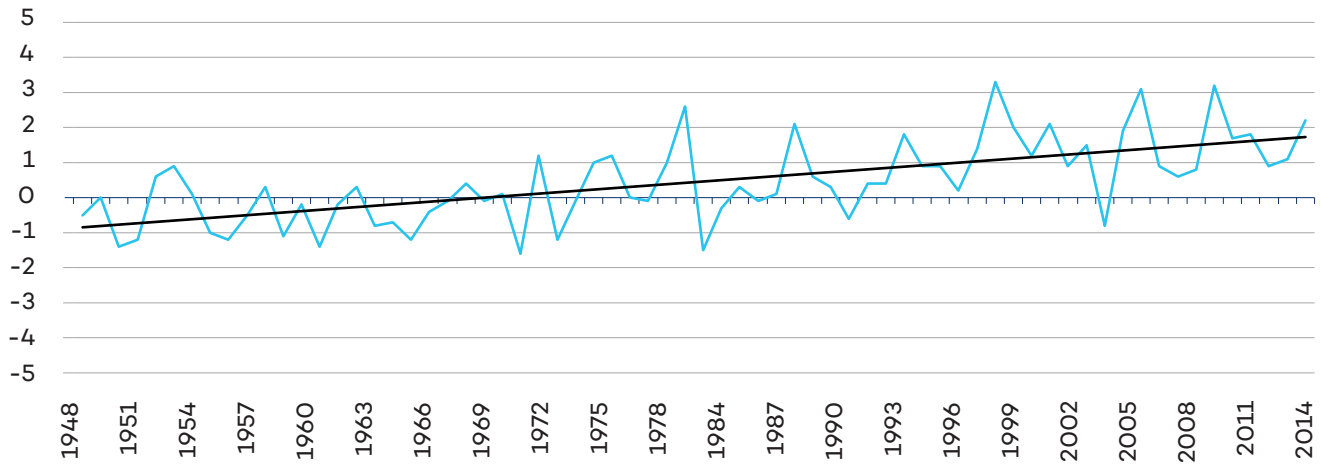


Figure 49. Temperature departure from 1961–1990 normal (degrees Celsius), Mackenzie District, 1948–2015

Source: Environment and Climate Change Canada, Climate Trends and Variations Bulletin, 2018.

[119] Significant at the 99 per cent confidence level.

[120] Significant at the 95 per cent confidence level.

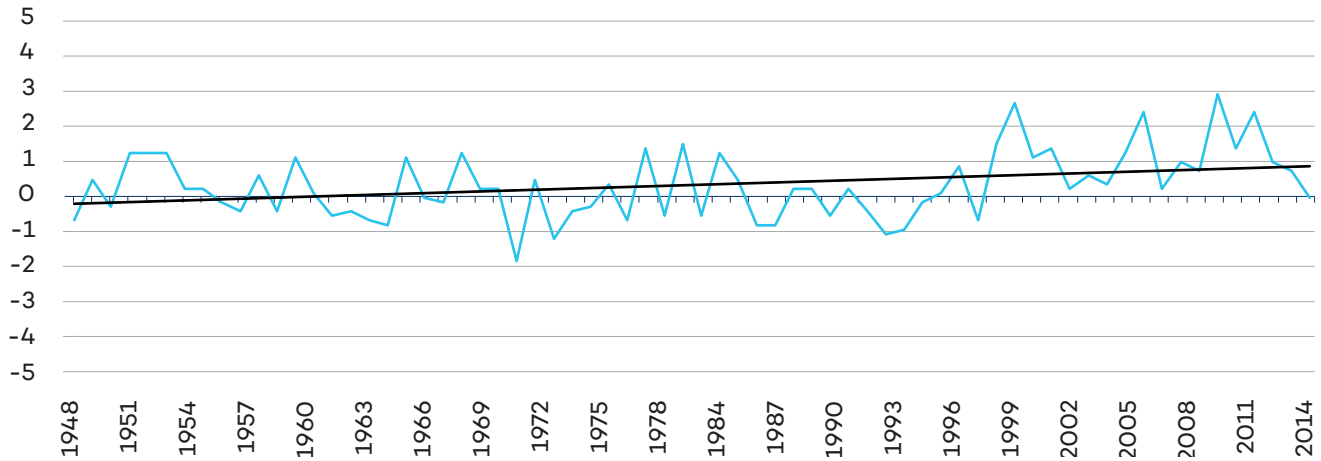


Figure 50. Temperature departure from 1961–1990 normal (degrees Celsius), Atlantic Canada, 1948–2015

Source: Environment and Climate Change Canada, Climate Trends and Variations Bulletin, 2018.

Indicator NC8 – Snow Cover

Theme: Natural Capital – *Climate*

Geographic scope: National

Time series: 1972 to 2015

Frequency: Annual

Description: This indicator presents an annual series of estimates of the average area covered by snow at the national level from 1972 to 2015. Snow cover extent is examined annually and for the months of October and November—the period that marks the onset and expansion of snow cover for much of Canada—and April, May and June—the spring snow melt period.

Relevance to comprehensive wealth: Snow cover is an important indicator of climatic conditions and is considered an essential climate variable by the World Meteorological Organization-Global Climate Observing System. The United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) also use snow cover extent in their work.

Method of calculation and data sources: Data for snow cover were derived from the National Oceanic and Atmospheric Administration's Climate Data Record Northern Hemisphere gridded weekly snow chart dataset. These data are based on analysis of satellite imagery. The data were collected and analyzed by Statistics Canada (Henry, 2012). Data are now compiled regularly by the Climate Research Division of Environment and Climate Change Canada.[121]

Limitations: As with precipitation (Indicator NC6) and temperature (Indicator NC7), the extent of snow cover is highly variable from year to year. As a result, trends in snow cover are sensitive to start and end dates.

Reliability: Snow Cover is considered very reliable.[122]

Analysis: Though precipitation overall increased in recent decades (Indicator NC6), particularly in the north where snow cover is more persistent, this increase did not result in greater snow cover. The average annual snow-covered area in Canada fell by 5.1 per cent between 1972 and 2010 (Figure 51).[123] The minimum extent of snow cover was about 5.2 million square kilometres and the maximum was about 6.2 million square kilometres. The fact that snow cover extent declined at the same time as precipitation increased is consistent with the increased temperatures witnessed over the period (Indicator NC7).

Snow cover extent during the fall onset period did not change significantly from 1972 to 2015, with average extent in the months of October and November showing no upward or downward trend. However, snow cover extent during the period of the spring melt showed a significant downward decline in May[124] and June[125] (Figure 52). Snow cover extent during April did not show a significant trend. The fact that snow cover extent declined at the same time as precipitation (Indicator NC6) increased

[121] See https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/snow-cover.html

[122] See Footnote 78 for details of the reliability scale used in this report.

[123] Annual average snow cover data are not available past 2010.

[124] Significant at the 95 per cent confidence level.

[125] Significant at the 99 per cent confidence level.

is consistent with the increased temperatures witnessed over the period (Indicator NC7). So, although precipitation has increased, it has not resulted in increased snow cover.

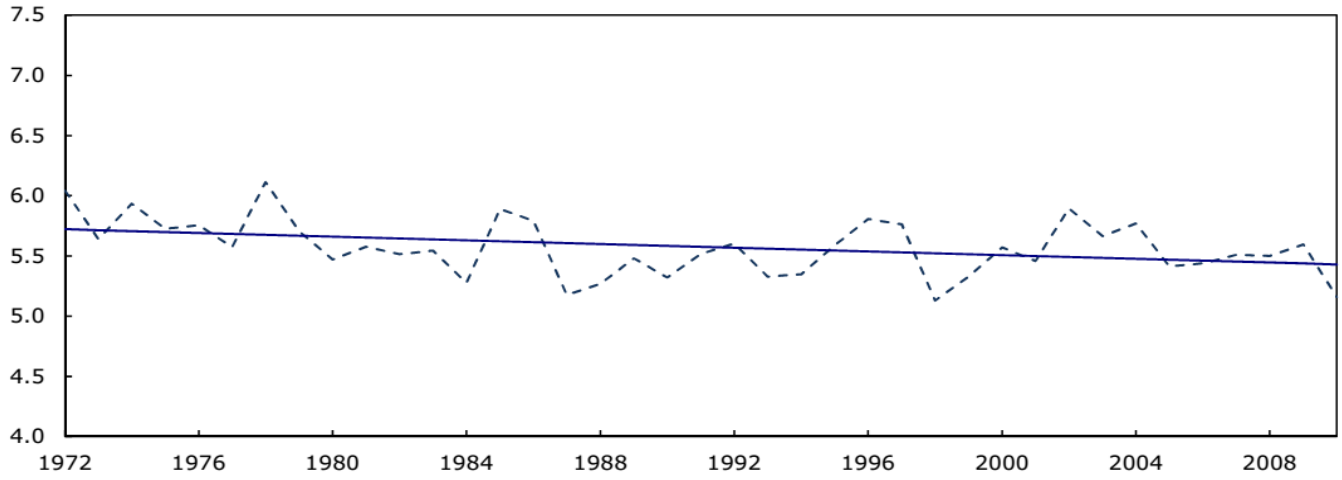


Figure 51. Trend in average annual snow cover, Canada, 1972–2010

Source: Henry, 2012.

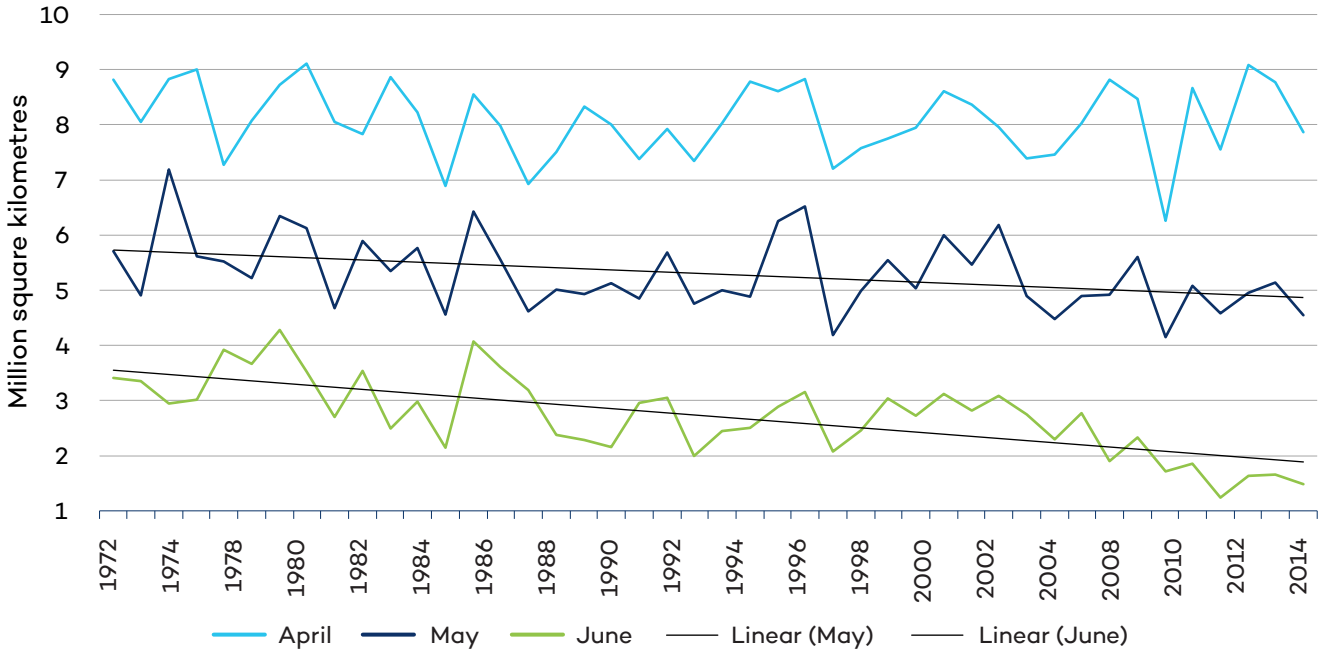


Figure 52. Trend in average snow cover during the melt period, Canada, 1972–2015

Source: Environment and Climate Change Canada, Climate Research Division, 2017.

Indicator NC9 – Glacier Mass

Theme: Natural Capital – *Climate*

Geographic Scope: Regional

Time series: 1960 to 2015

Frequency: Annual

Description: This indicator presents changes to the cumulative mass balance of six glaciers in Western Canada over the period of 1960 to 2015. Glacier mass increases through the accumulation of snow and ice throughout the winter. Mass decreases due to melting, evaporation, calving (breaking off of icebergs) and sublimation in the spring and summer.

Glacier mass balance measures the net result of mass increase and decrease over the course of a year. If a glacier gains more mass than it loses in a year, it has a positive mass balance. Cumulative mass balance sums mass balance over time, indicating the trend in glacier mass.

Cumulative mass balance is measured for six glaciers in two regions. The Helm, Peyto and Place glaciers are located in the Western Cordillera (Figure 54). The Devon Ice Cap, Meighen Ice Cap and White Glacier are located in the High Arctic (Figure 53).

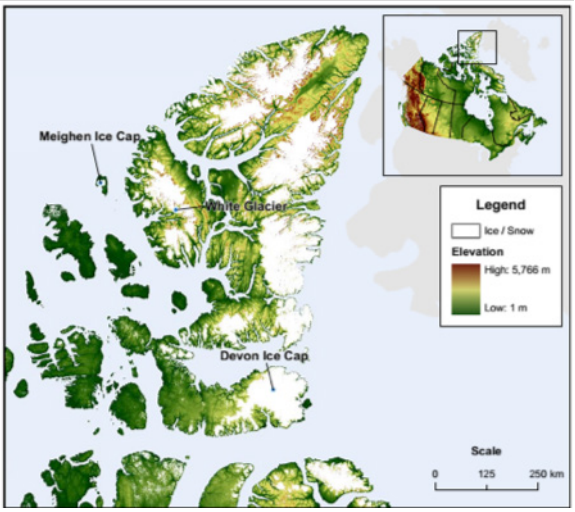


Figure 53. High Arctic glaciers

Source: Fritzsche, 2010.

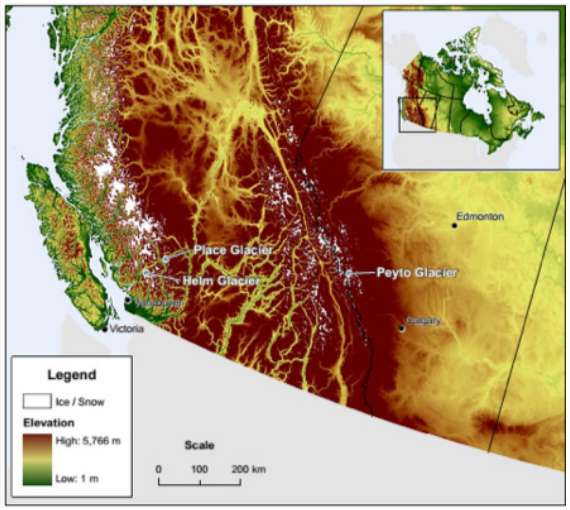


Figure 54. Western Cordillera glaciers

Source: Fritzsche, 2010.

Relevance to comprehensive wealth: Glacier mass balance is an important indicator of climatic conditions and is considered an essential climate variable by the World Meteorological Organization-Global Climate Observing System.

Glacier mass loss is expected to be a primary cause of climate change-related sea level rise, which threatens coastal cities and resources (IPCC, 2014). Glaciers are also an important source of fresh water during the summer months in parts of the country, particularly the Rocky Mountains and Prairies. Loss of glacier mass threatens water yield in these areas (Indicator NC10).

Method of calculation and data sources: The data for glacier mass balance are derived from the Climate Change Geoscience Program at Natural Resources Canada's Earth Science Sector. Monitoring of glaciers in Canada is undertaken by a number of government departments and universities. Data for each glacier varies in duration. The data were collected by the World Glacier Monitoring Service (2018) and analysis is based on Fritzsche (2010).

Limitations: While the six glaciers analyzed for this indicator are intended to be representative, they represent only a small portion of the total glacier coverage in Canada.

The data are updated intermittently.

Reliability: Glacier Mass is considered reliable.[126]

Analysis: All six glaciers experienced mass losses from 1960 to 2015. Those in the Western Cordillera (Figure 55) experienced significantly higher losses than those in the High Arctic (Figure 56). While this indicator covers only a short period in the lives of these glaciers, other evidence collected by glaciologists indicates that the current rates of loss are unprecedented (Fritzsche, 2010).

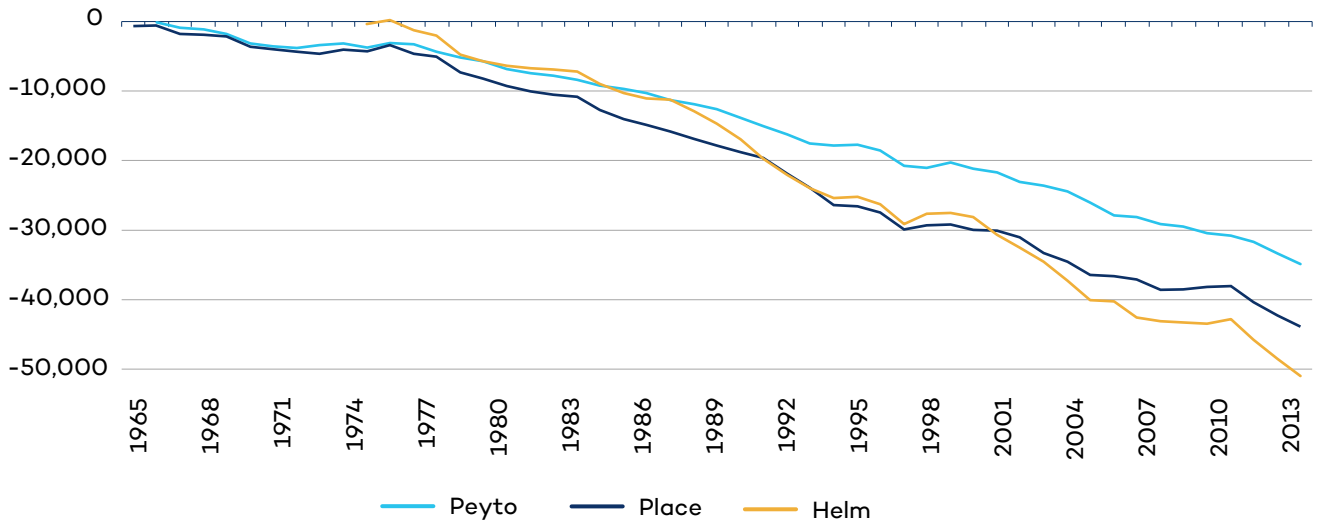


Figure 55. Glacier cumulative mass balance, Western Cordillera (equivalent millimetres of water), 1965–2015

Source: World Glacier Monitoring Service (2018).

126 See Footnote 78 for details of the reliability scale used in this report.

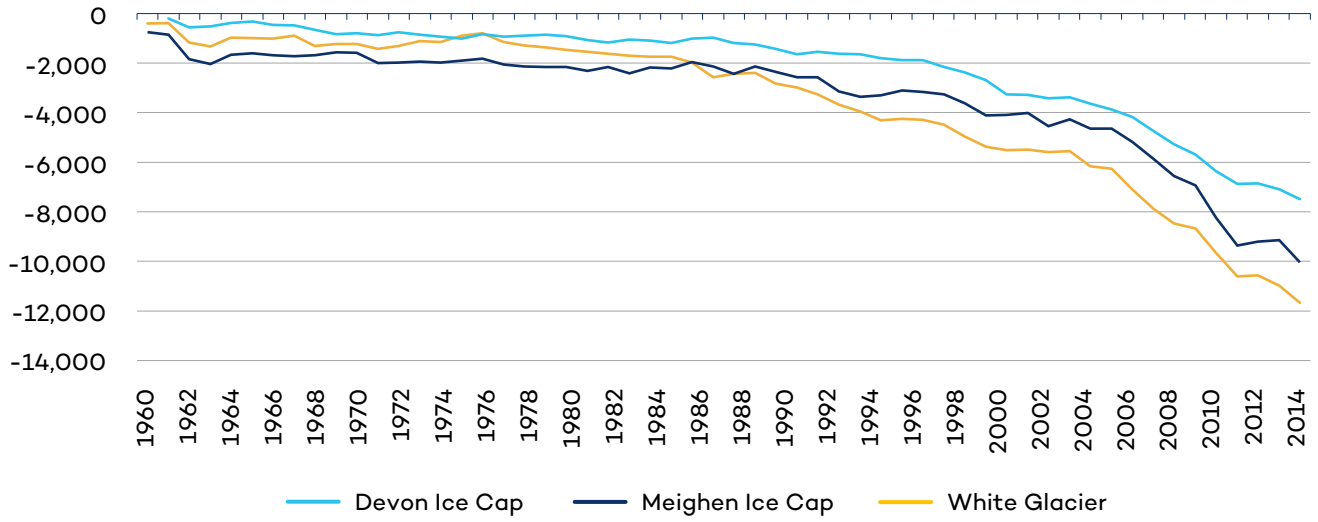


Figure 56. Glacier cumulative mass balance, High Arctic (equivalent millimetres of water), 1960–2015

Source: World Glacier Monitoring Service (2018).

Indicator NC10 – Water Yield

Theme: Natural Capital – Climate

Geographic scope: National, regional

Time series: 1971 to 2014

Frequency: Annual

Description: This indicator presents estimates of water yield for Canada for the country as a whole and 25 drainage areas (Figure 57) from 1971 to 2014. Water yield is a measure of water renewal derived by monitoring flows of surface water in Canada's rivers and streams. Surface flows are a combination of flows originating from groundwater, precipitation and melting snow and ice (Bemrose, Kemp, Henry, & Soulard, 2009).

Relevance to comprehensive wealth: For water use to be sustainable, consumption of water from surface and groundwater must not exceed the amount of water returned to the environment by natural sources. Estimates of water yield provide an approximation of water renewal.

Estimates of water yield at the national level are important for understanding sustainability, but water yield varies considerably between regions. Regional water use needs to be assessed accordingly.

Measuring water yield is important not only because consumption patterns change, but also because renewal patterns are changing. Precipitation, snow cover and glacier mass all impact water yield (see indicators NC6, NC8 and NC9).

Figure 57. Drainage areas of Canada

Source: Statistics Canada, 2010.

Method of calculation and data sources: The indicator is based on a method developed at Statistics Canada (Bemrose et al., 2009). Water yield is estimated using a database of natural streamflow observations from the HYDAT database operated by Environment Canada. Streamflow values are converted to runoff depths and spatially interpolated to account for areas without direct measurement. The spatial estimates are scaled to create a national estimate of water yield as a 30-year average.

Limitations: Water yield is not a perfect measure of water renewability because some surface flow originates from non-renewable sources, specifically from the melting of glaciers that are declining in mass over time (Indicator NC9).

Reliability: Water Yield is considered reliable.[127]

Analysis: The average annual water yield in Canada from 1971 to 2014 was 3,497 cubic kilometres (Table 13). Water yield is not evenly distributed across the country. The Pacific Coastal drainage area had the highest average annual yield. Drainage areas in the Prairies had the lowest yields, with the Assiniboine-Red drainage area having the lowest annual average yield and the lowest yield per square metre.

Water yield did not show a significant upward or downward trend over the period 1971 to 2014 in the southern portion of the country (Figure 58). An assessment of the trend over time for the country as a whole is not possible due to the scarcity of waterflow monitoring stations in the north.[128]

Table 13. Average annual water yield, Canada and Selected Drainage Regions, 1971–2014

Drainage area	Total yield (km^3)	Yield per unit area (m^3/m^2)
Canada	3,497	0.35
Pacific Coastal	514	1.54
Fraser-Lower Mainland	130	0.56
Columbia	68	0.78
Peace-Athabasca	99	0.20
North Saskatchewan	10	0.07
South Saskatchewan	10	0.06
Assiniboine-Red	9	0.05
Great Lakes	137	0.43
Ottawa	65	0.44
St. Lawrence	73	0.61
North Shore-Gaspé	291	0.79
Saint John-St. Croix	30	0.73
Maritime Coastal	106	0.86
Newfoundland	128	0.34

Source: Statistics Canada, Annual Water Yield for Selected Drainage Regions and Southern Canada, CANSIM 153-0109 and Statistics Canada (2017), Table 2.2.

127 See Footnote 78 for details of the reliability scale used in this report.

128 Northern data are adequate for the purposes of estimating annual average water yield over the long term (as in Table 11) but not for assessing change over time on an annual basis (M. Henry, Statistics Canada, personal communication).

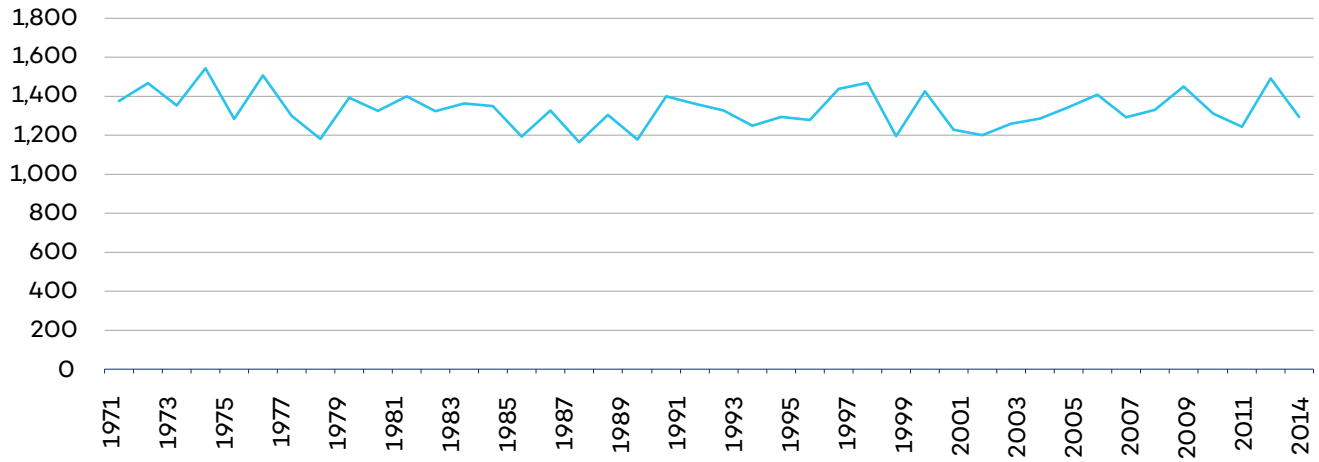


Figure 58. Water Yield, Southern Canada, 1971–2012

Source: Statistics Canada, Annual Water Yield for Selected Drainage Regions and Southern Canada, CANSIM 153-0109.

Indicator NC11 – Sea Ice Extent

Theme: Natural Capital – *Climate*

Geographic scope: National

Time series: 1968 to 2015

Frequency: Annual

Description: This indicator presents data on the average area covered by sea ice during the summer. Total ice cover is the area covered by all sea ice. Multi-year ice cover is the area covered by ice that has persisted for at least one summer. The trend for total ice cover is presented for nine sea ice regions and three shipping route regions. The trend for multi-year ice cover is presented for five sea ice regions and two shipping route regions. The average area covered by sea ice is expressed in square kilometres—the rate of change is expressed as the absolute change in sea ice coverage per decade and as a percentage relative to the first year of the time series (1968). The rate of change is based on the overall decline in the linear trend.

The nine sea ice regions are spread across two domains (Figure 59). The Southern Beaufort Sea, Kane, Canadian Arctic Archipelago, Foxe and Baffin Bay regions are in the Arctic domain. The Northern Labrador Sea, Davis Strait, Hudson Strait and Hudson Bay regions are in the Hudson Bay domain.

Figure 59. Sea ice regions

Source: Henry, 2011.

Relevance to comprehensive wealth: Sea ice extent is an important indicator of climatic conditions and is considered an essential climate variable by the World Meteorological Organization-Global Climate Observing System. The United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) also use sea ice extent in their work (Henry, 2011).

Sea ice covers a substantial part of the Earth's surface and plays a major role in global climate regulation. Snow-covered sea ice is relatively reflective, reflecting sunlight and the heat it contains back into space. Dark ocean water, on the other hand, absorbs much more of the sun's incoming energy. Reduced summer sea ice may therefore contribute to global warming (Natural Resources Canada, n.d.).

Method of calculation and data sources: Data for this indicator are derived from weekly sea ice charts produced by the Canadian Ice Service, using a combination of aerial surveys, surface observations, airborne and ship reports and satellite data. The data were compiled into a time series by the Climate Processes Section of the Climate Research Division at Environment Canada (Henry, 2011). Data are compiled regularly by the Climate Research Division of Environment and Climate Change Canada.

Limitations: This indicator has no major limitations.

Reliability: Sea Ice Extent is considered very reliable.[129]

Analysis: The annual average extent of total sea ice declined in all regions between 1968 and 2015, with regions in the Hudson Bay domain seeing the greatest declines. The Northern Labrador Sea and the Hudson Strait regions experienced the greatest declines, at 17 per cent per decade (Figure 60) and 15 per cent per decade (Figure 61) respectively.[130]

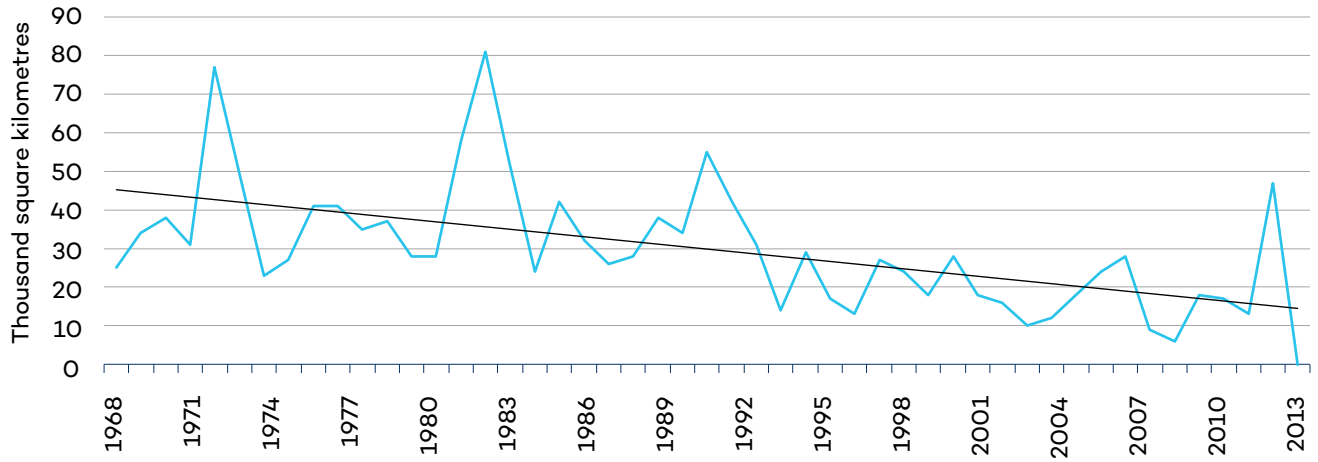


Figure 60. Average area of total sea ice during summer, North Labrador Sea Ice Area, 1968–2015

Source: Environment and Climate Change Canada, Sea Ice in Canada, Canadian Environmental Sustainability Indicators.[131]

[129] See Footnote 78 for details of the reliability scale used in this report

[130] Both trends significant at the 99 per cent confidence level.

[131] See https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/sea-ice.html

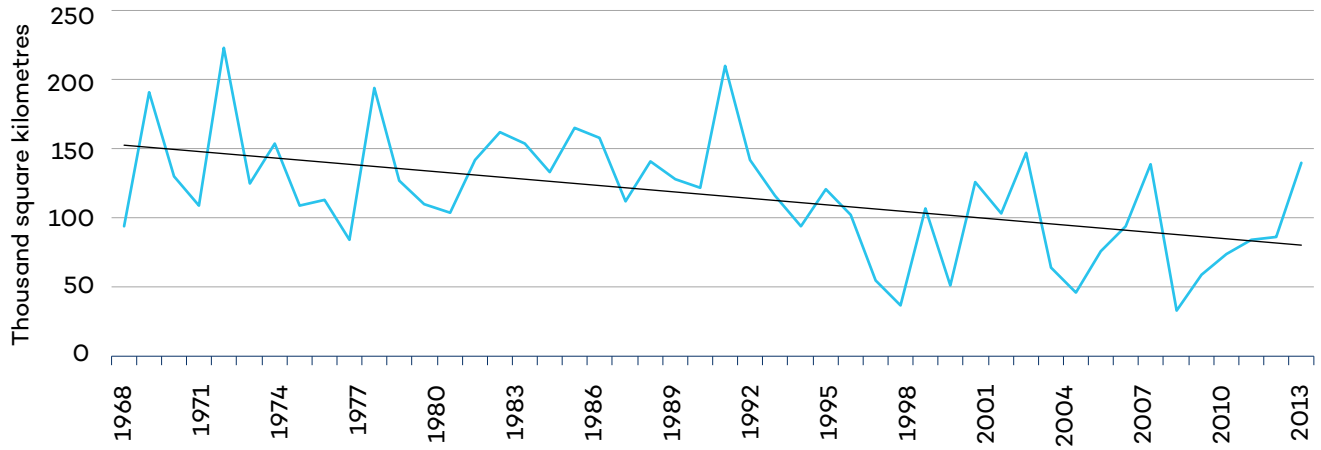


Figure 61. Average area of total sea ice during summer, Hudson Strait Sea Ice Area, 1968–2015

Source: Environment and Climate Change Canada, Sea Ice in Canada, Canadian Environmental Sustainability Indicators.

While the regions of the Arctic domain experienced smaller relative changes in total sea ice coverage, they saw larger absolute changes. The Canadian Arctic Archipelago, which contains the greatest area of ice (418,000 km^2 in 2015), shrank 4.4 per cent per decade[132] from 1968 to 2015 (Figure 62).[133]

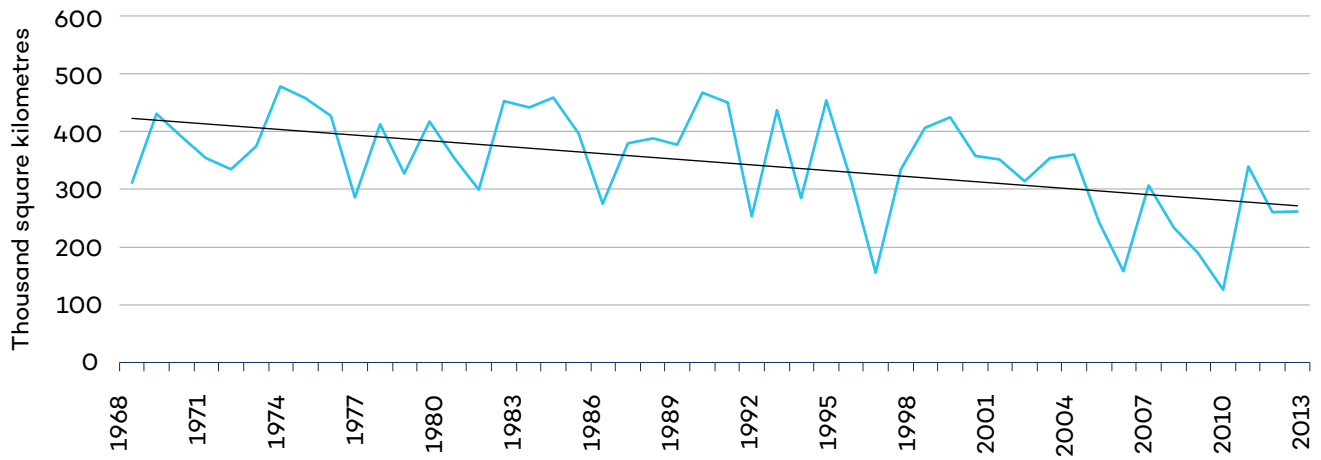


Figure 62. Average area of total sea ice during summer, Canadian Arctic Archipelago Sea Ice Area, 1968–2015

Source: Environment Canada, Sea Ice in Canada, Canadian Environmental Sustainability Indicators.

As with total sea ice extent, multi-year sea ice extent also saw significant declines, with the trend falling from more than 600 thousand square kilometres in the Canadian Arctic domain in 1968 to less than 400 thousand square kilometres in 2015 (significant at 99 per cent) (Figure 63).

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132 Significant at the 99 per cent confidence level.

133 According to the United States National Snow and Ice Data Center (2016), 2016 set new record lows for arctic sea ice extent during the months of January, February, April and May. May 2016's average sea ice extent was 580,000 km2 below the previous record low for the month set in 2004 and 1.39 million km^2 below the 1981 to 2010 long-term average.

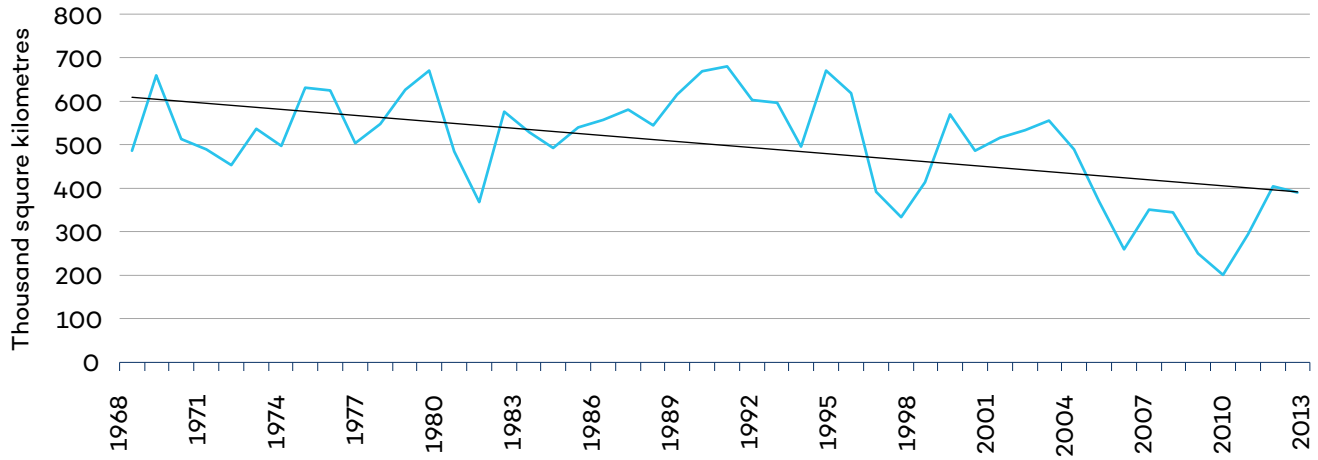

Figure 63. Average area of multi-year sea ice during summer, Canadian Arctic domain (km²), 1968–2015

Source: Environment and Climate Change Canada, Sea Ice in Canada, Canadian Environmental Sustainability Indicators.

4.4
Human Capital Indicators

Indicator HC1 – Human Capital Index

Theme: Human Capital

Geographic Scope: National

Time series: 1970 to 2015

Frequency: Annual

Description: The Human Capital Index measures the aggregate value of real (inflation-adjusted) per capita human capital, which represents the skills, experiences and competencies embodied in the population. These can be thought of as stocks of capital that provide economic returns in the form of higher incomes and greater productivity. Human capital is developed both through formal learning (such as the education system and on- the-job training) and informal learning (such as interaction with friends and family). The development of human capital takes place over a person's whole lifetime. The accumulation of human capital is therefore said to be *lifelong* and *life-wide* (UNU–IHDP & UNEP, 2014).

Relevance to comprehensive wealth: Human capital represents a very large share of comprehensive wealth in every country; in Canada, its share is about 80 per cent. Investment in human capital generates economic benefits for individuals and for the broader community. As people develop their human capital, they become more employable and may also enjoy higher wages. Businesses experience benefits from a more productive workforce. The benefits of human capital investment are not just economic though. Individuals and the broader community also enjoy non-economic benefits from human capital, such as improved subjective well-being and greater levels of civic engagement (UNU–IHDP and UNEP, 2014).

Method of Calculation: The Human Capital Index presented here is taken from a Statistics Canada research study (Gu & Wong, 2010)[134] that used a variant[135] of the Jorgenson–Fraumeni lifetime-income approach to estimate human capital in Canada. The lifetime-income approach measures human capital as the net present value of expected future wages (see Annex 6 for further information on the methodology and Annex 1 for a comparison of the lifetime-income approach with other approaches to measuring human capital).[136] The index is measured in chained 2007 dollars.

Limitations: The primary limitation of the lifetime-income approach is the assumption that differences in income truly reflect differences in productivity and, implicitly, differences in the value of human capital from person to person. Incomes vary for many reasons, not all of which are attributable to productivity differentials. Estimates of human capital based on wages may therefore be somewhat distorted (Le et al., 2003).

Reliability: The Human Capital Index is considered to be reliable (Class 2). If it was considered an official statistic by Statistics Canada rather than the result of a research study, it would be considered very reliable.[137]

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134 The authors of this study kindly provided updated human capital estimates to 2015 for use here (Gu, personal communication).

135 Gu and Wong treat non-market activities differently than Jorgensen and Fraumeni, who estimated the value of non-market activities (including leisure) using the same wage rate as market work. This implies the same level of human capital whether a country is fully employed or has significant unemployment. Gu and Wong, on the other hand, leave non-market activities out of their analysis entirely and focus only on the value of time spent in market employment.

136 No national statistical office, including Statistics Canada, currently produces official estimates of human capital. Statistics Canada is one of only a handful that have studied the issue as a research topic.

137 See Footnote 78 for details of the reliability scale used in this report.

Analysis: The Human Capital Index changed little from 1980 to 2015 (Figure 64) with the average Canadian ending the period with just slightly less ($496,000) human capital than s/he had in 1980 ($498,000) in real terms.

The index peaked in 1986 and then dipped during the 1990–91 recession. It recovered some of its lost ground from 1992 to 2001 but steadily, and increasingly rapidly, declined from 2001 to 2015 (Figure 65 shows the index with a modified scale to emphasize change).

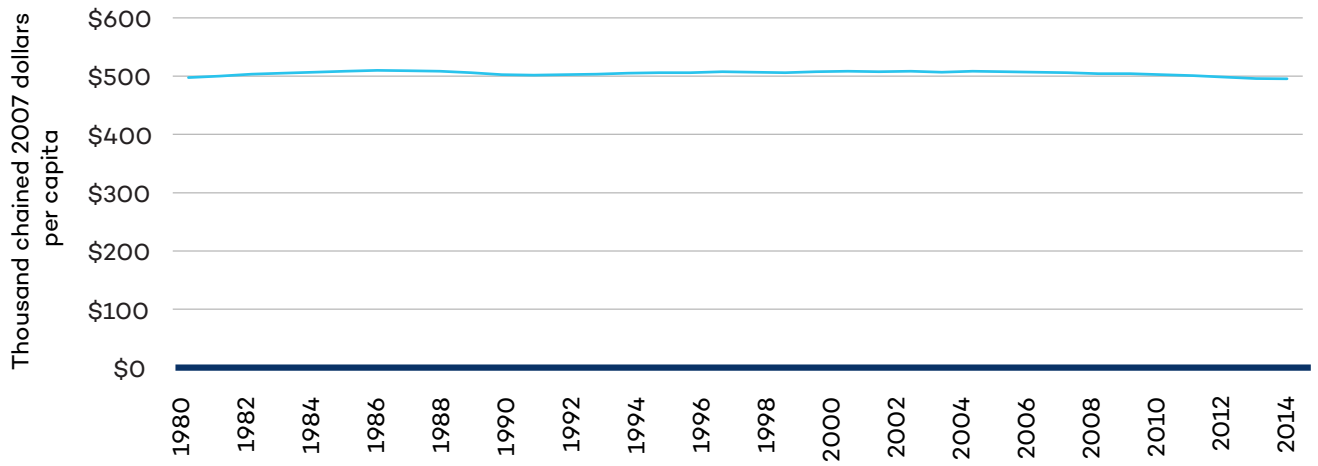

Figure 64. Human Capital Index, Canada, 1980–2015

Source: Current study based on data obtained on special request from Statistics Canada.

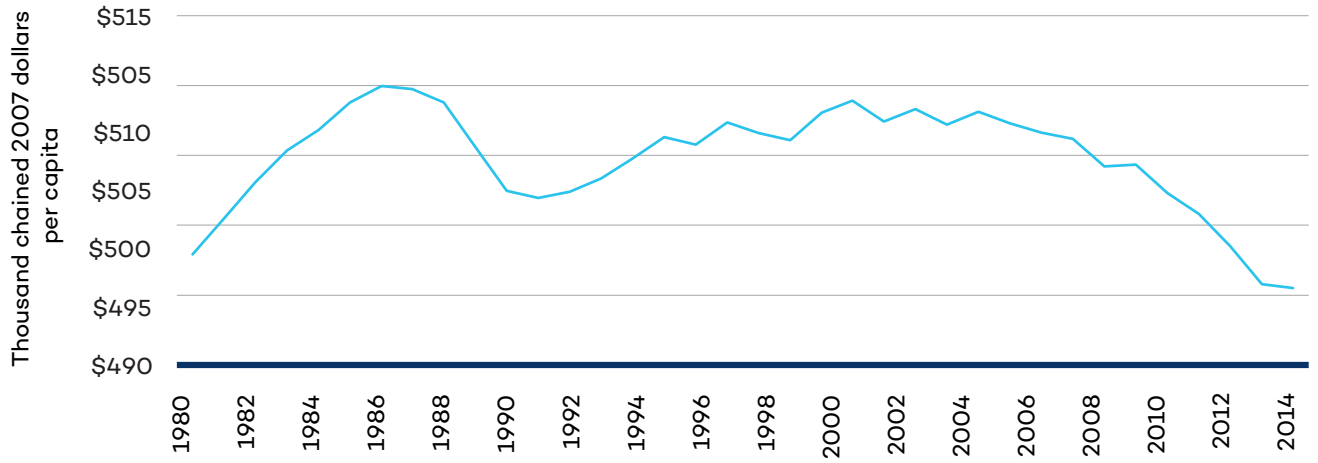

Figure 65. Human Capital Index (scale adjusted to emphasize change), Canada, 1980–2015

Source: Current study based on data obtained on special request from Statistics Canada.

Indicator HC2 – Education Spending Index

Theme: Human Capital – *Education inputs*

Geographic Scope: National

Time series: 1980/81 to 2014/15

Frequency: Annual

Description: The Education Spending Index measures real per-pupil spending on elementary, secondary and post-secondary education nationally.

Relevance to comprehensive wealth: Spending on the education system is an important indicator of the investment in human capital. It is important to capture spending by both public and private organizations as well as by individuals (UNU–IHDP & UNEP, 2014).

Method of Calculation: The Education Spending Index is measured by combining Statistics Canada's estimates of spending on public and private elementary/secondary schools,[138] community colleges[139] and universities[140] (adjusted for inflation[141] and divided by student enrolments[142] to convert them to a per-pupil basis) into an annual total for 1980 to 2015. The total is measured in chained 2007 dollars.

Limitations: Statistics Canada's data source for post-secondary education spending changed in the early 2000s, causing a break in the time series in 2004 (see Footnotes 139 and 140).

Statistics Canada's data source for prices levels in elementary/secondary schools changed in the early 2000s, causing a break in the time series in 2003 (see Footnote 141).

Statistics Canada's data sources for student enrolments changed in the 1990s, causing breaks in the time series for elementary/secondary enrolments in 1997 and for post-secondary enrolments in 1992 (see Footnote 142).

Education spending data are measured on a fiscal-year basis by Statistics Canada, so the index is not directly comparable with other indicators in this study, all of which are calendar-year based.

Data for the Territories are incomplete for the early years of the time series, so they are not included separately in the analysis. They do, however, figure in the Canada totals. Given the above, trends in the Education Spending Index should be interpreted with caution.

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138 *Public and Private Elementary and Secondary Education Expenditures*, CANSIM Table 478-0015.

139 **For 1980/81 to 2004/05:** *Postsecondary Non-university Education (College) Expenditure*, CANSIM Table 478-0004. **For 2005/06 to 2014/15:** *Financial Information of Community Colleges and Vocational Schools, Revenues by Type of Fund*, CANSIM Table 477-0060.

140 **For 1980/81 to 2004/05:** *University Education Expenditures*, CANSIM Table 478-0007. **For 2005/06 to 2014/15:** F*inancial Information of Universities and Degree-Granting Colleges, Revenues by Type of Funds*, CANSIM Table 477-0058.

141 Deflation was carried out using the implicit price index for final domestic demand (Statistics Canada, Price indexes, *gross domestic product,* CANSIM Table 380-0066).

142 For **elementary and secondary levels**, enrolment data are based on data from CANSIM Table 477-0025 *(Number of Students in Regular Programs for Youth, Public Elementary and Secondary Schools)* for the period 1997/98 to 2014/15 and on data from the publication *Education in Canada* (Catalogue No. 81-229; available only in hard copy) for the period 1980/81 to 1996/97. For **colleges and universities**, enrolment data are based on data from CANSIM Table 477-0019 *(Postsecondary Enrolments, by Registration Status, Pan-Canadian Standard Classification of Education)* for 1992/93 to 2014/15 and on data from the publication *Education in Canada* (Catalogue No. 81-229; available only in hard copy) for the period 1980/81 to 1991/92. College and university data from *Education in Canada* for 1980/81 to 1991/92 were adjusted upward to make them consistent with data from CANSIM Table 477-0019. The adjustment was based on the average of the ratio of enrolments from the two sources for the period 1992/93 to 1996/97 when both are available.

Reliability: The Education Spending Index is considered only acceptable (Class 3) due to the various time series breaks and data adjustments required for its compilation.[143]

Analysis: The Education Spending Index increased substantially over the period, rising from $21,950 to $30,740 (chained 2007 dollars), for an average annual growth rate of 0.97 per cent (Figure 66). The majority of the growth (72 per cent) came from growth in spending on primary and secondary education. Growth in spending on post-secondary education was flat for nearly two decades from 1980/81 to 1998/99 but then grew by 18 per cent to 2014/15.

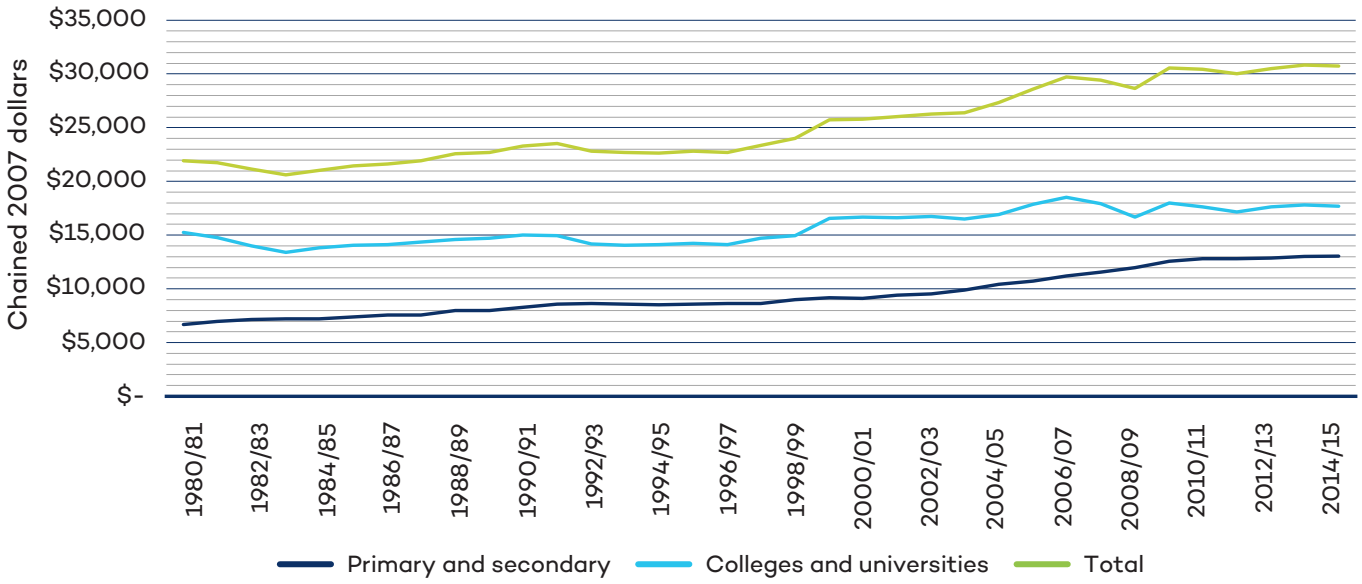

Figure 66. Education Spending Index, Canada, 1980/81–2014/15

Note: Education spending data are not available on a calendar-year basis.
Source: Current study based on Statistics Canada data.

[143] See Footnote 78 for details of the reliability scale used in this report.

Indicator HC3 – Educational Attainment

Theme: Human Capital

Geographic Scope: National, provincial/territorial

Time series: 1986 to 2016

Frequency: Every five years

Description: Educational Attainment measures the highest certificate, diploma or degree held by the population aged 15 and older at the federal and provincial/territorial levels. The attainment levels considered are:

- No certificate, diploma or degree
- Secondary school diploma or equivalent
- Apprenticeship or trades certificate or diploma
- College, CEGEP or other non-university certificate or diploma
- University certificate or diploma below bachelor's level
- University certificate or diploma below bachelor's level
- University degree.

Relevance to comprehensive wealth: Formal education is an important part of human capital development and investment. An indicator of educational attainment is useful as a complement to the value of human capital (Indicator HC1 – Human Capital Index). It provides an alternative means of judging the success of Canadian education investments.

Method of Calculation: Educational attainment is a derived from Statistics Canada's Census of Population.[144] Respondents are asked to report all certificates, diplomas and degrees earned.

Limitations: For 2011, the National Household Survey replaced the Census of Population for certain variables, including educational attainment. Differences in the two surveys mean that comparisons of the data for 2011 with other years should be undertaken with caution.

As with all non-monetary indicators, Educational Attainment is not directly comparable with other indicators in this report.

Reliability: Educational Attainment is considered very reliable.[145]

Analysis: Canadians were significantly better educated in 2016 than 1986 (Figure 67). Nearly half (47 per cent) of the population aged 15 and over had no formal education certificate, diploma or degree in 1986 and only 9 per cent had a university degree. By 2016, less than one fifth (18 per cent) had no formal certificate, diploma or degree, while 23 per cent had a university degree. All provinces and territories followed the national trend.

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144 In 2011, from the *National Household Survey*.

145 See Footnote 78 for details of the reliability scale used in this report.

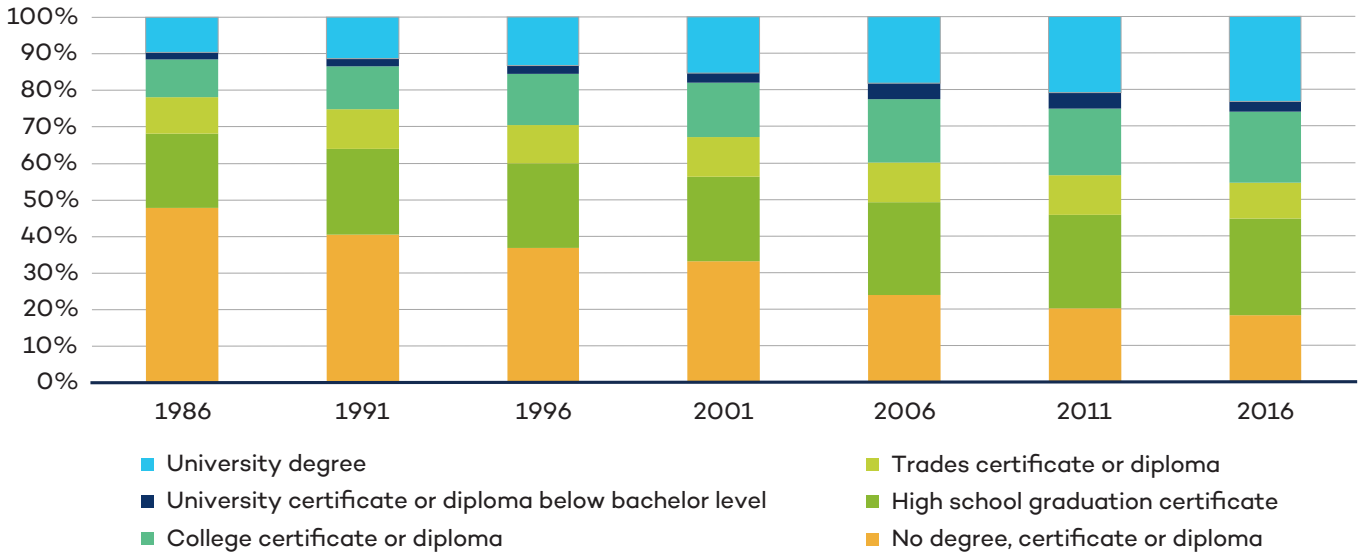


Figure 67. Share of population 15 and over by highest level of education, Canada, 1986, 1991, 1996, 2001, 2006, 2011 and 2016

Source: Current study based on Statistics Canada data.

Table 14. Change in educational attainment by level, Canada, 1986 to 2016

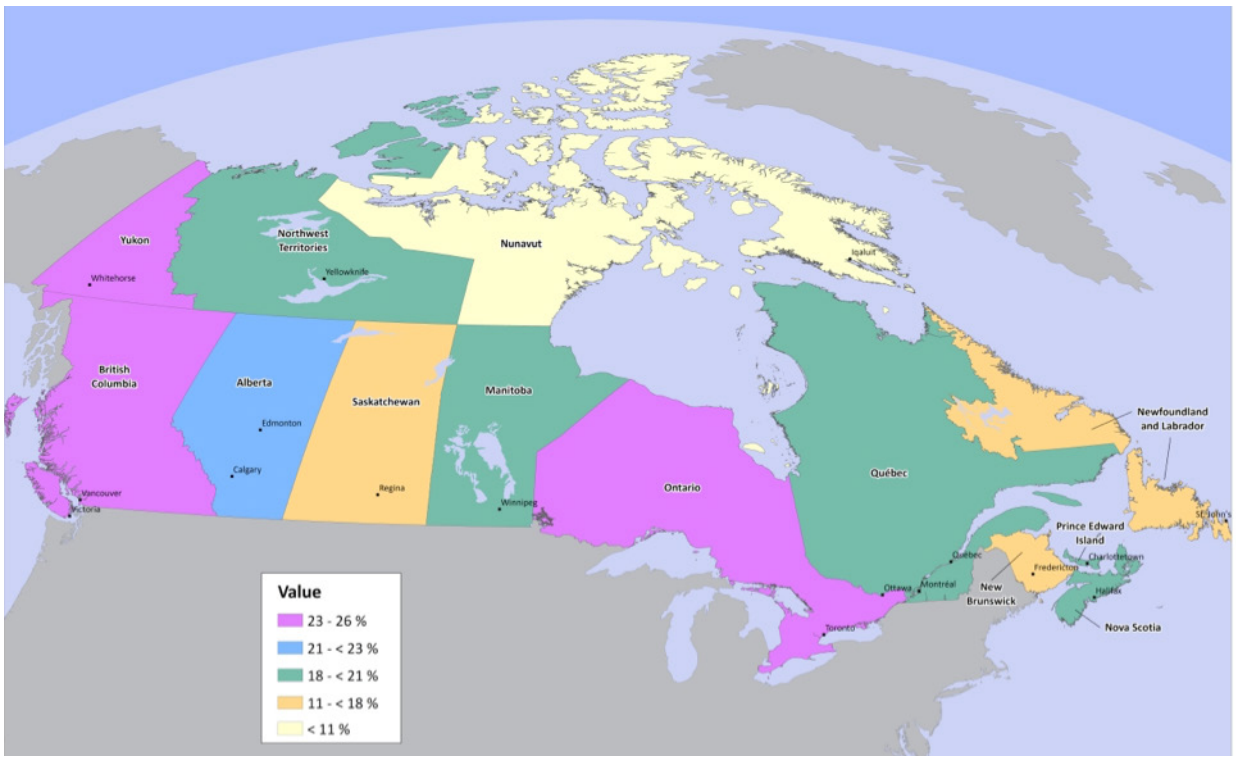
Level of attainment	Change
No certificate, diploma or degree	-30%
High school	6%
Trade diploma or certificate	0%
College	9%
University, below bachelor's degree	1%
University, bachelor's degree or higher	14%

Source: Current study based on Statistics Canada data.

The share of the population aged 15 and older holding no certificate, diploma or degree fell by 30 per cent between 1986 and 2016 (Table 14). The share of the population attaining all other levels of education (other than a trade certificate or diploma) rose.

Among the provinces and territories, Nunavut had the highest share of inhabitants age 15 and older with no certificate, diploma or degree in 2016 (51 per cent), followed by the Northwest Territories (27 per cent) and Newfoundland and Labrador (23 per cent); British Columbia and the Yukon had the lowest (16 per cent each), followed by Alberta (17 per cent) and Ontario (18 per cent).

Nunavut also had the lowest share of inhabitants aged 15 and over with a university degree (11 per cent), followed by Newfoundland and Labrador (15 per cent) and New Brunswick (17 per cent); Ontario had the highest (26 per cent), followed by British Columbia and the Yukon (25 per cent each) (Map 4).



Map 4. Share of population 15 and older with a university degree, provinces and territories, 2016

Source: Current study based on Statistics Canada data.

Indicator HC4 – Adult Skills

Theme: Human Capital

Geographic Scope: National, provincial/territorial

Time series: 2012

Frequency: Intermittent

Description: Adult Skills measures adult literacy, numeracy and problem solving[146] skills based on results from the *Programme for the International Assessment of Adult Competencies* (PIAAC), an initiative of the OECD. Technological change and the rapid expansion of information and communication technologies have changed the skills needed in the workplace and in daily life.

Relevance to comprehensive wealth: Adult skills are an important part of human capital that do not always arise from formal education. For this reason, an indicator based on data that directly measure skills is an important complement to the indicators of education spending and attainment presented above (Indicators HC2 and HC3).

Technology has become a central aspect of everyday life, and the labour market has increasingly shifted toward valuing skills related to analyzing and communicating information. Low proficiency in information processing skills results in worse results in the labour market and fewer opportunities to improve those skills. This results in people being left behind and in lower economic growth for the economy as a whole.

Method of Calculation: PIAAC was designed by a group of international experts and is administered in Canada by Statistics Canada (Statistics Canada, 2013b). PIAAC is an internationally comparable survey of the cognitive and workplace skills needed to participate in society and in the economy. The survey was undertaken in Canada at the national and provincial/territorial level in 2012 and measured the population aged 16 to 65. It consisted of a background questionnaire and a competencies assessment.

Limitations: PIAAC has been administered only once in Canada, so it is not yet possible to assess how adult skills have changed over time. However, Canadian results can be compared to OECD averages, and provinces/territories can be compared with one another.

As with all non-monetary indicators, Adult Skills is not directly comparable with other indicators in this report.

Reliability: Adult Skills is considered very reliable.[147]

Analysis: Canadians scored just above the OECD average for literacy in 2012 (Table 15). PEI, Nova Scotia, Ontario, Manitoba, Alberta, British Columbia and the Yukon all scored above the OECD average. Newfoundland and Labrador, New Brunswick, Quebec, Saskatchewan, the Northwest Territories and Nunavut all fell below the OECD average. Alberta was the highest-scoring jurisdiction in terms of literacy: Nunavut scored lowest.

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146 Specifically, problem solving in technology-rich environments.

147 See Footnote 78 for details of the reliability scale used in this report.

Canada scored 265.5 in numeracy, below the OECD average of 269. All provinces and territories scored at or below the OECD average. Nationally, Alberta scored the highest in numeracy (269.1). Nunavut scored the lowest (200.5), well below the OECD average.

Table 15. Adult Literacy and Numeracy, Canada, provinces and territories, 2012

	Literacy		Numeracy	
	Average Score	Share of the population aged 16 to 65 scoring at or above literacy level 3[a]	Average Score	Share of the population aged 16 to 65 scoring at or above numeracy level 3[b]
Canada	273.5	51.5	265.5	45.3
Newfoundland and Labrador	265.4	45.3	251.9	34.5
Prince Edward Island	277.5	54.7	265.0	44.2
Nova Scotia	273.9	49.7	262.8	41.8
New Brunswick	268.3	46.5	255.7	36.9
Quebec	268.6	46.8	264.9	56.1
Ontario	275.5	53.2	266.3	46.2
Manitoba	273.9	51.7	264.2	45.2
Saskatchewan	271.6	50.1	262.8	43.5
Alberta	277.7	55.1	269.1	47.3
British Columbia	274.8	54.1	266.3	47.7
Yukon	277.2	55.7	263.1	44.2
Northwest Territories	253.3	36.1	239.4	30.3
Nunavut	219.1	16.9	200.5	12.5

[a] Level 3 literacy skills correspond to a score of at least 276 and imply the ability to comprehend texts that are dense or lengthy.

[b] Level 3 numeracy skills correspond to a score of at least 276 and imply the ability to understand mathematical information that may not be explicit, is sometimes embedded in unfamiliar contexts and is represented in complex ways.

Source: Current study based on Statistics Canada data.

Problem solving is assessed solely using proficiency levels. Thirty-seven per cent of Canadians scored at or above level 2 proficiency,[148] which was above the OECD average of 34 per cent. The share of inhabitants at level 2 was at least as high in all provinces/territories (other than Nunavut and Newfoundland and Labrador) as the OECD average.

[148] Level 2 problem solving tasks typically require the use of both generic and specific technology applications. Some navigation across pages and applications is required, and tasks may involve multiple steps and operators. Some integration and inferential reasoning may be needed.

4.5
Financial Capital Indicators

Indicator FC1 – International Investment Position Index

Theme: Financial Capital

Geographic scope: National

Time series: 1990–2015

Frequency: Annual

Description: The International Investment Position Index measures the real per capita value of Canada's net foreign financial assets; that is, the real per capita value of the difference between Canadians' net holdings of foreign financial assets and non-residents' net holdings of Canadian financial assets.

Relevance to comprehensive wealth: The International Investment Position Index is relevant only to national comprehensive wealth (domestic comprehensive wealth, by definition, includes only Canadian assets held within the country's physical borders). When the index is positive, it represents Canadians' claims on the income of other countries. When it is negative, it represents the claims of non-residents on Canadian income. It thus represents either an addition to Canada's national comprehensive wealth (when positive) or a reduction in that wealth (when negative). It is the only element of the comprehensive wealth portfolio that both contributes to and deducts from Canadians' wealth depending on the circumstances. It is also the narrowest element of the portfolio, contributing to wealth only by serving as a source of monetary income flows and only for Canadians that own foreign assets.

Method of calculation: The index is calculated by deflating Statistics Canada's estimate of Canada's international investment position in nominal terms[149] by the implicit price index for final domestic demand[150] and dividing by population.[151]

Limitations: Ideally, an estimate of the international investment position in real terms would be available directly from Statistics Canada. The use of the implicit price index for final domestic demand to deflate Statistics Canada's nominal estimate, while statistically sound, likely results in less accurate estimates than would be possible using the more sophisticated deflation techniques available to Statistics Canada.

Reliability: The International Investment Position Index is considered reliable (Class 2).[152]

Analysis: Canada's International Investment Position Index (IIPI) was consistently negative from 1990 to 2013, meaning that non-residents owned more Canadian financial assets than Canadians owned foreign financial assets in real per capita terms. The trend up to 2013 was varied but moved generally toward a diminishing gap between the two—that is, toward the net balance of foreign financial asset ownership being in Canada's favour.

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149 Statistics Canada, *International Investment Position*, CANSIM Table 376-0142.

150 Statistics Canada, *Price indexes, gross domestic product*, CANSIM Table 380-0066.

151 Statistics Canada, *Estimates of population, by age group and sex for July 1*, CANSIM Table 051-0001.

152 See Footnote 78 for details on the reliability scale used in this report.

In 2014, likely for the first time in Canada's history,[153] the IIPI moved into positive territory, with Canadians owning more foreign financial assets than non-residents owned Canadian assets. In real per capita terms, the average Canadian owned about $9,000 in net foreign financial assets in 2015 compared with net foreign liabilities of about $13,800 in 1990 (Figure 68).

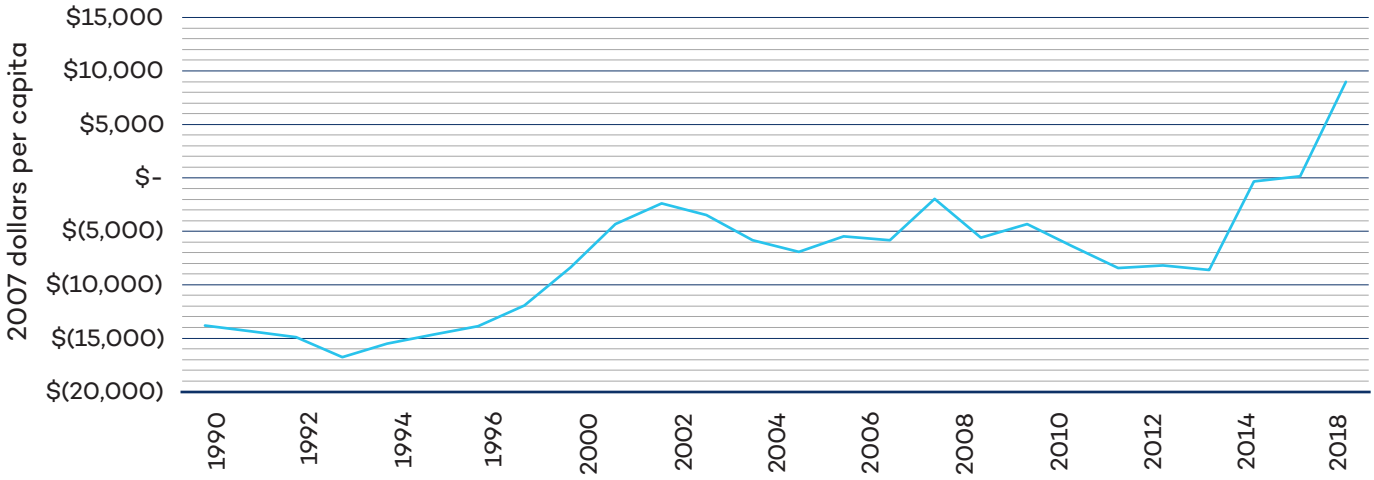


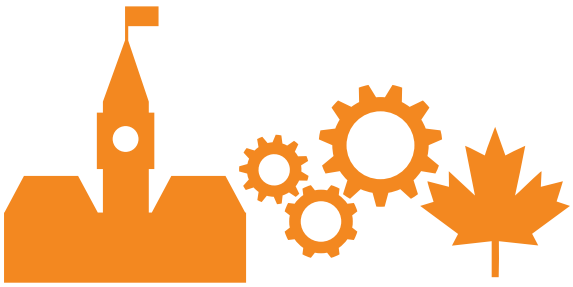
Figure 68. Canada's international investment position, market value, 1990–2015

Source: Current study based on Statistics Canada data.

Though a positive development from the point of view of comprehensive wealth, it is important to note the historic move of the IIPI into positive territory in 2014 was not the result increasing Canadian external investment. In fact, foreign acquisition of Canadian financial assets outstripped Canadian acquisitions of foreign assets in 2014, as it did in all years after the 2008 financial crisis and in most years prior to that as well. Rather, the reason for Canada's shift into positive IIPI territory in 2014 was revaluation of Canada's financial assets due to the relatively better performance of the U.S. stock market and the decline in the value of the Canadian dollar, both of which tend to increase the Canadian-dollar value of Canada's foreign financial assets. The ongoing strong performance of the U.S. stock market and the continuing relatively low value of the Canadian dollar meant that the IIPI remained positive in 2015.

[153] It is not possible to be certain whether Canada had a positive IIP in any year prior to 2014. Certainly, it did not between 1990 and 2013. Prior to 1990, the way in which Statistics Canada estimated the IIP was different. Book values (that is, the value at which assets were acquired) rather than current market values were used as the basis for the estimates. Annual book-value estimates going all the way back to 1945 are available from Statistics Canada, with occasional estimates beginning in 1926. Over the entire period from 1926 to 2015 (and still in 2018), Canada's book-value IIP was negative in every year for which estimates are available. It is only the market-value estimate of the IIP that moved into positive territory after 2014. While there may have been a year prior to 2014 when the market-value IIP would also have been positive, there is no way of knowing this for sure.

4.6
Social Capital Indicators



Indicator SC1 – Participation in Group Activities

Theme: Social Capital – *Civic engagement*

Geographic scope: National and provincial

Time series: 2003, 2008, 2013

Frequency: Every five years

Description: Participation in Group Activities tracks the share of people who participated in or were members of a group, organization or association[154] in the previous year.

Relevance to comprehensive wealth: There is a synergistic relationship between participation in group activities and interpersonal trust. As individuals participate more in their communities and in other group activities, they learn to trust others more. Likewise, greater trust in others makes people more likely to participate in groups. The result is a virtuous circle in which trust promotes cooperation and cooperation promotes trust.

Group participation brings diverse people together, strengthening social ties and encouraging the development of collective social capital. Participation in groups, organizations or associations aids in the development of certain behaviours and democratic principles such as cooperation, participation and interpersonal trust, even when these behaviours are not the primary aim of the group (Putnam, 2000; Newton & Norris, 2000).

Method of calculation: Data are collected via Statistics Canada's *General Social Survey* (GSS) cycle on social engagement, which is administered every five years. The social engagement cycle is aimed at gathering data to monitor changes in the living conditions and well-being of Canadians and to provide information on specific social policy issues of current or emerging interest. A question on group participation has been part of the GSS social engagement cycle since 2003. The GSS targets all people age 15 years of age and older and covers all 10 provinces by telephone interview. Data are broken down by sex, age and province.

Limitations: Data are not available for the Territories.

As with all non-monetary indicators, Participation in Group Activities is not directly comparable with other indicators in this report.[155]

Reliability: The estimates of Participation in Group Activities are considered very reliable (Class 1).

Analysis: The share of people who participated in group activities increased from 2003 to 2013. In 2003, 61 per cent of Canadians took part in a group compared to 65 per cent who did so in 2013. This upward trend was evident in all provinces, though the change was negligible in New Brunswick and Saskatchewan (Figure 69). Overall, the results across time and across regions were quite uneven, suggesting that no clear trend in group activity participation is evident.

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154 The list of groups, organizations and associations is quite broad. It includes unions or professional organizations, political organizations, sports or recreational groups, cultural or educational groups, social clubs, youth groups and others.

155 See Footnote 78 for details of the reliability scale used in this report.

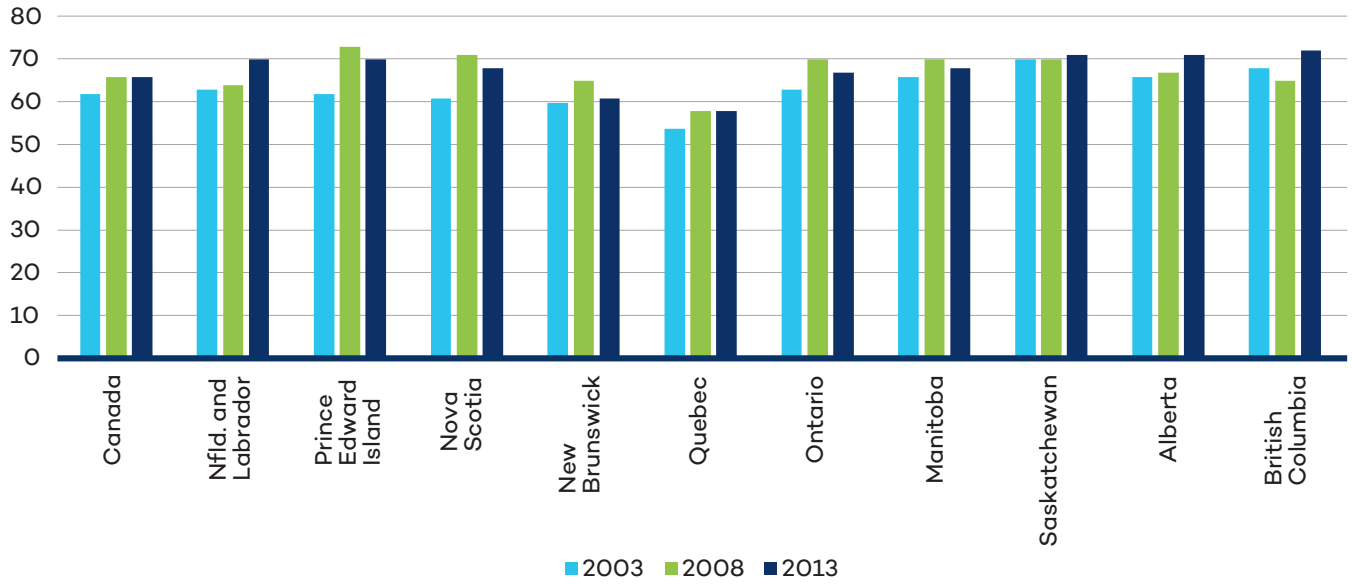

Figure 69. Share of the population participating in group activities, by province, 2003, 2008 and 2013

Source: Current study based on Statistics Canada data.

All age groups showed an increase in group participation between 2003 and 2013, including those 75 years and older. The increased involvement of seniors likely reflects the better health status of that group (Turcotte, 2015a).

Quebec had the lowest group participation rate in 2013 (57 per cent); British Columbia had the highest rate (71 per cent). While all provinces saw increases in participation from 2003 to 2013, many saw decreases between 2008 and 2013.

Indicator SC2 – Volunteering

Theme: Social Capital – *Civic engagement*

Geographic scope: National and provincial

Time series: 2004, 2007, 2010, 2013

Frequency: Every three years

Description: Volunteering measures the share of persons aged 15 and over who took part in any activities without pay on behalf of a group or organization at least once in the preceding 12 months, including any unpaid help provided to schools, religious organizations, sports or community associations.

Relevance to comprehensive wealth: Rates of volunteering provide an additional lens on the extent of Canadians' civic engagement (complementing Indicator SC1 – Participation in Group Activities) that is focused more closely on tangible benefits.

Volunteers provide time and expertise to services and programs that may not otherwise be delivered. Volunteerism is strongly related to the vitality of communities and helps meet basic needs of vulnerable populations.

Method of calculation: Data are collected via Statistics Canada's Survey of Giving, Volunteering and Participation, which has been undertaken every three years since 2004 and is now part of the regular General Social Survey (GSS) cycle. The GSS targets all people age 15 and older and covers all 10 provinces by telephone interview. Data are broken down by sex, age and province.

Data limitations: Data are available for the Territories for 2004, 2007 and 2010 but not for 2013.

As with all non-monetary indicators, Volunteering is not directly comparable with other Comprehensive Wealth indicators in this report.

Reliability: Volunteering is considered very reliable.[156]

Analysis: The volunteer rate in Canada rose from 45 per cent in 2004 to 47 per cent in 2010 before falling to 43.6 per cent in 2013 (Figure 70). Saskatchewan had the highest volunteer rate in 2013, at 56.2 per cent. As with Indicator SC1 – Participation in Group Activities, Quebec was the province with the lowest rate (32.1 per cent) in 2013.

[156] See Footnote 78 for details of the reliability scale used in this report.

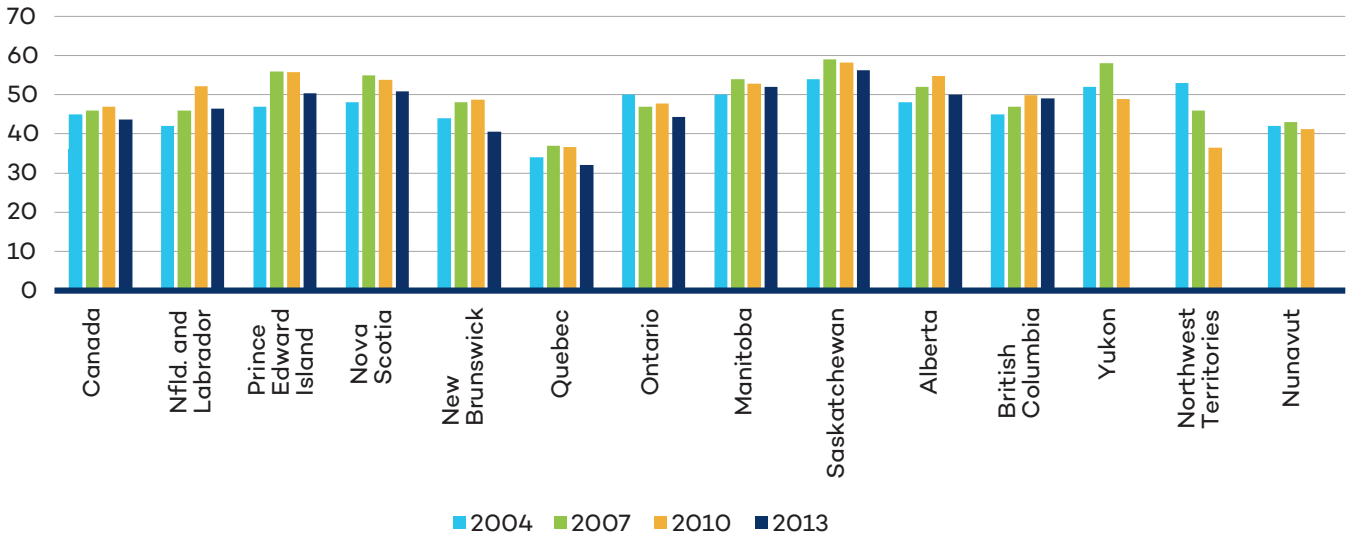

Figure 70. Volunteering rates, Canada and provinces/territories, 2004, 2007, 2010 and 2013

Note: Data are not available for the Territories for 2013.

Source: Current study based on Hall, Lasby, Gumulka, & Tryon, 2006; Turcotte, 2015b; Vezina & Crompton, 2012.

Only three provinces (New Brunswick, Ontario and Quebec) saw declines in volunteerism between 2004 and 2013, though all provinces saw declines from 2010 to 2013. The large share of the country's population in Ontario and Quebec meant that these provinces drove the slight overall decline in the national volunteer rate from 2004 to 2013. The largest decline in any province was found in Ontario, falling from 50 per cent in 2004 to 44 per cent in 2013. The largest increase was seen in Newfoundland and Labrador, rising from 42 per cent to 46.4 per cent.[157] As for the Territories, volunteering rates declined in all of them from 2004 to 2010. The decline was most notable in the Northwest Territories, where the rate fell from 53 per cent to 36.5 per cent.

Overall, the results across time and across regions were quite uneven, suggesting that no clear trend in volunteering is evident.

[157] It is possible that the decline in 2013 is a statistical artefact rather than a reflection of an actual decline in the rate of volunteering.

Indicator SC3 – Diversity in Social Networks

Theme: Social Capital – *Civic engagement*

Geographic scope: National and provincial

Time series: 2003, 2008, 2013

Frequency: Every five years

Description: Diversity in Social Networks measures the number of people who in the past month were in contact with at least a few friends from an ethnic group visibly different from their own.

Relevance to comprehensive wealth: Measuring diversity in social networks reveals whether "bonding" or "bridging" linkages are being made in Canadian society. "Bridging" linkages are those made between groups that are different. The opposite is "bonding" linkages, those made when people make connections only with other people like themselves. Bonding links help create more tightly knit groups. Bridging links are important for the opportunities they provide for sharing of knowledge and ideas and the creation of consensus between diverse groups.

Method of calculation: Data are collected via Statistics Canada's General Social Survey (GSS) cycle on social engagement, which is administered every five years. The social engagement cycle is aimed at gathering data to monitor changes in the living conditions and well-being of Canadians and to provide information on specific social policy issues of current or emerging interest. A question on diversity in social networks has been part of the GSS social engagement cycle since 2003. The GSS targets all people 15 years of age and older and covers all 10 provinces by telephone interview. Data are broken down by sex, age and province.

Limitations: Diversity in Social Networks reveals only one type of "bridging": that between visibly different ethnic groups. An indicator of bridging might also look at bridging among individuals from different income categories, regions, linguistic groups, religions and educational levels.[158]

As with all non-monetary indicators, Diversity in Social Networks is not directly comparable with the other indicators in this report.

Reliability: Diversity in Social Networks is considered very reliable.[159]

Analysis: The proportion of people in Canada who were in contact with at least a few friends from a visibly different ethnic group increased from 54 per cent in 2003 to 59 per cent in 2013 (Figure 71). An upward trend in the diversity of social networks was apparent in all provinces.

[158] All of these dimensions, except religion, are captured by the GSS.

[159] See Footnote 78 for details of the reliability scale used in this report.

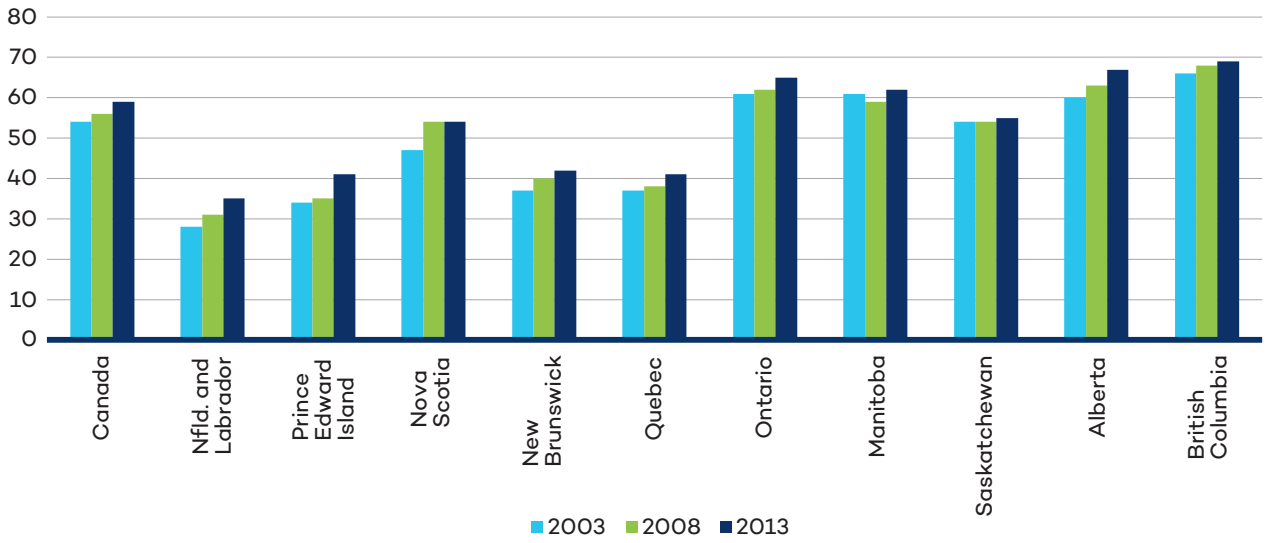

Figure 71. Share of people who in the past month were in contact with at least a few friends from an ethnic group visibly different than their own, by province, 2003, 2008 and 2013

Source: Current study based on Statistics Canada data.

The greatest increases in the diversity of social networks took place in Newfoundland and Labrador, Prince Edward Island, Nova Scotia and Alberta, which all experienced a 7 per cent increase between 2003 and 2013.

Diversity in social networks varied considerably between the provinces. British Columbia, Alberta, Ontario and Manitoba all had levels of diversity in social networks greater than 60 per cent. Levels in Quebec, New Brunswick, Prince Edward Island and Newfoundland and Labrador, on the other hand, were 41 per cent or less. This variance may be related to the ethnic diversity of the provinces themselves, as British Columbia, Ontario, Alberta and Manitoba have the highest proportion of visible minorities, while Newfoundland and Labrador, New Brunswick, and Prince Edward Island have the lowest (Turcotte, 2015a). Quebec seems to be an outlier, as it has a relatively high proportion of visible minorities but a low diversity of social networks.

Overall, the results were quite consistent over time and across regions, suggesting the upward trend in diversity in social networks is real.

Indicator SC4 – Control Over Public Decisions

Theme: Social Capital – *Civic engagement*

Geographic scope: National and provincial

Time series: 1993–2011

Frequency of update: Intermittent/during federal elections

Description: Control Over Public Decisions measures the share of Canadians that feel they have a say in the public decisions that affect their everyday lives.

Relevance to comprehensive wealth: A feeling of having a high level of control over government decisions can encourage further civic engagement and lead to improved performance of institutions. People are more likely to participate in and trust their government if they feel they have control over government decision making. This leads to a positive cycle of increasing participation and increasing trust.

Method of calculation: Data are collected as part of the Canadian Election Study (CES) administered by a group of academics led by Professor Patrick Fournier of the University of Montreal (Fournier et al., 2011). The CES began as an academic project in 1965 to examine attitudes toward Canadian elections and democracy. Similar studies are carried out in the United States, United Kingdom, the Netherlands and New Zealand. Elections Canada has participated in the CES since 1997.[160]

Limitations: Data were not collected for the 1997 election or for elections prior to 1993.

As with all non-monetary indicators, Control Over Public Decisions is not directly comparable with other Comprehensive Wealth indicators in this report.

Reliability: Control Over Public Decisions is considered reliable.[161]

Analysis: Data suggest there was been an increase during the 1990s in individuals' feelings of control over public decisions (Figure 72). Since 2000, a fairly stable majority of people (56–62) have disagreed with the statement "People like me don't have any say about what the government does," though there was slight drop between 2008 and 2011.

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[160] Historical data from the CES back to 1965 can be accessed via Queen's University's *Canadian Opinion Research Archive* (http://www.queensu.ca/cora/ces.html).

[161] See Footnote 78 for details of the reliability scale used in this report.

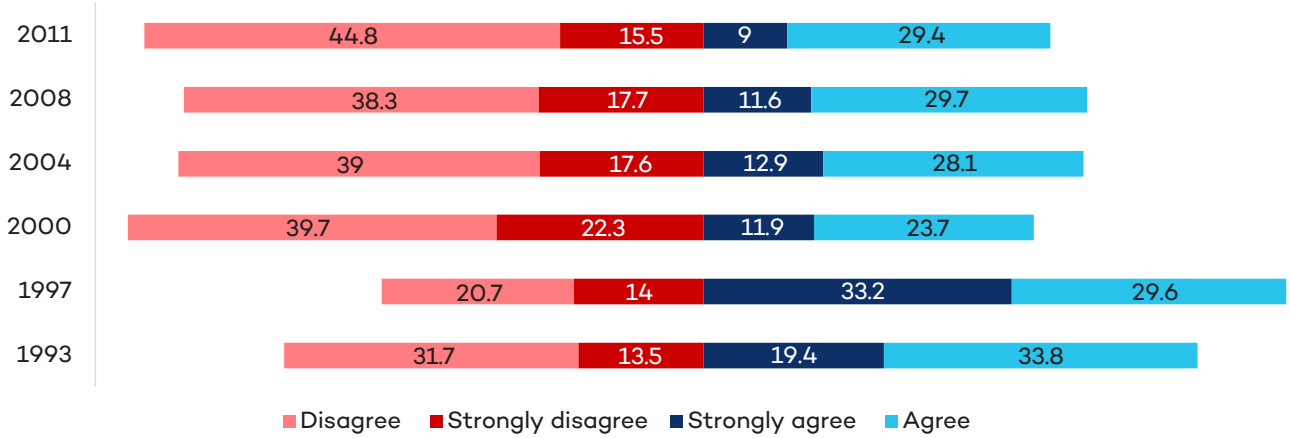

Figure 72. Share of people who believe "People like me don't have any say about what the government does," 1993, 2000, 2004, 2008 and 2011

Source: Current study based on Blais et al., 1997, 2000, 2004; Fournier et al., 2011; Gidengil et al., 2008; Johnston et al., 1993.

Indicator SC5 – Voter Turnout

Theme: Social Capital – *Civic engagement*

Geographic scope: National, provincial/territorial and municipal (Census Metropolitan Areas)

Time series: 1990 to 2015

Frequency: Each federal, provincial/territorial and municipal election

Description: Voter Turnout measures the share of registered voters who turn out to vote in elections.

Relevance to comprehensive wealth: Voter turnout provides a measure of civic engagement and the extent to which people are involved in government decision making. Elections are the most fundamental processes of democratic engagement, and high turnouts are generally considered to be positive.[162] A common concern is that low voter turnouts undermine the notion that electoral outcomes (and therefore policies of government) reflect the will of the general population.

Method of calculation: Data on voter turnout are provided by Elections Canada. Voter turnout is calculated by the number of votes cast divided by the number of registered voters.

Limitations: The denominator of voter turnout, "registered voters," may be changing over time, since not all eligible voters necessarily register to vote. The rate of this change is unknown. This is particularly a problem for municipal elections, for which consistent methods for voter registration do not exist. Other factors may limit the comparability of results across jurisdictions; for instance, it may be more convenient to vote in some jurisdictions (easier registration, more numerous polling stations).

As with all non-monetary indicators, Voter Turnout is not directly comparable with other Comprehensive Wealth indicators in this report.

Reliability: Voter Turnout is considered very reliable.[163]

Analysis: Provincial elections tend to have the highest voter turnouts, with an average of 67.5 per cent of registered voters voting in elections held between 1990 and 2015 (Table 16). Municipal voter turnout is often quite low, with an average of just 40.3 per cent in elections held from 1990 to 2015. High variability in voter turnout is seen in elections at all levels.

Prince Edward Island had the highest voter turnout in the most recent provincial/territorial election up to and including 2015 (Figure 73). Prince Edward Island also had the highest turnout among provinces/territories in the 2015 federal election, followed closely by New Brunswick and Yukon (Figure 73). The Northwest Territories had the lowest voter turnout in the most recent provincial/territorial election, while Nunavut and Newfoundland and Labrador had the lowest turnouts in the most recent federal election (Figure 74).

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[162] High turnout cannot always be taken as a sign of high voter engagement, as governments in several countries, including Australia, have compulsory voting laws.

[163] See Footnote 78 for details of the reliability scale used in this report.

Table 16. Voter turnout results in municipal, provincial and federal elections held between 1990 and 2015 (per cent)

	Municipal elections	Provincial/territorial elections	Federal elections
Max	58.4	85.8	69.6
Min	19.6	40.6	58.8
Average	40.3	67.5	64.4

Sources: Current study based on data from Elections Canada, provincial election authorities, municipal websites and the Association of Municipalities Ontario.

Voter turnout in federal elections generally declined between 1980 and 2015, with turnout hitting a historic low of 58.5 per cent in the 2008 election. Turnout moved upward in the two most recent elections (2011 and 2015) (Figure 75). It is too early to tell whether this represents a trend back to voting rates similar to those in the 1980s, which were relatively high by historical standards, or simply a temporary bend in a downward trend.[164]

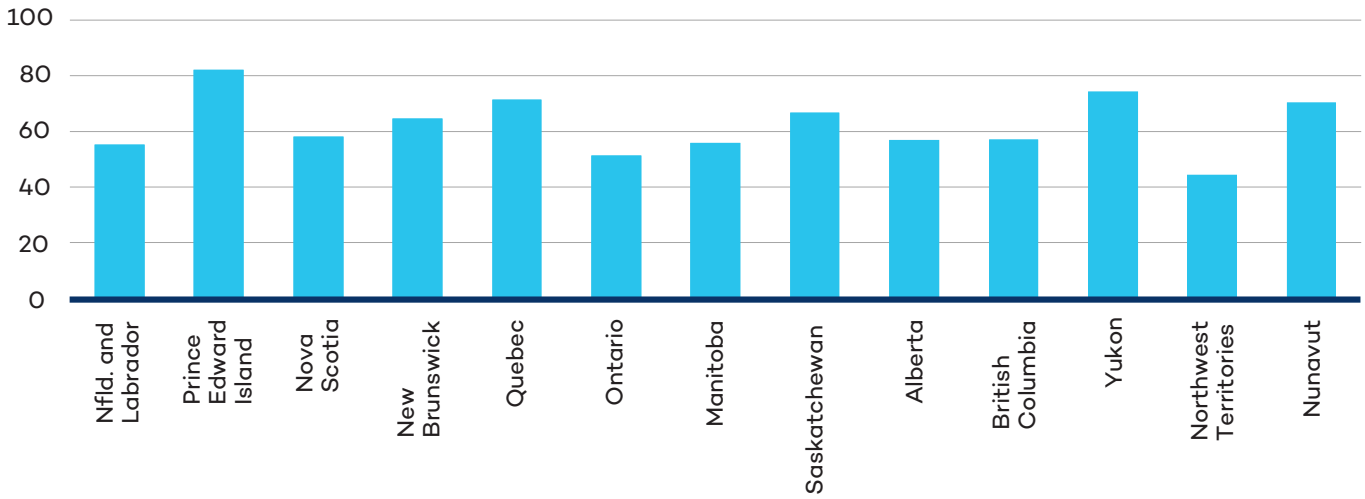

Figure 73. Voter turnout, most recent provincial/territorial elections, 2015 or earlier (per cent)

Source: Current study based on Elections Alberta, n.d.; Elections BC, 2013; Elections Manitoba, 2011; Elections New Brunswick, 2014; Elections Newfoundland and Labrador, 2015; Elections Nova Scotia, 2013; Elections Nunavut, 2013; Elections NWT, 2015; Elections Ontario, 2014; Elections Prince Edward Island, 2015; Elections Quebec, 2014; Elections Saskatchewan, 2016; Elections Yukon, 2011.

[164] The highest turnout ever recorded for a federal election was 79.4 per cent in 1958. In comparison, the turnout rates for the 1984 and 1988 elections were both 75.3 per cent.

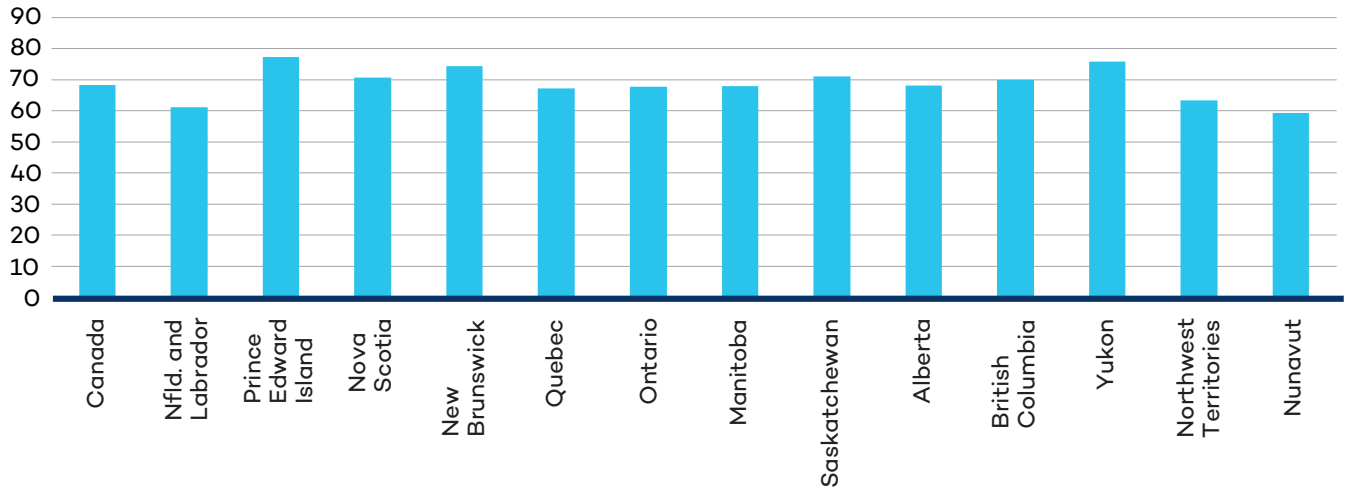

Figure 74. Voter turnout by province, 2015 federal election (per cent)

Source: Current study based on data from Elections Canada.

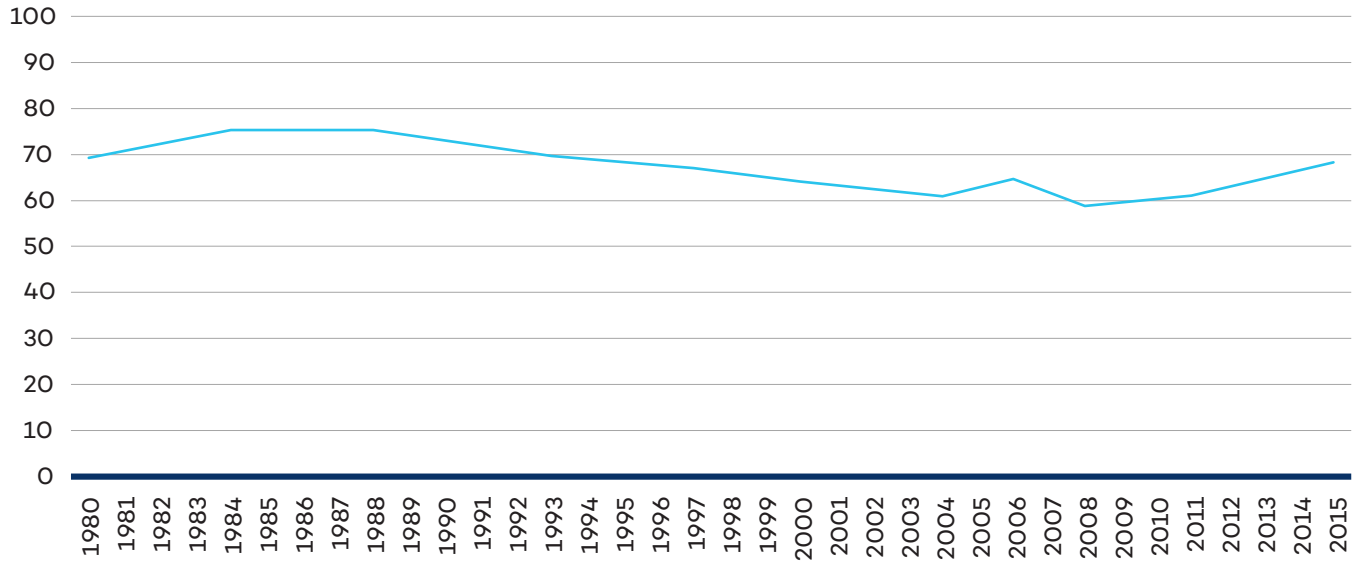

Figure 75. Voter turnout, federal elections from 1980 to 2015 (per cent)

Source: Current study based on data from Elections Canada.

Indicator SC6 – Generalized Trust

Theme: Social Capital – *Trust and cooperative norms*

Geographic scope: National and provincial

Time series: 2003–2013

Frequency of update: Every five years

Description: Generalized Trust measures the share of Canadians who think that, in general, most people can be trusted.

Relevance to comprehensive wealth: Trust in others, particularly in strangers and people who are different, is referred to as *generalized trust*. A degree of trust in strangers is necessary for the creation and maintenance of productive social norms. Generalized trust "is often considered an element facilitating social contracts: higher levels of trust mean lower transaction costs and improved likelihood of productive interactions." Trust in others is an important element of collective social capital. Trust in strangers is important for the survival of community institutions and networks (Turcotte, 2015a).

Method of calculation: Data are collected via Statistics Canada's General Social Survey (GSS) cycle on social engagement, which is administered every five years. The social engagement cycle is aimed at gathering data to monitor changes in the living conditions and well-being of Canadians and to provide information on specific social policy issues of current or emerging interest. A question on generalized trust has been part of the GSS social engagement cycle since 2003. The GSS targets all people age 15 years of age and older and covers all 10 provinces by telephone interview. Data are broken down by sex, age and province.

Limitations: Data are not available for the Territories.

As with all non-monetary indicators, Generalized Trust is not directly comparable with other comprehensive wealth indicators in this report.

Reliability: Generalized Trust is considered very reliable.[165]

Analysis: In 2013, about half of Canadians (54 per cent) felt that most people can be trusted (Figure 76), essentially unchanged from 2003. Prince Edward Island and British Columbia had the highest levels of generalized trust in 2013 (63 per cent). As with other indicators (Participation in Group Activities – SC1, Volunteering – SC2 and Diversity in Social Networks – SC3) Quebec had lower levels of generalized trust than other provinces. A notable trend is that generalized trust fell from 2003 to 2008 and then rose again in 2013 in all provinces. With the exception of Quebec, generalized trust remained below 2003 levels in 2013. Overall, the results across time and across regions were quite uneven, suggesting that no clear trend in generalized trust is evident.

[165] See Footnote 78 for details of the reliability scale used in this report.

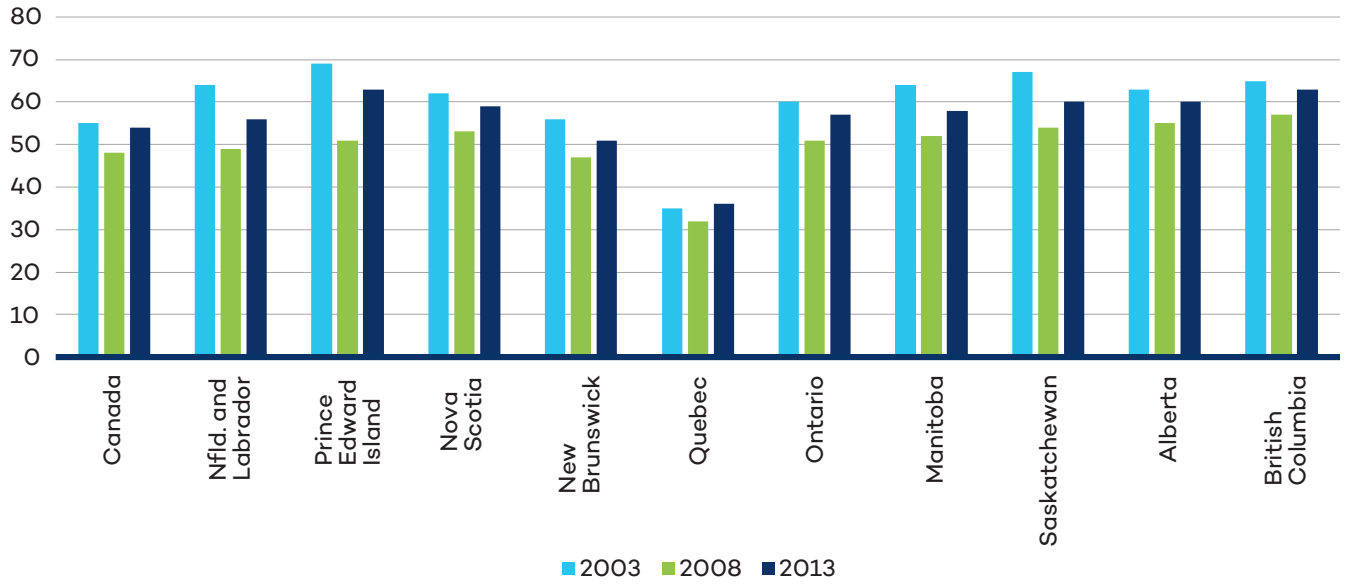

Figure 76. Share of Canadians who feel that most people can be trusted, Canada and provinces, 2003, 2008 and 2013

Source: Current study based on data from Statistics Canada.

Indicator SC7 – Trust in Neighbours and Strangers

Theme: Social Capital – *Trust and cooperative norms*

Geographic scope: National and Provincial

Time series: 2003–2013

Frequency of update: Every five years

Description: Trust in Neighbours and Strangers measures the share of Canadians who trust their neighbours and strangers.

Relevance to comprehensive wealth: The share of Canadians who believe that, generally speaking, most people can be trusted is a standard question used to evaluate generalized trust (see Indicator SC6 – Generalized Trust). However, since there is some uncertainty in interpreting the results of this question (for example, how do respondents interpret "most people" and what kind of situations are they considering?), additional indicators are helpful to assess Canadians' level of trust in one another.

Method of calculation: Data are collected via Statistics Canada's General Social Survey (GSS) cycle on social engagement, which is administered every five years. The social engagement cycle is aimed at gathering data to monitor changes in the living conditions and well-being of Canadians and to provide information on specific social policy issues of current or emerging interest. A question on trust in neighbours and strangers has been part of the GSS social engagement cycle since 2003. The GSS targets all people age 15 years of age and older and covers all 10 provinces by telephone interview. Data are broken down by sex, age and province.

Limitations: Data are not available for the Territories.

As with all non-monetary indicators, Trust in Neighbours and Strangers is not directly comparable with other Comprehensive Wealth indicators in this report.

Reliability: Trust in Neighbours and Strangers is considered very reliable.[166]

Analysis: In 2013, the average trust in neighbours in Canada was 3.7 on a scale of 1 to 5 where 1 is low, essentially the same level as in 2003 (Figure 77). Newfoundland and Labrador and Prince Edward Island had the highest trust in neighbours in 2013 at 4. Quebec scored the lowest on this indicator (3.5).

As with Generalized Trust (Indicator SC6) all provinces saw a significant decline in trust in neighbours from 2003 to 2008 followed by a subsequent rise in 2013. There was little difference between the 2003 values and the 2013 values except in Newfoundland and Labrador, PEI, Manitoba and Saskatchewan, where levels remained slightly below 2003 in 2013.

[166] See Footnote 78 for details of the reliability scale used in this report.

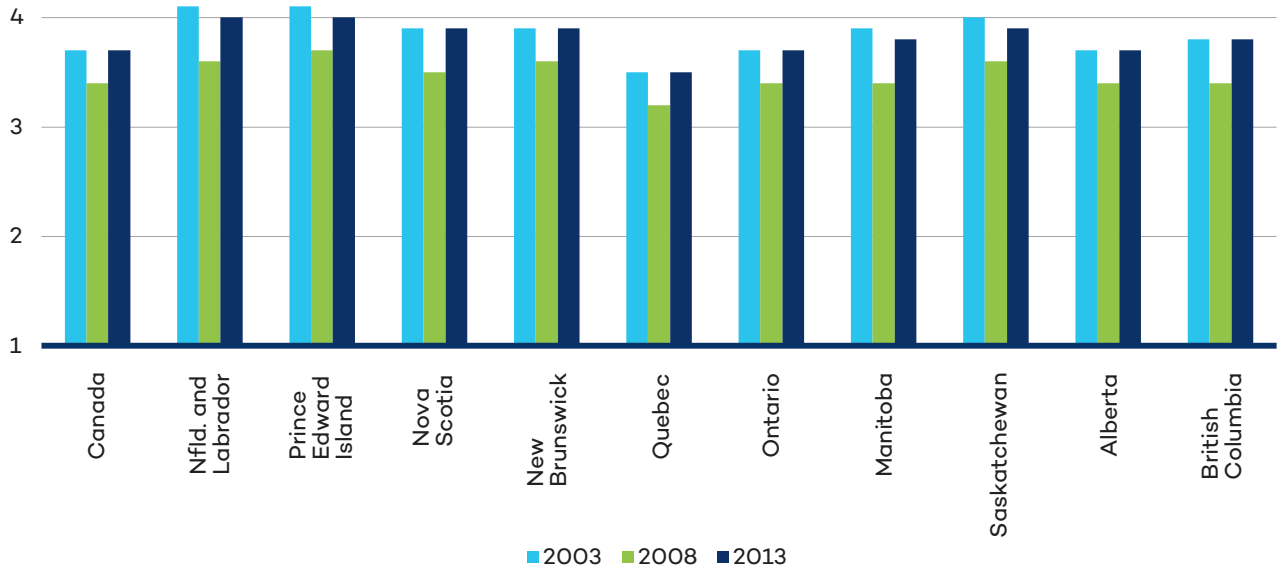

Figure 77. Trust in neighbours, Canada and provinces, 2003, 2008 and 2013

Note: 1 is "Cannot be trusted at all" and 5 is "Can be trusted a lot"

Source: Current study based on data from Statistics Canada.

With respect to trust in strangers, the average level across the country in 2013 was 2.4 (again on a scale of 1 to 5). Prince Edward Island had the highest level of trust in strangers in 2013, with a score of 2.7. Quebec scored the lowest at 2.1. Across all provinces trust in strangers is lower than trust in neighbours. As with generalized trust and trust in neighbours, trust in strangers dropped in 2008 and rose again in 2013. However, unlike trust in neighbours, there were increases in all provinces in trust in strangers from 2003 to 2013 (Figure 78).

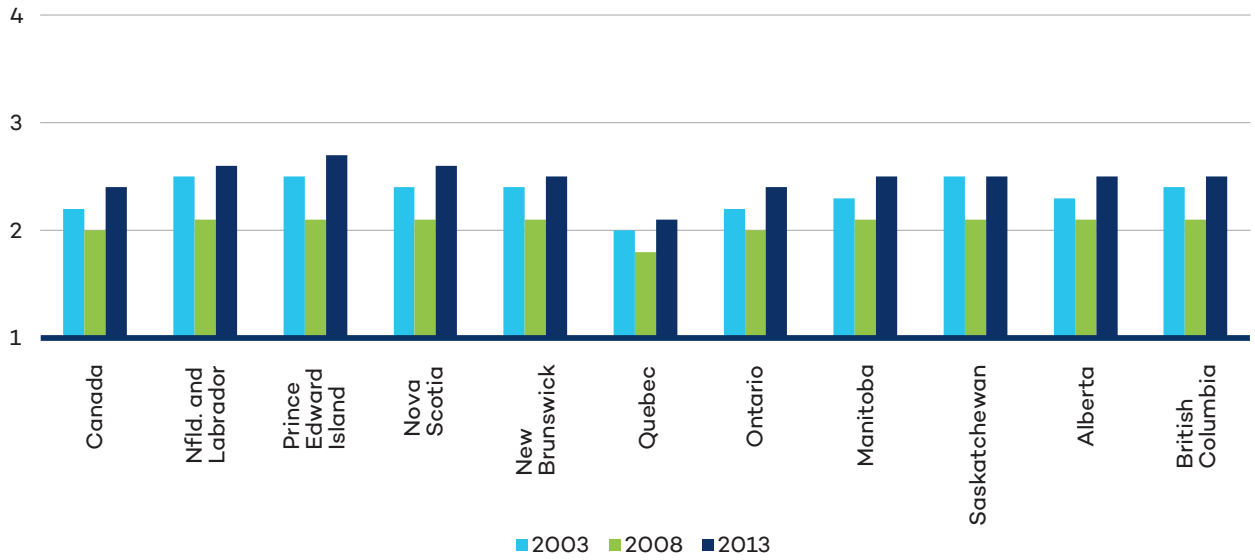

Figure 78. Trust in strangers, Canada and provinces, 2003, 2008 and 2013

Note: 1 is "Cannot be trusted at all" and 5 is "Can be trusted a lot"

Source: Current study based on data from Statistics Canada.

Overall, the results across time and across regions were quite uneven, suggesting that no clear trend in either trust in neighbours or strangers is evident.

Indicator SC8 – Trust That a Lost Wallet Will Be Returned

Theme: Social Capital – *Trust and cooperative norms*

Geographic scope: National and provincial

Time series: 2003, 2008, 2013

Frequency of update: Every five years

Description: Trust That a Lost Wallet Will Be Returned measures the share of Canadians who believe a lost wallet or purse would be returned with the money in it by someone who lives close by.

Relevance to comprehensive wealth: The indicators of Generalized Trust (Indicator SC6) and Trust in Neighbours and Strangers (Indicator SC7) bring progressively more focus to the measurement of trust. This indicator provides an even more concrete assessment of trust. Trust is a broad and abstract concept and it is useful to evaluate it using the specific example of a lost purse or wallet. Doing so reflects trust in the shared values and understandings of how people are expected to behave in society.

Method of calculation: Data are collected via Statistics Canada's General Social Survey (GSS) cycle on social engagement, which is administered every five years. The social engagement cycle is aimed at gathering data to monitor changes in the living conditions and well-being of Canadians and to provide information on specific social policy issues of current or emerging interest. A question on trust in neighbours and strangers has been part of the GSS social engagement cycle since 2003. The GSS targets all people age 15 years of age and older and covers all 10 provinces by telephone interview. Data are broken down by sex, age and province.

Limitations: Data are not available for the Territories.

As with all non-monetary indicators, Trust That a Lost Wallet Will Be Returned is not directly comparable with other Comprehensive Wealth indicators in this report.

Reliability: Trust That a Lost Wallet Will Be Returned is considered very reliable.[167]

Analysis: In 2013, the share of Canadians who felt they were very likely to have a lost purse or wallet returned if found by a neighbour was 45 per cent (Figure 79). This was a decrease of one per cent from 2003 (46 per cent). As with Generalized Trust and Trust in Neighbours and Strangers, the majority of provinces showed a decline in 2008 followed by a rebound in 2013. Newfoundland and Labrador had the highest share of people who felt they were very likely to have a purse or wallet returned (63 per cent). As with other social capital indicators, Quebec scored the lowest (42 per cent). However, Quebec was one of only two provinces (along with British Columbia) where the belief that a lost wallet or purse would be returned increased from 2003 to 2013.

Overall, the results across time and across regions were quite uneven, suggesting that no clear trend in Trust That a Lost Wallet Will Be Returned is evident.

[167] See Footnote 78 for details of the reliability scale used in this report.

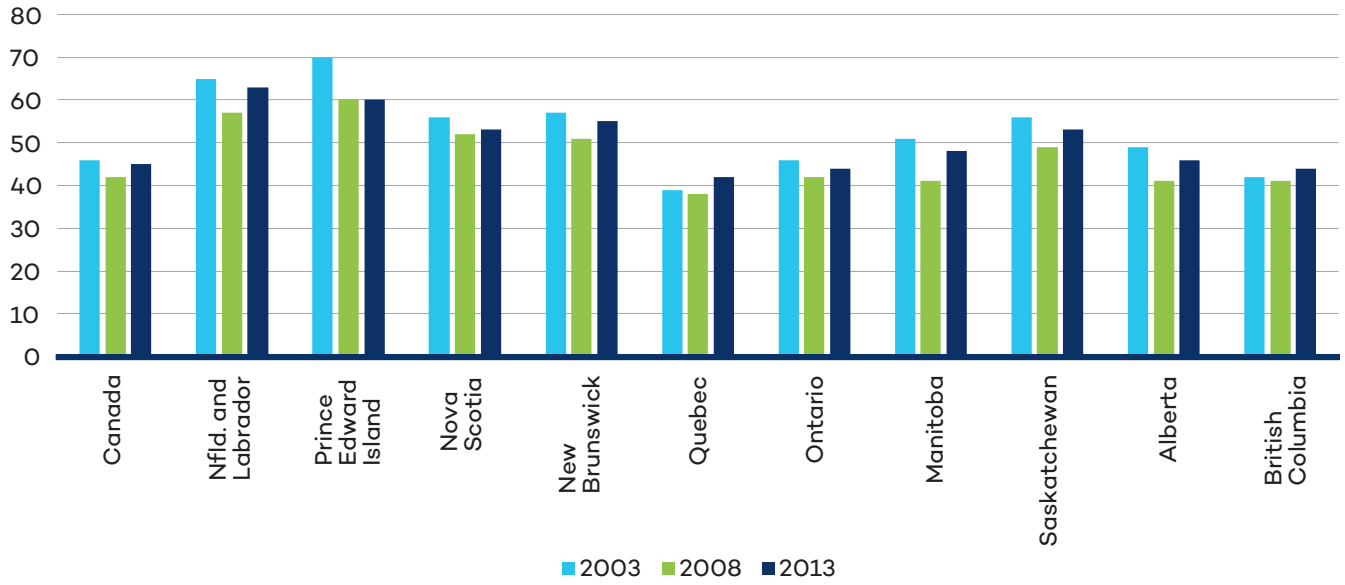

Figure 79. Share of Canadians who believe it is very likely a lost wallet or purse will be returned if found by a neighbour, by province, 2003, 2008 and 2013

Source: Current study based on data from Statistics Canada.

Indicator SC9 – Trust in Institutions

Theme: Social Capital – *Trust and cooperative norms*

Geographic scope: National

Time series: 1993 to 2011

Frequency of update: Intermittent/during federal elections

Description: Trust in Institutions measures the confidence that Canadians place in the government. Unlike the previous trust indicators, which focused on trust in individuals, this indicator measures the trust people place in institutions.

Relevance to comprehensive wealth: Trust in institutions (the electoral system, parliament, the judicial system, or government more broadly) is essential for the smooth functioning of society. Like generalized trust, trust in institutions likely reduces transaction costs. It also affects peoples' relationship with the state—for example, the extent to which they are willing to vote in elections (Pammett & LeDuc, 2003) or pay or avoid paying their taxes (Putnam, 2001).

Trust in institutions is often gauged via questions about trust or confidence in either (a) specific institutions (for example, parliament, police, media, corporations, etc.) or (b) government more broadly. Either approach is reasonable, but trust in government provides a broader view of social capital and trust in institutions.

Method of calculation: Data are collected as part of the Canadian Election Study (CES) administered by a group of academics led by Professor Patrick Fournier of the University of Montreal (Fournier et al., 2011). The CES began as an academic project in 1965 to examine attitudes toward Canadian elections and democracy. Similar studies are carried out in the United States, United Kingdom, the Netherlands and New Zealand. Elections Canada has participated in the CES since 1997.[168]

Limitations: Due to data limitations, the indicator measures trust in the federal government only.

Data were not collected for the 2006 election or consistently prior to the 1993 election.

As with all non-monetary indicators, Trust in Institutions is not directly comparable with other indicators in this report.

Reliability: Trust in Institutions is considered reliable.[169]

Analysis: Confidence in the federal government varied considerably from 1993 to 2011, though there was a general trend toward greater confidence. Only 31.1 per cent of people reported having some degree of confidence in 1993, whereas 55.2 per cent had confidence in the government in 2011, the first year that more than half of the population felt that way (Figure 80). The share of people who have a great deal of confidence varied but remained consistently low, peaking at 6.1 per cent in 2011. The share of people who have no confidence at all, in contrast, fell more or less steadily from 15.3 per cent in 1993 to 7.1 per cent in 2011.

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[168] Historical data from the CES back to 1965 can be accessed via Queen's University's *Canadian Opinion Research Archive* (http://www.queensu.ca/cora/ces.html).

[169] See Footnote 78 on page for details of the reliability scale used in this report.

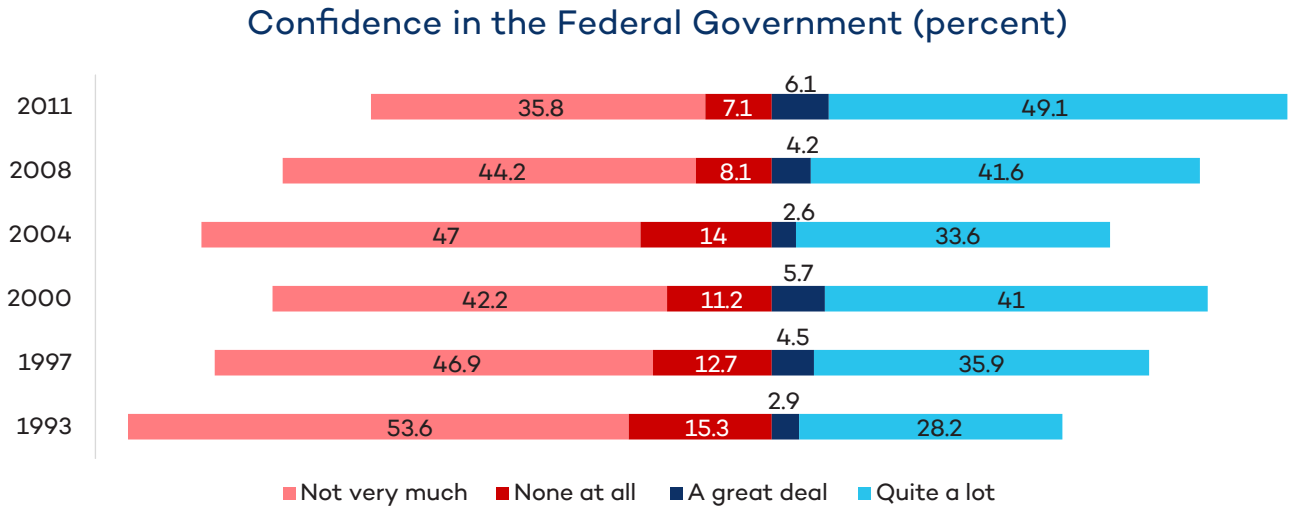

Figure 80. Share of Canadians expressing confidence in the federal government, 1993, 1997, 2000, 2004, 2008 and 2011

Source: Current study, based on Fournier et al., 2011.

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Comprehensive Wealth

ANNEXES

ANNEX 1 DATA QUALITY AND STATISTICAL SOURCES OF ERROR

The concept of comprehensive wealth, though new to many, dates back to the 1990s. Thinking about the individual elements of it dates back much further, most famously to Adam Smith and his 18th century work on the wealth of nations. The late University of British Columbia economist Anthony Scott (1956) characterized the environment in natural capital terms by the 1950s. Work on measuring human capital began seriously in the 1960s (Schultz, 1960, 1961). Social capital, though somewhat newer, has been an area of active research since the 1980s (Coleman, 1988; Putnam, 1995).

The statistical methods used to measure comprehensive wealth in this study are well established and will be familiar to those accustomed to working with national economic, environmental or social statistics.

The data used were the best data available from Statistics Canada and, in a few cases, other sources:

- Global Forest Watch Canada was the main source of data used to compile the ecosystem indicators (indicators NC2 to NC5).
- Natural Resources Canada and Agriculture and Agrifood Canada data were used in the estimation of timber and built-up land assets in the Natural Capital Index (Indicator NC1).

OECD data were used for several of the indicators presented in the case study on green growth (see Text Box 9 and Annex 4).

Though based on the most up-to-date concepts, methods and data available, the estimates produced for the study—like all statistical estimates—are inevitably subject to error. In this annex, we discuss possible sources of error.

A1.1 Missing Assets

The mostly likely source of error in the comprehensive wealth indexes compiled here (the NCWI and DCWI) is that one or more important assets is missing from them. The most obvious missing asset is social capital, which we measured using a variety of non-monetary indicators but could not be included in the indexes because monetary measures of social capital are not yet available.

There are two reasons why we believe the exclusion of social capital from the CW indexes may not significantly affect either their levels or their rates of growth. First, since the indexes both include only market assets, they are estimates of the wealth underpinning market production only. While social capital likely contributes to market production in Canada, we believe that its value in that regard is mainly captured in the value of the other assets that make up the comprehensive wealth portfolio. In other words,

because Canada has high levels of social capital, its produced, natural and human capital assets are worth more than they would be in a country where "doing business" was more difficult. Thus, the exclusion of social capital from the indexes may not significantly impact their levels.[170]

Second, even if the value of social capital were not caught by the value of other assets, we do not see evidence based on the non-monetary indicators we have compiled to suggest that social capital is growing over time. Thus, we believe its exclusion from the indexes is unlikely to affect their rates of growth.

The other two assets missing from the comprehensive wealth indexes are both forms of market natural capital: fish stocks and commercial water resources. Neither of these could be measured in monetary terms for this study. Fish stocks, which could not be valued due to data gaps, are likely of low value in Canada (as in other countries) because of dissipation of rents in the commercial fishing industry. Their exclusion from the indexes is therefore unlikely to have a significant impact on their values.

The value of commercial water resources, such as water in hydroelectric, irrigation and drinking water reservoirs, is likely of some consequence in Canada. Estimation of their values was again not possible due to gaps in data, though a rough estimate of the value of hydroelectric reservoirs based on two studies from the early 1980s (Bernard, Bridges & Scott, 1982; Zuker & Jenkins, 1982) is possible. It suggests a figure of between $7,000 and $14,000 in 2015 (chained 2007 dollars per capita) for the water in hydroelectric reservoirs, with relatively little growth from 1980 to 2015. This offers evidence that the values in question may not be large in comparison with overall national comprehensive wealth (over $700,000 in real per capita terms in 2015) but that they are of some consequence.

A1.2 Quality of Statistics Canada's Human Capital Estimates

Though already well developed, research on the concepts, methods and data that underlie the measurement of comprehensive wealth is ongoing. Statistics Canada's human capital estimates, in particular, are based on the results of research studies and are not "official statistics."[171] For this reason, some caution is called for in interpreting the trend in the value of human capital. Given that human capital accounts for the majority of comprehensive wealth in Canada (as in other developed countries), this caution is also called for in interpreting the trend in overall comprehensive wealth.

Two main approaches to valuing human capital are available: the lifetime-income approach of Jorgenson and Fraumeni (1989, 1992) and the education investment (cost-based) approach of Schultz (1960) and Kendrick (1976). Both approaches have been the subject of much research and are well-developed conceptually, methodologically and empirically. Statistics Canada's estimates of human capital are based on the lifetime-income approach. This method has been used to estimate the value of human capital in at least 17 other middle- and high-income countries. The data required to implement the lifetime-income approach include wage rates, rates of employment by sex, age, educational attainment levels, years of schooling and population survival rates. Statistics Canada, as an advanced statistical agency, has access to good data in all of these areas.

[170] This does not mean that social capital does not have significant value as a source of non-market production and this value, to the extent it exists, would not be captured in the value of other assets. Thus, the exclusion of social capital from the comprehensive wealth indexes could mean that their values are substantially lower than they should be as measures of the basis for both market and non-market production.

[171] It is worth noting that the same would be true in any country, as human capital is not yet released as an official statistic anywhere.

Both approaches are conceptually sound, though the lifetime-income approach is more consistent with economic theory and provides a better measure of productive base needed for future production, which is the focus of comprehensive wealth. Additionally, the methodology of the lifetime-income approach requires construction of a database with all the basic elements required to construct a volume index of human capital. This provides a sound basis for deflating the estimates to measure real change over time, again of central importance in the context of comprehensive wealth. In contrast, the cost-based approach requires choice of an exogenous price index to deflate education expenditures, a choice that can be challenging. Also difficult is the choice of the rate at which to depreciate investments in education, as little empirical evidence exists to provide guidance. The lifetime-income approach, in contrast, does not require a depreciation rate (UNECE, 2016).

The two central choices required in the lifetime-income approach are the rate at which to deflate future income and the assumed rate of growth of future income. Both of these are arbitrary to some extent, though there is theoretical and empirical reasoning that can help guide the decision (UNECE, 2016). In the case of the discount rate, Statistics Canada uses weighted average return to debt and equity in the Canadian economy (5.1 per cent).[172] The growth in real income was assumed to be equal to historical labour productivity growth in the Canadian business sector (1.7 per cent). Both of these rates can be considered to be on the conservative side. It is important to note that, while the assumptions regarding these rates will affect the estimated level of human capital, they have no impact on its rate of growth.

In theory, the lifetime-income and cost-based approaches to measuring human capital should yield similar results (in the absence of market imperfections). In practice, the results are quite different. The value of human capital as estimated by the cost-based approach is usually considerably smaller than that estimated by the lifetime-income approach. The reasons for this include the difficulty in identifying all of the costs related to creating human capital, the fact that some human capital is likely innate (and not created by explicit investments) and the possibility that the lifetime-income approach overestimates the value of human capital (UNECE, 2016).

The view here is that the lifetime-income approach is best suited to the analysis of comprehensive wealth. It comes closer to measuring the true value of human capital, with cost-based estimates offering more of a lower bound on the value. Importantly, the lifetime-income approach is likely better suited to assessing real change over time, as it is based on a more robust approach to deflation and the major assumptions underlying it do not have an impact on temporal change.

It is important to note that neither approach is perfect, and both could benefit from additional conceptual and methodological research and empirical testing. By either method, the value of human capital is large in comparison to the other elements of comprehensive wealth, so getting the value "right" —both in terms of its level and even more importantly in terms of change over time—is important. It is hoped that this and similar reports will spur additional work in the area. The recent publication of a draft guide to human capital measurement for statistical agencies by the UN Economic Commission for Europe (2016) is an important step in the right direction.

[172] It should be noted that the value of human capital (but not its growth rate) is quite sensitive to the choice of discount rate. The lower the discount rate, the higher the value of human capital. It could be argued that 5.1 per cent is higher than recent economic experience would justify as a discount rate, meaning that the value of human capital as calculated by Statistics Canada (but, again, not the growth rate) may be somewhat low.

ANNEX 2 COMPARISON OF RESULTS WITH OTHER STUDIES

As noted in the introduction, this study is one of only a few analyses of comprehensive wealth undertaken for Canada. The others are:

- The wealth component of the Index of Economic Well-Being compiled by the Ottawa-based Centre for the Study of Living Standards (Osberg & Sharpe, 2011).
- The three global "inclusive wealth" reports[173] prepared by Professor Partha Dasgupta of Cambridge University with colleagues at UNEP, Kyushu University and elsewhere (UNU–IHDP & UNEP, 2012, 2014; Managi & Kumar, 2018).
- The work of the World Bank on measuring "the wealth of nations" (World Bank, 2006, 2011 and 2018).

The results of this study are compared with Osberg and Sharpe, the Inclusive Wealth Report 2018 and the 2018 World Bank report below. As will be seen, though the reports are not directly comparable in all ways, the other studies largely corroborate the findings here.

A2.1 Comparison With Osberg and Sharpe

The analysis here differs from that by Osberg and Sharpe in several ways. First, and most importantly, Osberg and Sharpe take a cost-based approach to the measurement of human capital rather than the lifetime-income-based approach used in this analysis.[174] As will be seen, this results in quite different conclusions regarding the level and the rate of growth of human capital. Second, Osberg and Sharpe include additional components in their analysis that are excluded here and leave out some that we have included.[175] Third, they restrict themselves to monetary measures, whereas both monetary and non-monetary measures are used here; among other things, this permits the analysis here to delve more deeply into natural capital and, especially, social capital. Finally, Osberg and Sharpe combine their estimates of comprehensive wealth with estimates of a variety of other economic variables into an overall Index of Economic Well-Being. It is the trend in the overall index that is the main feature of their analysis (though they of course discuss the trends in each of the components of their comprehensive wealth index). This contrasts with the focus here, which is entirely on the trend in comprehensive wealth.

Osberg and Sharpe's analysis covers nearly the same time period as the analysis here (1981–2014 versus 1980–2015), so comparison of the results is not greatly hampered by different analytical periods. As

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173 "Inclusive wealth" is a synonym for comprehensive wealth.

174 See Annex 1 and Section 4.2.2 in IISD's 2016 report on comprehensive wealth (Smith et al., 2016) for a discussion of the two approaches to measuring human capital.

175 Osberg and Sharpe include their own estimate of the value of "research and development" capital and make a downward adjustment to wealth for the social cost of greenhouse gas emissions; neither of these are included here. We include agricultural land, built-up land and inventories in our analysis; Osberg and Sharpe exclude them.

noted above, Osberg and Sharpe restrict themselves to monetary measures, so only overall comprehensive wealth and the four sub-indexes for produced, natural, human capital and financial compiled here can be compared. No comparison with the non-monetary indicators of ecosystems, climate and social capital compiled here is possible. Since Osberg and Sharpe include financial capital in their estimates, the relevant comparison is with the national variant of the comprehensive index compiled here (NCWI).

Overall, Osberg and Sharpe find that real national *comprehensive wealth* per capita grew at an annual rate of 1.21 per cent between 1981 and 2014. This is considerably higher than the 0.23 per cent annual growth in this study's NCWI for the same time period.

While at first glance this may appear to be an important difference, in fact it is almost entirely due to Osberg and Sharpe's use of a different method for estimating *human capital*. While the analysis here uses an estimate of human capital from Statistics Canada based on the lifetime-income approach, Osberg and Sharpe use their own cost-based estimate of human capital. While both measures have their place in the analysis of human capital, the view here is that the lifetime-income approach is more appropriate to the analysis of the long-term prospects for sustaining development (see Annex 1 for further discussion).[176] If the lifetime-income estimates of human capital used in this analysis are substituted into Osberg and Sharpe's analysis, their estimate of the annual growth in real per capita comprehensive wealth from 1981 to 2014 falls to 0.20 per cent, almost identical to the figure of 0.23 per cent here.

With regard to the estimated level of real per capita national comprehensive wealth, Osberg and Sharpe's results are, not surprisingly, different from those here. They estimate it to have been about $270,000 (2007 constant dollars) in 2014 compared to $692,000 (2007 chained dollars) here. Again, this difference is almost entirely due to their choice of human capital measure, which is considerably lower than the one here.

Looking at the components of comprehensive wealth in more detail, Osberg and Sharpe find that real *fixed capital* per capita grew at an annual average rate of 1.55 per cent from 1981 to 2014, very close to the figure of 1.66 per cent for the Fixed Capital Index over the same period based on the analysis here.[177] Their estimated level of real per capita produced capital in 2014 ($102,140 in 2007 constant dollars) is again very close to that here ($104,500 in 2007 chained dollars).

Osberg and Sharpe find that real *natural capital* per capita declined at a rate of 0.96 per cent annually. This figure is quite different from the 0.50 per cent decline in this study's Market Natural Capital Index over the period 1981 to 2014.[178] However, essentially all of the difference is accounted for by our inclusion of agricultural and built-up land assets and their exclusion by Osberg and Sharpe. With built-up land excluded from the analysis,[179] our Market Natural Capital Index declined by 1.05 per cent from 1981 to 2014, close to the decline in Osberg and Sharpe's figures. Their estimated level of real per capita natural capital in 2014 ($18,437 in 2007 constant dollars) is much lower than that here ($86,270 in 2007 chained dollars), as would be expected given our inclusion of agricultural and built-up land, both of which are very valuable relative to other forms of natural capital.

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176 See Text Box 6 in IISD's 2016 report on comprehensive wealth for further explanation.

177 The small difference is accounted for by the fact that Osberg and Sharpe use Statistics Canada's produced capital data measured in so-called "constant 2007 dollars" whereas the data used here are measured in "chained 2007 dollars." The view taken here is that the latter are more appropriate.

178 The small difference is accounted for by differences in the scope of the measures and different methods for aggregating across different types of natural capital.

179 For reasons of data confidentiality, we are unable to calculate the index without agricultural land excluded, as agricultural land forms part of the natural capital index compiled on special request for us by Statistics Canada (see Annex 8 and Footnote 213 for further details).

In terms of *human capital*, Osberg and Sharpe find an annual average growth rate in real per capita terms of 1.16 per cent compared with a decline of 0.03 per cent for the Human Capital Index here. As discussed above, this difference is due to Osberg and Sharpe's use of a cost-based estimate of human capital rather than Statistics Canada's lifetime-income-based estimate. Their estimated level of real per capita human capital in 2014 ($155,247 in 2007 constant dollars) is, as expected,[180] considerably lower that here ($498,000 in 2007 chained dollars).

In terms of *financial capital*, it is not possible to make a direct comparison between the results here and Osberg and Sharpe's because they use a different approach to measurement of Canada's international investment position (IIP). Rather than measuring the IIP in market value terms, as is done here, they use Statistics Canada's book value estimate. Since all other assets are measured by Statistics Canada in market value terms, our view is that market value IIP is the more appropriate for the analysis of comprehensive wealth.

Overall, despite differences in concepts and methods, Osberg and Sharpe's findings largely confirm the results of the analysis here. The major distinction between the two studies is Osberg and Sharpe's use of the cost-based approach to measuring human capital. Accounting for the difference in results between these two methods, Osberg and Sharpe come to essentially the same overall conclusion as here: real per capita national comprehensive wealth grew at about 0.2 per cent annually in Canada over the past few decades.

A2.2 Comparison With the 2018 Inclusive Wealth Report

Comparing the results here with those from the 2018 global *Inclusive Wealth Report* (IWR2018; Managi & Kumar, 2018) is slightly less meaningful because the IWR2018 measures comprehensive wealth in U.S. rather than Canadian dollars, because it uses methods that are adapted to the production of comparable estimates across 140 countries with widely varying data availability and quality and because there are some substantial differences in the assets that are included. The IWR2018's time series (1990–2014) is also shorter than the one here, though the two time periods do overlap, so meaningful temporal comparisons are possible.

One distinct advantage of the IWR2018 is that it provides consistent estimates of comprehensive wealth for 140 countries, allowing comparison of Canada's performance with its peers on the basis of the IWR2018's methods and data sources. This is done at the end of this sub-section.

Like Osberg and Sharpe, the IWR2018 focuses only on monetary measures of comprehensive wealth. The IWR2018 does not include financial capital in its estimates, however, so the relevant comparison is with the Domestic Comprehensive Wealth Index (DCWI) compiled here rather than the NCWI. No comparison with the non-monetary indicators of ecosystems, climate and social capital compiled here is possible, as no equivalents to these are compiled in the IWR2018.

Overall, the IWR 2018 finds that Canadian real per capita domestic comprehensive wealth (measured in constant 2005 U.S. dollars) declined at an annual average rate of 0.25 per cent from 1990 to 2010. The equivalent figure based on the DCWI compiled for this analysis (measured in chained 2007 Canadian dollars) is an increase of 0.18 per cent. As noted, direct comparison of these growth rates

[180] As explained in Text Box 6, cost-based measures of human capital result in lower estimates than income-based estimates.

is not recommended due to the different methods, data, currency units and scope of the two studies. Nonetheless, the fact that the growth rates are both low (with the IWR2018's actually being negative) provides evidence to support the finding here that domestic comprehensive wealth grew slowly in Canada in recent decades.

With regard to the estimated level of real per capita comprehensive wealth, the results from the IWR2018 analysis are quite different than those here. The IWR2018 estimates Canada's real per capita domestic comprehensive wealth in 2014 to have been about $328,000 (constant 2005 U.S. dollars). The equivalent figure here is $692,000 (chained 2007 Canadian dollars).

Looking at the components of comprehensive wealth, the IWR2018 finds that real per capita *produced capital* in Canada grew at an annual average rate of 2.23 per cent from 1990 to 2014. The equivalent figure based on the Produced Capital Index compiled for this analysis is 1.7 per cent. The fact that the IWR2018 includes built-up land in the category of produced capital (we include it in natural capital) likely accounts for most of the difference. With regard to the level of real produced capital per capita, the results of the two studies are relatively close, with the IWR2018's figure being larger (accounting for currency differences), as would be expected with the inclusion of built-up land. The IWR2018's estimate for Canada in 2014 is about $108,000 (constant 2005 U.S. dollars), while the 2014 figure here is about $114,600 (chained 2007 Canadian dollars).

With regard to *natural capital*, the IWR2018 finds that Canadian real per capita natural capital declined at an annual average rate of 2.23 per cent from 1990 to 2014. The equivalent figure from this analysis is a decline of 0.5 per cent per cent annually. Part of this is explained by a large drop in forest resources from 2010 to 2014 in the IWR2018's estimates (what is behind this drop is not clear, as we do not find nearly as large a drop). The IWR2018 also finds a large drop in fossil fuel resources that we do not find. Finally, our estimates include built-up land, which increased substantially over the period (as noted, the IWR2018 includes built-up land in produced capital). The IWR2018 estimates that real per capita natural capital in 2014 was about $115,400 in constant 2005 U.S. dollars, while the figure here is about $95,500 in chained 2007 Canadian dollars.

Finally, with regard to *human capital*, the IWR2018 finds that Canadian real per capita human capital grew in constant 2005 U.S. dollars at an annual average rate of 0.51 per cent from 1990 to 2014. The equivalent figure based on the Human Capital Index compiled for this analysis using Statistics Canada methods and data in chained 2007 Canadian dollars is a decline of 0.08 per cent. The IWR2018's estimated level of real human capital per capita ($86,900 in constant 2005 U.S. dollars in 2014) is less than one fifth of that here ($496,000 in chained 2007 Canadian dollars). The reason for this large difference is not clear.[181]

Arguably more interesting than the comparison between the IWR2018's results and those here is the comparison of the IWR2018's results for Canada with those for other countries. Table A2.1 presents the IWR2018's estimates of real per capita comprehensive wealth for Canada and selected high- and middle-income countries. As can be seen, Canada ranked quite highly in terms of the level of comprehensive wealth in 2014 (5th of 23 countries) but almost at the bottom of the list (19th) in terms of its growth between 1990 and 20104.

[181] It is worth noting that the IWR2018's human capital estimates for Canada are considerably lower than those reported in previous editions of the report in 2014 and 2012. For instance, the 2014 IWR reported that per capita human capital in Canada to be about $268,000 (2005 U.S. dollars) in 2010, while the IWR2018 reported it to be just $85,000 (2005 U.S. dollars). The reason for the large decline in the value of the estimate is not clear.

It is worth noting that three of the four countries that ranked ahead of Canada in terms of the level of comprehensive wealth (New Zealand, Norway, Australia) are also highly endowed with natural capital and also ranked relatively poorly in terms of the annual growth in comprehensive wealth between (20th, 16th and 14th respectively). It would seem, then, that there is a correlation between being well endowed with natural capital and performing relatively poorly in terms of growing comprehensive wealth.[182]

Looking specifically at G7 nations,[183] Canada ranked first in terms of level of comprehensive wealth according to the IWR2018 thanks to its vast reserves of natural capital. Compared with its G7 peers, the IWR2018 estimates Canada to have nearly five times more natural capital in per capita terms than the next best endowed nation (the United States). This clearly puts the country in a position of strength.[184]

At the same time—and consistent with the findings of this study—the IWR2018 ranked Canada last among G7 members in terms of *growth* in comprehensive wealth. In other words, other G7 countries are doing better than Canada at managing the growth of their comprehensive wealth portfolios. And they are catching up to Canada's level as a result. In 1990, the average per capita comprehensive wealth in other G7 countries was 53 per cent of Canada's; by 2014, this share had climbed to 74 per cent. At current rates of growth, the IWR2018's findings suggest Canada will lose its first-place position in the G7 to Japan in 2024 and will fall to fifth place in less than a generation (2039).

Table A2.1. Comprehensive wealth in Canada and selected countries as reported in the IWR2018 – 1990–2014

Country	Real comprehensive wealth per capita*							Annual growth rate - 1990-2014	
	1990	1995	2000	2005	2010	2014	Rank (2014)	Per cent	Rank (2014)
Argentina	72	71	72	71	74	76	16	0.23%	15
Australia	367	365	368	376	385	392	3	0.27%	14
Brazil	76	71	68	65	64	65	17	-0.65%	21
Canada	**348**	**342**	**343**	**346**	**351**	**328**	**5**	**-0.25%**	**19**
China	30	31	33	35	39	44	20	1.61%	1
Costa Rica	36	34	34	35	37	43	21	0.74%	11
France	**161**	**174**	**186**	**199**	**213**	**222**	**12**	**1.35%**	**3**
Germany	**225**	**237**	**251**	**261**	**274**	**285**	**7**	**0.99%**	**9**
India	368	355	357	357	358	359	4	-0.10%	17
Indonesia	30	29	29	29	29	29	22	-0.14%	18
Italy	**147**	**159**	**171**	**185**	**195**	**196**	**15**	**1.21%**	**6**
Japan	**212**	**236**	**255**	**267**	**277**	**284**	**8**	**1.23%**	**5**
Mexico	51	52	53	56	58	60	18	0.68%	12
Netherlands	195	206	222	238	255	262	11	1.24%	4

182 It should be noted that IWR2018's estimates do not include the value of net foreign financial assets of nations. In the case of Norway, the country has amassed very significant net foreign financial assets in the form of a sovereign wealth fund created with rents from the extraction of North Sea oil. If these financial assets were included in the estimates for Norway, it would rank much higher in terms of the growth rate of comprehensive wealth between 1990 and 2010.

183 The G7 members are Canada, France, Germany, Japan, Italy, the United Kingdom and the United States.

184 If Canada's levels of natural capital were similar to other G7 nations, it would fall somewhere near the bottom of the group in terms of its level of comprehensive wealth

Country	Real comprehensive wealth per capita*							Annual growth rate - 1990-2014	
New Zealand	612	565	553	519	597	553	1	-0.42%	20
Norway	440	433	431	428	434	440	2	0.00%	16
Russian Federation	181	197	195	196	198	198	14	0.37%	13
Saudi Arabia	412	389	342	299	273	264	10	-1.84%	22
South Korea	61	76	93	110	126	138	16	3.46%	1
Sweden	230	238	255	273	291	298	6	1.09%	8
Turkey	39	41	43	45	48	51	19	1.12%	7
United Kingdom	**145**	**155**	**170**	**183**	**194**	**201**	**13**	**1.37%**	**2**
United States	**219**	**225**	**240**	**257**	**270**	**276**	**9**	**0.97%**	**10**

**All values expressed in thousand constants 2005 U.S. dollars.*

A2.3 Comparison with the World Bank's 2018 Report

Comparison of the estimates here with those from the World Bank's 2018 report is reasonably straightforward, as the scope and methods employed are broadly consistent. The major differences are the use of 2014 U.S. dollars as the basis of valuation in the World Bank's figures and the fact that the World Bank presents results only for the year 2014. Since the World Bank's figures include the value of financial capital, the relevant comparison is with the National Comprehensive Wealth Index (NCWI) compiled here.

Overall, the World Bank estimates per capita national comprehensive wealth in Canada to have been $1,016,593 (2014 U.S. dollars), which is considerably more than the $692,000 (chained 2007 dollars) estimated here for the 2014 NCWI, particularly when the CAD/USD exchange rate is taken into account. The majority of this difference is accounted for by differences in the estimated value of per capita human capital, which the World Bank estimates to have been $730,832 (2014 U.S. dollars) in 2014 compared to $496,000 here. Both estimates are based on the lifetime earnings approach to measuring human capital. The difference between them is explained by the different discount rates used by the World Bank (1.5 per cent) and by Statistics Canada in compiling the estimates used in this study (5.1 per cent). With a much lower discount rate, the World Bank's estimate of human capital is necessarily much larger than that here.

Another significant difference between the World Bank's figures and those here is in the value of produced capital. Whereas the World Bank estimates Canada's per capita produced capital to have been $229,999 (2014 U.S. dollars), we estimate it to have been $103,000 (chained 2007 dollars). The main reason for this discrepancy is a conceptual difference in the treatment of built-up land. Here we consider built-up land to be part of natural capital, whereas the World Bank considers it to be part of produced capital. Our view is that land, no matter what use it is put to, is a natural asset. Since built-up land is very valuable, its treatment as produced capital by the World Bank explains much of the gap between the estimates.

Not surprisingly, the World Bank's estimates of natural capital are lower than those here because, as just noted, we treat built-up land as part natural capital rather than produced capital. In total, the World Bank estimates Canada's per capita natural capital to have been $53,438 (2014 U.S. dollars), though $15,574 of this is made up of the value of protected areas and non-timber forest products, neither of which is included in the estimate here of $95,500 (chained 2007 dollars).

The two studies also have differing estimates of 2014 per capita *financial capital:* World Bank—$3,324 (2014 U.S. dollars); this study—$129 (chained 2007 dollars). The difference for this is likely found in the data source; whereas the World Bank study uses data from a global database compiled by academics, this study uses official figures from Statistics Canada. The latter are taken to be the more accurate.

Overall, in spite of considerable differences in terms of concepts, methods and valuation basis, the results of the World Bank's study are generally consistent with those here.

ANNEX 3 BOTTOM-UP VERSUS TOP-DOWN ESTIMATES OF NCWI AND NET NATIONAL INCOME

National comprehensive wealth is, in theory, the basis for national income. Since the version of the NCWI compiled in this study comprises only market assets,[185] it is possible to state this relationship more precisely: the NCWI as measured in this study is the basis for real net national income per capita (NNI) as measured by Statistics Canada (Equation 1).

$$NNI' = r(NCWI) \qquad \text{Equation 1}$$

where:

NNI' = real per capita net national income as measured by Statistics Canada[186]

r = the real rate of return on national comprehensive wealth

NCWI = the national comprehensive wealth index as compiled in this study.

Given Equation 1, two propositions should be true.

Proposition 1: In any given year, a reasonable "top-down" estimate of real NNI per capita should be possible by multiplying the NCWI by the prevailing rate of return on capital in the economy. We call this "top-down" real NNI per capita to distinguish it from the "bottom-up" estimate compiled by Statistics Canada from detailed survey data (Equation 2):

$$_{top-down}NNI'_t = (r_0 + \left[\frac{PI_t - PI_0}{PI_0}\right])(NCWI_t) \qquad \text{Equation 2}$$

where:

$_{top-down}NNI'_t$ = *top-down real net national income in year t*

r_0 = *the real rate of return on national comprehensive wealth in year 0*

PI_t = *Statistics Canada's index of productivity (CANSIM Table 383-0021) in year t*

$NCWI_t$ = *the national comprehensive wealth index for year t as compiled in this study.*

Proposition 2: The rate of growth of real NNI per capita over the long term should not be greater than the long-term rate of growth of the NCWI (adjusted for gains in productivity).

[185] The fact that the NCWI measures only market assets is the result of data gaps for non-market assets and not because the index is inherently suited only to market assets.

[186] As Statistics Canada does not actually measure NNI in real per capita terms, it has been calculated by deflating Statistics Canada's estimate of nominal aggregate NNI (CANSIM Table 380-0083) with the implicit price index for final domestic demand (CANSIM Table 380-0066) and dividing by population (CANSIM Table 051-0001).

Testing the first proposition for Canada for the period 1980–2015, we find that it holds up until 1986 but not afterward. Using a real rate of return in 1980 of 3.8 per cent,[187] we estimate top-down real NNI per capita given our estimated NCWI in each year according to Equation 2 (Table A3.1). From 1980 to 1986, we find that top-down real NNI per capita matches Statistics Canada's measured (bottom-up) value reasonably well (within +4/-2 per cent); from 1987 onward, top-down real NNI per capita is consistently lower, by a growing amount, than the bottom-up value. By 2015, top-down real NNI per capita is $28,300 whereas Statistics Canada's bottom-up measure is $39,300, a difference of 28 per cent (Table A3.1).

Testing the second proposition (that the rate of growth of real NNI per capita should be no greater than the rate of growth of productivity-adjusted NCWI), we again find that it holds until 1986 but not afterward. NCWI growth (adjusted for gains in multi-factor productivity) from 1980 to 1986 was 0.97 per cent annually. This compares well with the 0.87 annual growth in real NNI per capita as measured by Statistics Canada. After 1986, however, productivity-adjusted NCWI (adjusted for productivity) grew at a rate of just 0.28 per cent, while real NNI per capita grew 1.27 per cent annually on average.

Possible explanations for these results are discussed further below. First, it is useful to explore a third theoretical proposition to further probe our findings in relation to the NCWI.

> *Proposition 3: Since national comprehensive wealth is, in theory, equal to the discounted value of future of consumption, a reasonable "top-down" estimate of the NCWI should be possible in any year by taking the present value of an infinite stream of that year's real final consumption expenditure per capita discounted at the real interest rate prevailing in that year (Equation 3):*
>
> $$_{top-down}NCWI_t = \int_t^{\infty} C_s e^{-r(s-t)} ds$$ Equation 3
>
> where:
>
> $_{top-down}NCWI_t$ = a top-down estimate of real per capita national comprehensive wealth in year t (labelled "top-down" to distinguish it from the bottom-up estimate of NCWI we have compiled for this study)
>
> C_s = real final consumption expenditure per capita in year s as measured by Statistics Canada[188]
>
> r = the real rate of interest prevailing in year t.

Applying Equation 3 with a real interest rate in 1980 of 3.8 per cent (allowed to rise at the rate of growth of multi-factor productivity[189]), we estimate a top-down NCWI for each year from 1980 to 2015. Comparing these estimates with the bottom-up NCWI time series we compiled for this study (Table A3.1 at the end of this annex), we found, again, that top-down NCWI matches relatively well with bottom-up until 1986; top-down NCWI is, on average, 3 per cent lower than bottom-up during this period.[190] From

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187 This rate was determined by taking the average of the moving five-year average real yields on Government of Canada long-term bonds from 1958 to 1962 (which comes to 3.3 per cent) and adjusting it for multi-factor productivity growth to 1980. The period 1958–1962 was chosen to avoid the unrealistically low real bond yields caused by very high rates of inflation in the post-war years. Reassuringly, the rate we arrive at through this calculation, 3.8 per cent, is almost identical to the implicit rate of return on national comprehensive wealth in 1980 we derive by dividing real NNI per capita in 1980 by our estimated value of the NCWI in 1980 (3.9 per cent).

188 Calculated as real aggregate final consumption expenditure (CANSIM Table 380-0064) divided by population (CANSIM Table 051-0001).

189 Here we are assuming that the real rate of interest and real rate of return on capital are identical in the economy in the long term.

190 The fact that top-down NCWI is consistently lower than bottom-up during this period makes intuitive sense, since the Canadian economy was facing a number of challenges during this period that would keep final consumption expenditure (and therefore top-down NCWI) lower that it might have otherwise been: sharply falling oil prices, a deep recession in 1980–81 and extremely high inflation and interest rates.

1987 onward, however, top-down NCWI is consistently and increasingly larger than bottom-up (17 per cent on average). By 2015, we estimate top-down NCWI to have been $948,000 (chained 2007 dollars per capita) and bottom-up NCWI to have been $701,000. In other words, Statistics Canada's bottom-up measure of real NNI per capita in 2015 was at a level that would suggest the average Canadian had about 35 per cent more comprehensive wealth than we are able to identify based on the best available data on the individual elements of the comprehensive wealth portfolio and productivity growth.

There are a number of possible explanations for these findings. In the case of all three propositions, theory would be better borne out by evidence if our estimated bottom-up NCWI were higher and faster growing. While we believe that the assets missing from bottom-up NCWI (social capital and some types of market natural capital) mean it is somewhat too low, we do not believe that the value of the missing assets is large enough to account for the very sizable gap between the top-down and bottom-up versions of the index. We believe it is even less likely that they account for much of the divergence in their growth rates. We explore possible sources of incompleteness and statistical error further in Annex 1.[191]

Presuming that our bottom-up NCWI is reasonably complete and free from errors, other reasons why none of our theoretical propositions are borne out by evidence beyond 1986 must be found. These reasons need to explain why:

- Real net national income per capita as measured by Statistics Canada was consistently higher after 1986, and quite a lot higher by 2015, than theory suggests it could sustainably have been based on Canada's apparent level of comprehensive wealth (proposition 1).
- Why real net national income per capita as measured by Statistics Canada grew much faster than our productivity-adjusted NCWI after 1986 (proposition 2).
- Why the levels of real final consumption expenditure per capita as measured by Statistics Canada after 1986 imply an NCWI much higher than the one we observe based on the best data available today (proposition 3).

Though definitive answers to these questions would require analysis beyond the scope of this study, a few possibilities can be put forth.

First, some of the divergence between top-down and bottom-up NCWI is explained by the fact that consumption from 1986 onward was kept above its theoretically sustainable level by historically high levels of borrowing by both governments and households (Figure A3.1). The combined borrowing of governments and households was higher in every year after 1986 (with the exception of 1997-2001) than it had been in any year from 1961 to 1985. Governments in Canada have long histories of borrowing to support spending, doing so in all but 14 of the years from 1961 to 2015.[192] This is less the case for households, however—at least, it was until 1997. The household sector was a consistent net lender prior to 1997, lending in all but seven years from 1961 to 1996 and in every year from 1970 to 1996.[193] The sector's behaviour switched in 1997—the year interest rates hit their lowest level since the early 1960s—

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191 A possible statistical explanation for the divergence between top-down and bottom-up DCWI not discussed in Annex 10 is that multi-factor productivity (MFP) as currently measured by Statistics Canada is too narrow. MFP considers only the efficiency with which human capital and produced capital are employed in creating income. The exclusion of natural capital from MFP may mean that productivity growth is underestimated (Brandt, Schreyer, & Zipperer, 2013; Sustainable Prosperity, 2015). If true, this could explain part of the gap between the relatively strong growth in real per capita consumption and relatively weak growth in the NCWI found in this study, since we use MFP to adjust the rate of interest used in the present value calculation upon which the top-down NCWI is based.

192 Governments were net borrowers in all years from 1961 to 2015 except 1969, 1973–1974, 1997–2001, 2004–2008 and 2014.

193 Households were net lenders in all years from 1961 to 1996 except 1961–1965, 1968 and 1969.

and households began routinely net borrowing. The did so, at a generally growing rate, in every year from 1997 to 2015.[194] The highest combined per capita borrowing on record to 2015 ($3,580 in chained 2007 dollars) came in 2010. This borrowing permitted spending above and beyond what was possible on the basis of income alone. While some of this excess spending was used to finance the acquisition of assets (particularly houses), a portion of it would have gone toward final consumption expenditure on goods and services. That portion helped keep consumption above its long-term sustainable level, representing implicit capital consumption and explaining, at least in part, why proposition 3 does not hold after 1986. The excess spending would also have kept income higher than its long-term sustainable level, explaining in part why propositions 1 and 2 also do not hold after 1986.

Second, as discussed in Section 3.3.1, 15 of Canada's 19 key market natural assets declined in physical terms between 1980 and 2015; 12 of those that declined were sub-soil resources. The reason for these declines in sub-soil resources could be that spending on exploration for new reserves was, for whatever reason, below that needed to maintain the assets. (It could also mean that spending was adequate but that the search for new reserves was generally unsuccessful.) To the extent that spending was below what was needed to replace reserves, that would create room for spending elsewhere. Some of that spending may have been in the form higher wages, benefits and dividends for the executives, employees and shareholders of resource companies. Some of that income would, in turn, have been spent on final consumption expenditure, which would have helped keep consumption above its long-term sustainable level.

A similar argument can be made in the context of human capital. Human capital—the largest element of Canada's comprehensive wealth portfolio by far—did not grow from 1980 to 2015. This reason for this could be that spending on education, which is generally considered the means by which human capital is formed, was too low in Canada to allow human capital growth to keep pace with growth in consumption. As in the case of natural capital, the money not spent on education would go to support other spending. To the extent that it was spent on final consumption expenditure on goods and services, it too would have helped keep spending above its long-term sustainable level, again representing implicit capital consumption.[195]

Other, more benign, explanations can be proposed to explain the findings with regard to the three propositions. Improving terms of trade, for one, allowed the country to purchase relatively more imports for a given amount of exports. After having been more or less stable since 1961 (other than a rise around the time of the first oil crisis in the early 1970s), Canada's terms of trade improved by 24 per cent from 2002 to 2008 as a result of increasing resource commodity prices, the rising Canadian dollar and falling import prices. They subsequently fell, though remained 11 per cent above their 2002 level in 2015.

Increased holding gains on assets are another possible explanation. Canadian housing prices, for one, grew substantially over the period, especially after 1997. Some homeowners, particularly older Canadians with no children remaining at home, were able to capitalize on this by downsizing to smaller homes and taking capital gains. Similarly, increased capital gains from growing securities prices allowed some Canadians to spend more without necessarily depleting their financial assets.[196]

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194 It is worth noting that households have continued net borrowing at a record-setting pace since 2015 according to Statistics Canada's latest figures.

195 This argument is complicated by the fact that most spending on education is, in fact, considered final expenditure in the national accounts. Thus, increasing spending on education and reducing consumption of other final goods and services would have made no difference in the total amount of final expenditure in the economy. It might, however, have resulted in growth in human capital, which would have helped reduce the gap in the growth rates of consumption and national comprehensive wealth.

196 It is worth noting that Canadian households did, in fact, tend to deplete their financial assets over the period, with net acquisitions of

Finally, demographics certainly played a role, as Canada's population has increasingly moved into its retirement years. Individuals who have amassed pension savings tend to spend them—as intended—during their retirement years, contributing on the one hand to the divestment in financial assets and, on the other, to consumption. This effect was accentuated by the relatively large size of the baby boom generation, which began to retire in the early 2000s.

The degree to which the above factors—and others we may not have not explored—contributed to keeping consumption above its theoretically sustainable level requires, as noted, analysis beyond that possible here. It is likely that all the factors contributed to some extent. Knowing which were important and which weren't would be worthwhile, as some involve trends with negative consequences for wealth in the long term, while others are more benign.

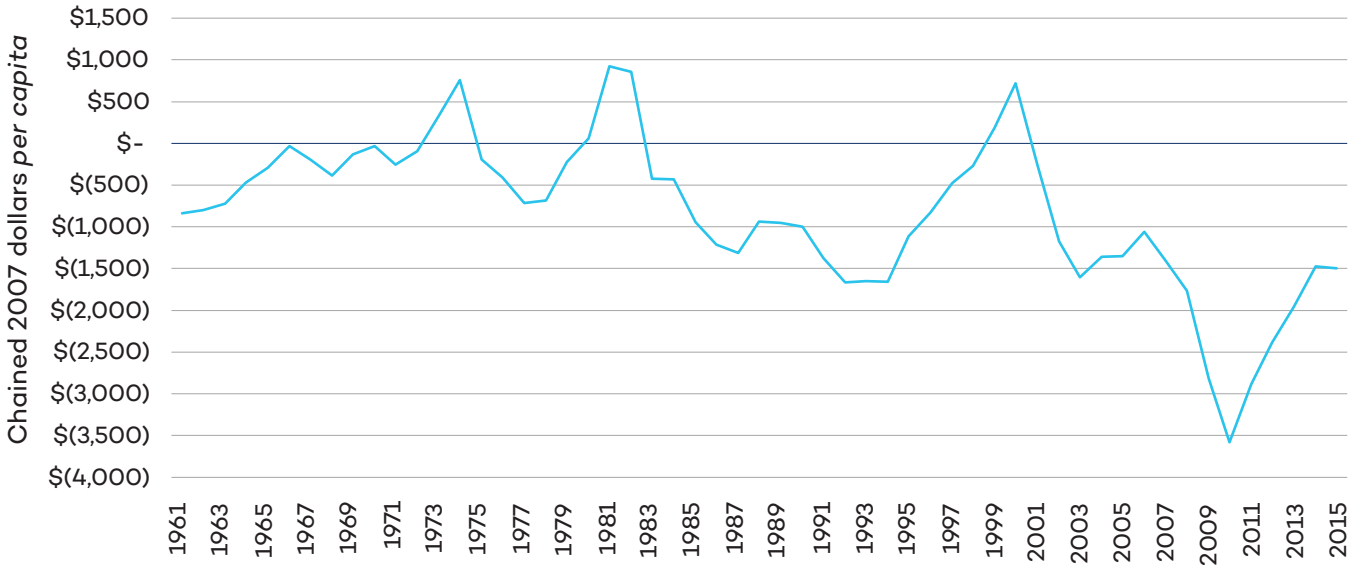

Figure A3.1. Combined household and government lending/borrowing, 1961–2015

Source: Current study based on Statistics Canada data.

financial assets being negative in every year after 1997. Holding gains served to mask the effect of this by increasing the value of financial assets in spite of their net depletion.

Table A3.1. Top-down versus bottom-up estimates of NCWI and net national income

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Bottom-up net national income[1]	$25.1	$25.2	$23.6	$24.4	$25.5	$26.5	$26.5	$27.6	$28.7	$28.8	$28.0	$27.1
Top-down net national income[2]	$25.1	$24.8	$24.6	$25.1	$26.1	$26.4	$26.1	$26.2	$26.3	$25.9	$25.3	$24.6
Ratio of top-down to bottom-up net national income	1.00	0.98	1.04	1.03	1.02	1.00	0.99	0.95	0.91	0.90	0.90	0.91
Bottom-up final consumption expenditure	$24.3	$24.3	$23.7	$24.0	$24.5	$25.4	$25.9	$26.4	$27.1	$27.4	$27.5	$27.2
Bottom-up NCWI[4]	$647	$650	$652	$655	$658	$660	$661	$661	$662	$660	$656	$654
Top-down NCWI[5]	$640	$638	$629	$625	$619	$635	$657	$667	$682	$698	$714	$723
Ratio of top-down to bottom-up NCWI	0.99	0.98	0.96	0.95	0.94	0.96	0.99	1.01	1.03	1.06	1.09	1.11
Multi-factor productivity index[6]	93.28	93.59	92.52	94.04	97.27	98.34	96.86	97.16	97.36	96.44	94.69	92.19

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Bottom-up net national income[1]	$26.8	$27.2	$28.0	$28.9	$29.2	$30.1	$30.2	$31.8	$34.2	$34.1	$34.5	$35.6
Top-down net national income[2]	$24.7	$24.9	$25.7	$25.9	$25.7	$26.1	$26.5	$27.4	$28.2	$28.2	$28.4	$28.1
Ratio of top-down to bottom-up net national income	0.92	0.92	0.92	0.90	0.88	0.87	0.88	0.86	0.82	0.83	0.82	0.79
Bottom-up final consumption expenditure	$27.2	$27.2	$27.4	$27.5	$27.6	$28.3	$28.8	$29.5	$30.4	$30.9	$31.6	$32.2
Bottom-up NCWI[4]	$654	$652	$655	$659	$659	$664	$669	$675	$680	$679	$676	$675
Top-down NCWI[5]	$719	$712	$700	$699	$709	$718	$726	$728	$734	$745	$753	$773
Ratio of top-down to bottom-up NCWI	1.10	1.09	1.07	1.06	1.08	1.08	1.09	1.08	1.08	1.10	1.11	1.14
Multi-factor productivity index[6]	92.84	93.86	96.14	96.49	95.61	96.62	97.23	99.55	101.65	101.72	103.03	102.27

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Bottom-up net national income[1]	$37.2	$38.5	$39.3	$40.0	$40.2	$36.5	$38.2	$39.5	$39.5	$40.0	$40.5	$39.3
Top-down net national income[2]	$28.1	$28.3	$28.4	$28.0	$27.6	$26.7	$27.1	$27.5	$27.3	$27.8	$28.2	$28.3
Ratio of top-down to bottom-up net national income	0.76	0.74	0.72	0.70	0.69	0.73	0.71	0.70	0.69	0.70	0.69	0.72
Bottom-up final consumption expenditure	$32.8	$33.5	$34.4	$35.4	$36.1	$36.0	$36.7	$37.1	$37.2	$37.4	$37.8	$38.2
Bottom-up NCWI[4]	$677	$681	$690	$688	$693	$688	$687	$686	$686	$693	$692	$701
Top-down NCWI[5]	$789	$806	$835	$869	$908	$928	$930	$926	$935	$932	$928	$948
Ratio of top-down to bottom-up NCWI	1.17	1.18	1.21	1.26	1.31	1.35	1.35	1.35	1.36	1.34	1.34	1.35
Multi-factor productivity index[6]	101.94	101.99	101.16	100.00	97.70	95.19	96.88	98.33	97.73	98.61	99.93	98.93

Notes:
All values are quoted in thousand chained 2007 dollars per capita.

1. Net national income as estimated by Statistics Canada.
2. Net national income estimated as the rate of return on bottom-up NCWI using a rate of return equal to 3.8 per cent plus growth in multi-factor productivity.
3. Real final consumption expenditure per capita calculated as Statistics Canada's estimate of real aggregate final consumption expenditure (CANSIM Table 380-0064) divided by population CANSIM Table 051-0001).
4. NCWI as compiled in this study.
5. NCWI estimated as the present value of an infinite stream of bottom-up final consumption expenditure discounted at 3.8 per cent plus growth in multi-factor productivity.
6. Multi-factor productivity index as estimated by Statistics Canada.

ANNEX 4
DETAILED FINDINGS OF THE GREEN GROWTH CASE STUDY

A4.1 Greenhouse Gas Productivity

Greenhouse gas emissions[197] per dollar of GDP[198] trended downward in the Canadian economy overall between 1997 and 2015 (Figure A4.1). In 1997, overall greenhouse gas productivity was about $2.11 per kilogram of greenhouse gas emissions (chained 2007 dollars). By, 2015, this figure had risen to $2.91 per kilogram (chained 2007 dollars), an average annual improvement of 1.8 per cent.

Looked at in more detail, it is clear that some sectors performed better than others. The mining, quarrying and oil and gas extraction industries were notable for being the only major sector of the economy to show a decline in greenhouse gas productivity over the period (Figure A4.2). On average, the productivity of these industries fell by 1.7 per cent annually. This is a particularly significant trend given that this sector is the largest contributor to emissions in the business sector. Most of the decline in the sector's productivity occurred after the 2008 financial crisis; levels have been stable since then.

The utilities industry fared better (Figure A4.3). Its greenhouse gas productivity grew from $0.30 to $0.44 per kilogram of emissions (chained 2007 dollars) over the period; an annual average growth rate of 2.2 per cent.

The manufacturing industries ended the period with slightly improved greenhouse gas productivity, even though they had improved their record considerably during the 2000s until the financial crisis of 2008 (Figure A4.4).

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197 Carbon dioxide, methane and nitrous oxide emissions expressed as equivalent carbon dioxide emissions.

198 Statistics Canada, *Physical Flow Account for Greenhouse Gas Emissions*, CANSIM Table 153-0114 and *Gross Domestic Product at Basic Prices*, CANSIM Table 379-0031.

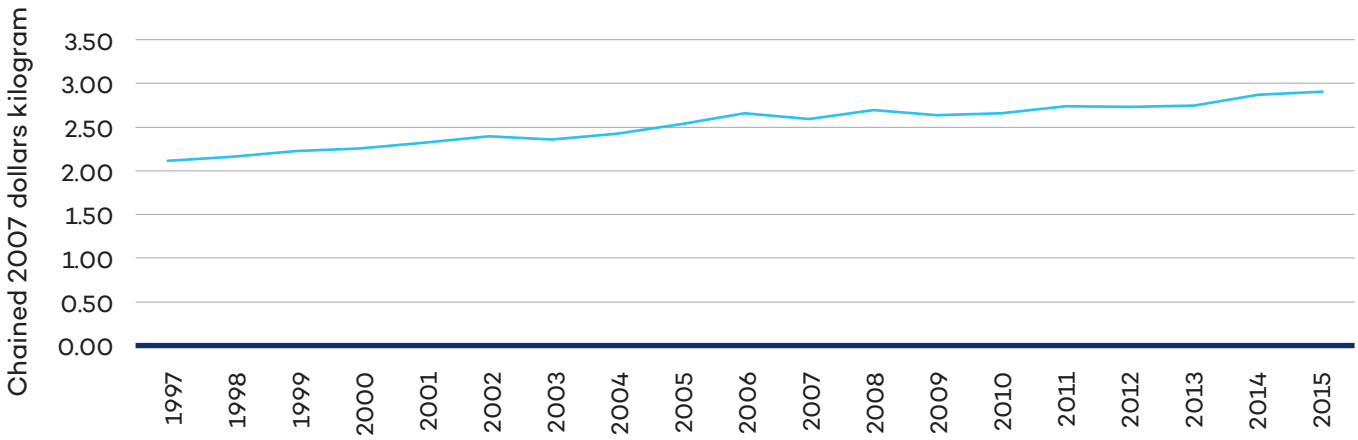

Figure A4.1. Greenhouse gas productivity, Total economy, 1997–2015

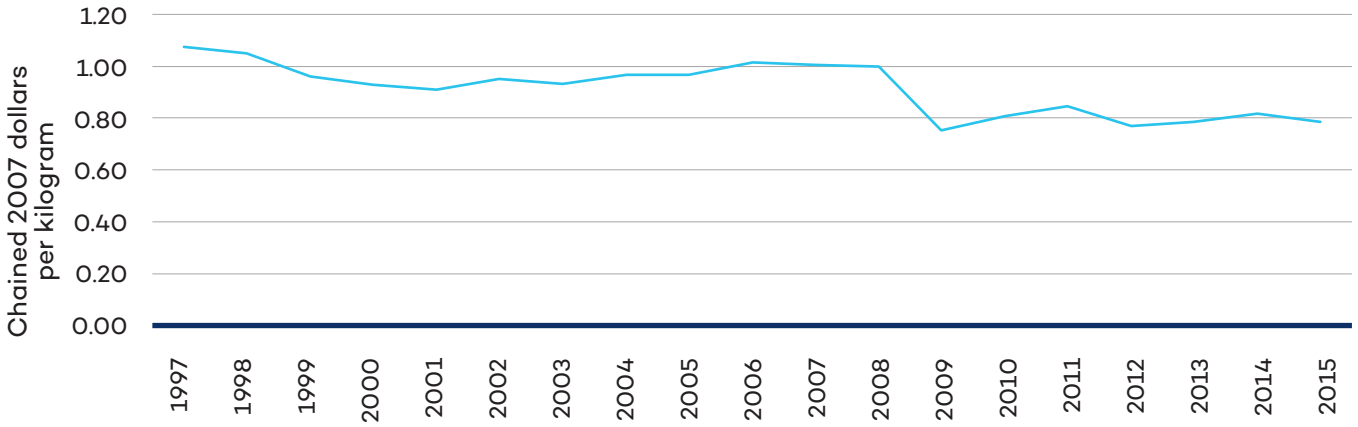

Figure A4.2 Greenhouse gas productivity, Mining, Quarrying and oil and gas extraction, 1997–2015

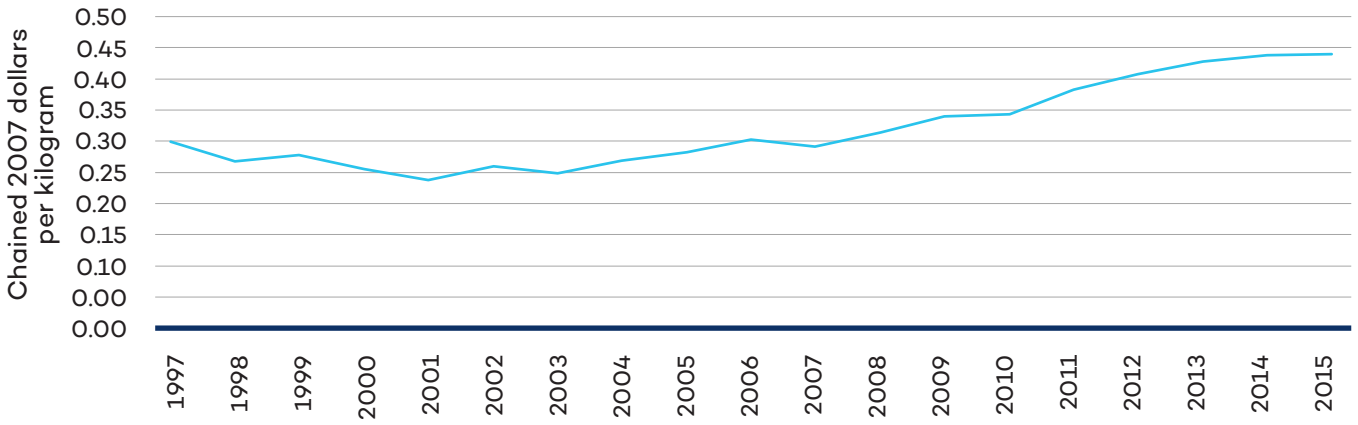

Figure A4.3 Greenhouse gas productivity, Utilities, 1997–2015

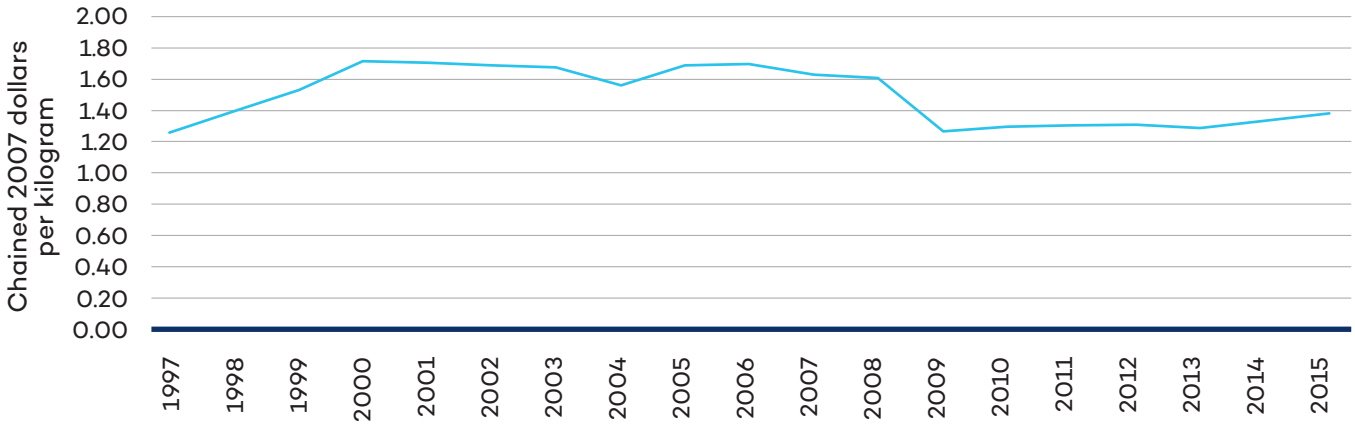

Figure A4.4. Greenhouse gas productivity, Manufacturing, 1997–2015

While Canada's greenhouse gas productivity has improved since 1997, a comparison with our international peers shows that the country has not done as well as it might have. Canada lags in terms of CO_2 productivity compared with other OECD member states. It ranked just 34th of 35 member states in 2014 (Table A4.1).[199]

Table A4.1. CO_2 productivity, OECD member states, 2014

Rank	OECD Member State	GDP per unit of energy-related CO_2 emissions (USD per kilogram)
1	Switzerland	11.37
2	Sweden	11.13
3	Norway	8.70
4	France	8.46
5	Denmark	6.99
6	Iceland	6.63
7	Ireland	6.35
8	Latvia	6.31
9	Portugal	6.24
10	Spain	6.22
11	Italy	6.19
12	United Kingdom	6.03
13	Austria	6.02
14	Hungary	5.70
15	Luxembourg	5.21
16	Netherlands	5.11
17	Belgium	5.07
18	Slovak Republic	4.92
19	Chile	4.84
20	New Zealand	4.82

[199] OECD.stat, *Green Growth Indicators*, Production-based CO_2 Productivity and Energy Productivity. Note that the OECD green growth indicator database does not include an indicator of water productivity.

Rank	OECD Member State	GDP per unit of energy-related CO_2 emissions (USD per kilogram)
21	Germany	4.77
22	Turkey	4.53
23	Finland	4.53
24	Mexico	4.50
25	Slovenia	4.43
26	Greece	4.00
27	Israel	3.94
28	Japan	3.73
29	Poland	3.18
30	United States	3.13
31	Czech Republic	3.04
32	Korea	2.99
33	Australia	2.79
34	Canada	2.71
35	Estonia	1.88

Source: OECD.stat, Green Growth Indicators, Production-based CO2 Productivity and Energy Productivity

A4.2 Environmental Innovation

The development of new technologies is an important driver of economic growth and productivity. New technologies can lower demands on natural capital by reducing the need for raw materials and limiting pollution emissions.

Though Canada fared relatively well compared to its OECD peers in the 1990s, by the late 2000s Canadian development of environment-related technologies had fallen behind the OECD overall in terms of the number of environmental inventions patents that are environmentally related. In 2013, 17.3 new technologies were created per thousand persons in Canada, while 20.4 new technologies were created per thousand persons in the OECD as a whole.

Canada fared better in terms of the share of all inventions that are environmentally related, either leading or matching the performance of the OECD as a whole for the entire period 1990 to 2013 (Figure A4.5).[200]

[200] OECD.stat, Green Growth Indicators, Development of Environment-Related Technologies.

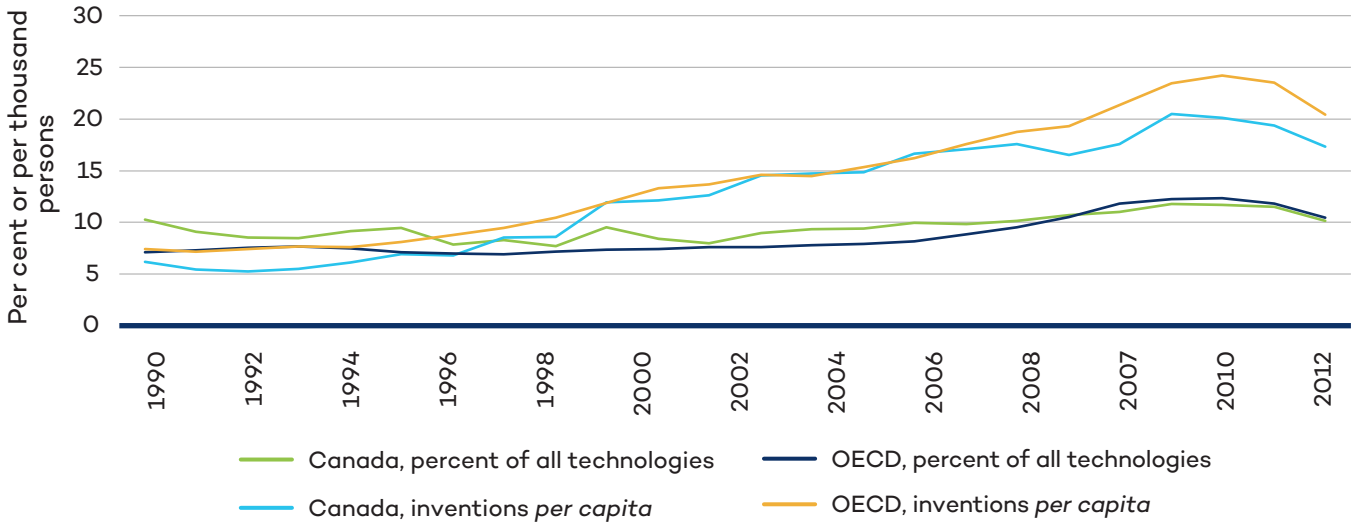

Figure A4.5. Environment-related technology development, Canada and OECD, 1990–2013

Source: OECD.stats, Green Growth Indicators, Development of Environment-Related Technologies.

A4.3 Environmental Taxes

Environmental taxes[201] can help move the economy toward sustainability by ensuring consumers and producers pay prices that reflect the burdens the economy places on natural capital. The prices of most market goods and services do not currently include the costs of such things as excessive demand for raw materials or emissions of pollution. This can lead to consumption of these goods and services beyond what is optimal for overall well-being.

The 2012/2013 revenue from environmental taxes and fees in Canada (Arros, 2015) was estimated to be $16.8 billion. The federal government collected the largest share of this revenue. Provincially, Quebec, Ontario and British Columbia took in the most revenue (Figure A4.6).

201 Environmental taxes include, among others, taxes on plastic bags and bottles, energy, water and greenhouse gas emissions.

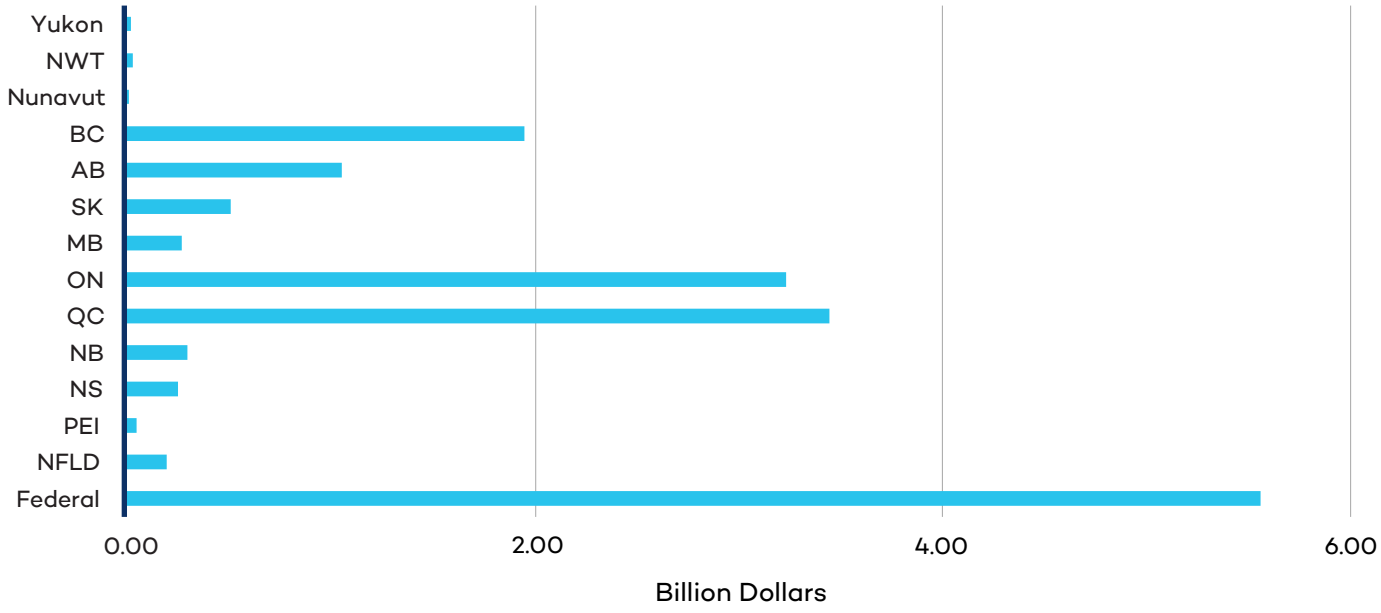

Figure A4.6. Environment taxes and fees, Federal/provincial/territorial governments, 2012/13

Source: Arros, 2015.

Compared to other OECD member states for which data are available, Canada ranked second last in 2014 in terms of the share of national tax revenue derived from environmental taxes at 3.7 per cent (Table A4.2).[202]

[202] OECD.stat, *Green Growth Indicators*, *Environmentally Related Taxes, of Total Tax Revenue*.

Table A4.2. Environmental taxes as a share of national tax revenue, OECD member states – 2014[203]

Rank	OECD Member State	Environmental taxes as a share of national tax revenue (per cent)
1	Turkey	13.31
2	Slovenia	10.58
3	Korea	10.34
4	Israel	9.59
5	Italy	8.80
6	Denmark	8.18
7	Estonia	7.95
8	Czech Republic	7.93
9	Greece	7.69
10	Ireland	7.61
11	United Kingdom	7.20
12	Hungary	6.81
13	Austria	6.72
14	Finland	6.58
15	Switzerland	6.57
16	Portugal	6.41
17	Chile	6.09
18	Slovak Republic	5.62
19	Spain	5.59
20	Norway	5.42
21	Germany	5.38
22	Luxembourg	5.25
23	Sweden	5.18
24	Iceland	5.17
25	Belgium	4.51
26	France	4.36
27	New Zealand	4.19
28	Canada	3.70
29	United States	2.77

Source: OECD.stat, Green Growth Indicators, Environmentally Related Taxes, of Total Tax Revenue.

[203] Data not available for Australia, Japan, Mexico, Netherlands, and Poland

ANNEX 5
VALUATION OF MARKET NATURAL ASSETS

The valuation of market natural assets is based on the concept of resource rent. Rent is the return to the natural asset as a factor of production in an economic activity; for example, the return to the commercial forest as an input into timber harvesting industry.

Resource rent is calculated as the difference between the revenues earned in a resource extraction activity in a given year and the costs of that activity, including materials, energy, labour and produced capital inputs (opportunity cost plus depreciation):

$$RR = TR - C - (rK + \delta)$$ Equation 4

where,

RR = annual resource rent

TR = total revenue from resource extraction (net of subsidies)

C = total extraction costs (materials, energy, labour)

r = rate of interest

K= the value of the produced capital stock used in the extraction process

δ= depreciation of the produced capital stock.

Following economic theory that says the value of an asset is equal to the present value of the expected future income from its use, the in situ value of market natural assets can be estimated as:

$$V = \int_{t=1}^{T} RR/(1+r)^t$$ Equation 5

where,

V = in situ value of the natural resource asset

t = time

T = the expected remaining asset life[204]

RR = annual resource rent (calculated as above).

[204] In the case of sustainably managed renewable resources such as timber and fish, asset life can be assumed to be infinite (though the effect of discounting future income is such that the value of resource rents more than about 40 years in the future is essentially zero). In the case of non-renewable resources, asset life is generally assumed to be equal to the ratio of remaining reserves to current extraction; for example, an iron mine with 100 megatonnes of reserves and annual extraction of 5 megatonnes would have an expected asset life of 20 years.

Various assumptions can be made regarding the evolution of revenues and costs over time. The simplest assumption is constancy, meaning that resource rent remains constant over the life the asset. Projected changes in revenues and costs can also be modelled if sufficient information is available about their likely rates of change.

The valuation method described here is consistent with that recommended by the United Nations in the *System of Environment-Economic Accounting* (United Nations et al., 2014). It is the same approach used in the 2018 Inclusive Wealth Report (Managi & Kumar, 2018) and by Statistics Canada (1997).

ANNEX 6
TECHNICAL DETAILS OF STATISTICS CANADA'S LIFETIME-INCOME APPROACH TO HUMAN CAPITAL MEASUREMENT[205]

The formula for average human capital per capita is given by Equation 6:

$$h_{e,a} = w^e_{1,a} y^e_{1,a} + w^e_{2,a} y^e_{2,a} + sr_{a,a+1} h_{e,a+1}(1+g)/(1+r) \qquad \text{Equation 6}$$

Where:

a = age: 15 to 74

e = educational attainment levels (1 to 5): 1 = zero to eight years of school, 2 = some or completed high school, 3 = some post-secondary education below bachelor's degree, 4 = bachelor's degree, 5 = master's degree or above

$h_{e,a}$ = average human capital or average lifetime labour income per capita for individuals with age (a) and education level (e)

$w^e_{1,a}$ = probability of engaging in paid employment for individuals with age (a) and education level (e), defined as the number of paid workers over the population for that cohort

$y^e_{1,a}$ = annual labour compensation of paid workers with age (a) and education level (e)

$w^e_{2,a}$ = probability of engaging in self-employment for individuals with age (a) and education level (e)

$y^e_{2,a}$ = annual labour compensation of self-employed workers with age (a) and education level (e)

$sr_{a,a+1}$ = the probability of surviving on more year from age (a)

g = real income growth rate, and

r = discount rate.

[205] Based on the methodology described in Gu and Wong (2010).

This equation is estimated separately for men and women. Equation 6 requires an estimate of the growth rate of real income. In this case, it is assumed to equal labour productivity growth in the Canadian business sector for the period measured, as real income growth has closely followed labour productivity in the past. Following Gu and Wong, the discount rate is set at 5.1 per cent, which is the weighted average of real rates of return to equity and debt.

Modifications are made to Equation 6 in order to account for individuals pursuing further studies so as to incorporate the increase in human capital. Individuals who pursue further education have two possible earning streams, one at their current education level and one at their higher education level (Equation 7):

$$h_{e,a} = w^e_{1,a}y^e_{1,a} + w^e_{2,a}y^e_{2,a} + \frac{(1 - senr^e_a)sr_{a,a+1}h_{e,a+1}(1+g)}{1+r} + \frac{\sum_{m=1}^{M_e}\left(\frac{senr^e_a}{M_e}\right)sr_{a,a+m}h_{e+1,a+m}(1+g)^m}{(1+r)^m}$$

Equation 7

where,

$senr^e_a$ = School enrolment rate, which is defined as the proportion of individuals with education level (e) who are studying for a higher education level (e+1); and

M_e = number of years that the individuals with education level (e) spends to complete a higher education level (e+1).

The total value of human capital is the sum of all individuals being counted. Human capital is impacted by the makeup of the population being measured. The total value of human capital will be smaller for a population with a large proportion of individuals at an older age, as this group has fewer earning years ahead of them. Proportion of the population with a certain educational level and wages paid also impacts the level of human capital.

In addition to the total value of human capital, it is also useful to measure changes in the value of human capital. Changes can occur either because of changing prices or changing volumes of human capital. A weighted volume estimate provides a measure that is abstracted from changing prices. The difference between the growth of the weighted and unweighted counts is the growth of human capital per capita. Human capital per capita will reflect changes in the makeup of the population being studied, for example as the population ages or becomes more educated.

The weighted volume index is calculated by Equation 8:

$$\Delta \ln K = \sum_s \sum_e \sum_a \bar{v}_{s,e,a} \Delta \ln L_{s,e,a}$$ Equation 8

where,

K = the volume index of aggregate human capital stock

$L_{s,e,a}$ = the number of individuals with gender (s) age (a), and education level (e),

$\bar{v}_{s,e,a}$ = the weighted sum of the growth rate of individuals with gender (s) age (a), and education level (e),

Δ = a first difference, or change between two consecutive periods, for example:

$$\Delta \ln K = \ln K(t) - \ln K(t-1)$$

Separate aggregate accounts can be constructed based on gender, age or education to examine the impact of demographic changes. Partial volume accounts capture the shift of the population distribution between categories such as men and women, or the five educational levels.

The net present value of lifetime-income of a person is their current income plus the present value of his/her income in the remaining years of his/her life. The lifetime-income approach assumes that the future income of an individual is equal to the current incomes of individuals with the same gender and education but one year older. The expected lifetime-income of a person is his/her current income plus his/her expected income in the following period multiplied by the probability of surviving to the following period. Lifetime incomes are calculated with a backwards recursion beginning at age 74, as it is assumed that all individuals are retired by age 75. So, the lifetime-income of a 73-year-old is his/her current income, plus the current income of a 74-year-old with the same education and gender.

Individuals are classified into five educational levels: zero to eight years of schooling, some or completed high school, some post-secondary school below bachelor's degree, bachelor's degree, and master's degree or higher. It is assumed that individuals with zero to eight years of schooling take three years to complete the next education level (some or completed high school). All other education levels are expected to take two years.

The evolution of human capital over time can be examined by breaking the changes in human capital into three components: investment in human capital, depreciation of human capital and revaluation of human capital. Investment in human capital reflects changes in the working-age population due to raising children, formal education and migration. Depreciation is the result of aging, death and emigration. Revaluation is the change in the human capital of individuals over time.

ANNEX 7
ADDITIONAL DISCUSSION OF FINANCIAL CAPITAL TRENDS

A7.1 The Importance of Holding Gains in Household Financial Capital Growth

Holding gains and other changes[206] in the value of household financial assets not related to actual transactions played an increasingly important role in household financial capital from 1990 to 2015.

In 1990, changes other than investments accounted for about 60 per cent of the total change in net household sector financial assets (Figure A7.1). Beginning in 1997, non-investment changes began to account for more than 100 per cent of this change and did so in all years from 1997 to 2015 (except for the three years when total change in net financial assets was negative). The share sat at 146 per cent in 2015. This was because the household sector's net investment in financial assets was actually negative in every year from 1997 to 2015. All growth in the value of these assets from 1997 to 2015 was due to holding gains and other non-investment changes.

Since holding gains are volatile, and North America was many years into an historic bull market by 2015, reliance on holding gains to assure the increase in household financial assets carries with it risk that was greater than would be the case had increases in financial assets also rested on positive net investments over the period.

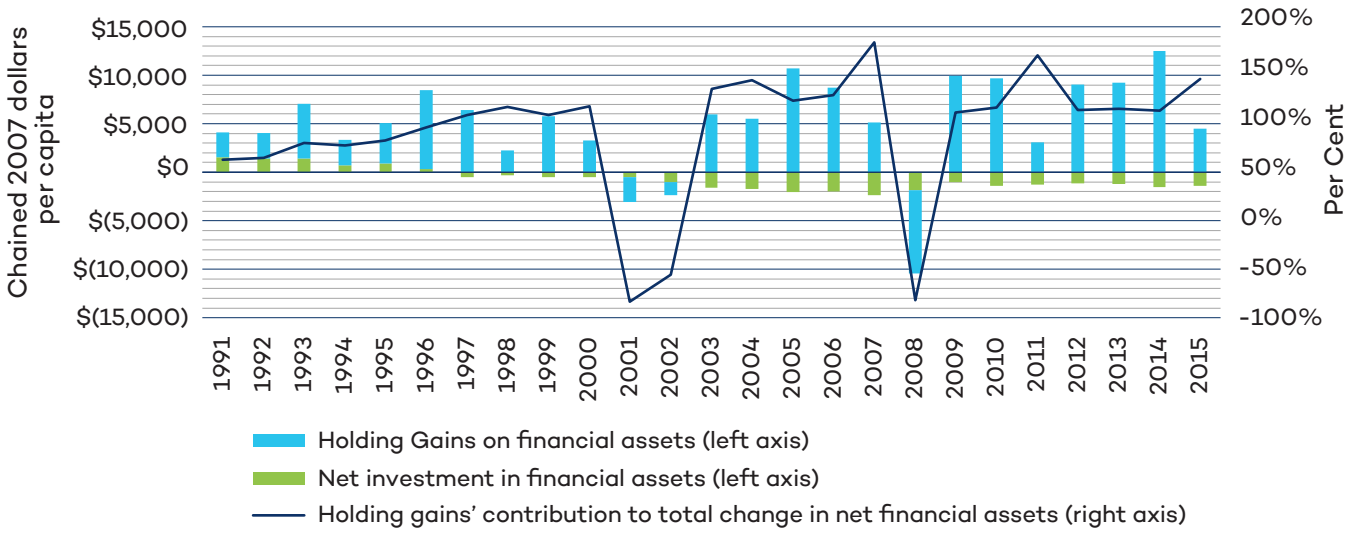

Figure A7.1. Sources of change in net household financial assets, Canada, 1991–2015

[206] In addition to holding gains, other changes in asset values not related to transactions include writing off of bad debts and shifts in classification of an economic unit (for example, when a household moves to another country and takes its assets with it).

A7.2 Trends in Discretionary Retirement Saving

Households save for retirement in different ways. Some saving is through mandatory pension plans, which include:

- The Canada or Quebec Pension Plans, which all workers—aside from the self-employed—are required to contribute to.
- Employer-administered (trusteed) pension plans that workers in some organizations (about 38 per cent of the workforce as of 2015) participate in.

Beyond saving through mandatory pension plans, many households choose also to set aside part of their disposable income in the form of discretionary retirement savings. The RRSP is a popular and long-standing vehicle for doing so. Just less than 60 per cent of households owned an RRSP in 2016, a figure that has been stable since 1999 and about one-quarter (25.7 per cent) of households made a contribution to their RRSP in 2015.

Another potential vehicle for discretionary retirement saving is the tax-free savings account (TFSA), a relatively new and increasingly popular means for Canadians to save. Only introduced in 2009, over 42 per cent of Canadian household reported owing a TFSA in 2016, with total holdings of about $163 billion. How much of this amount was earmarked as retirement savings is uncertain. Given the importance of the RRSP—and potentially TFSA—as vehicles for discretionary retirement saving, it is worth considering the related investment trends in more detail.

From 1990 to 1997, the average working-age (20–64) Canadian increased his/her annual RRSP contribution by 10.1 per cent annually in real terms, from about $950 to $1,870. This pattern of rapidly increasing RRSP contributions ended in 1997, after which RRSP contributions per working-age Canadian declined on average by 0.9 per cent annually in real terms to 2015. This change is consistent with the choice that many households were making during this period to invest in real estate and consumer durables rather than financial assets. Still, average RRSP contributions per working-age Canadian in 2015 were about $1,570 in real terms, well ahead of average contributions in 1990 (though lower than in 1997).

At the same time, RRSP withdrawals per Canadian 65 and over increased by 4.4 per cent annually in real terms between 1990 and 2015, from about $23,000 to about $34,700. This may be because the average retiree was getting older and was being forced to withdraw more from his/her RRSP as s/he got older. Or perhaps new retirees wanted to live better than older ones and were drawing down their RRSP assets faster than their predecessors. Or perhaps more RRSP funds were being withdrawn for purposes other than retirement.

On top of the differing trends in RRSP contributions and withdrawals, the ratio of retirees to workers increased 1.4 per cent annually between 1990 and 2015 as the baby boomers began to retire. Thus, relatively fewer workers were making RRSP contributions—and their contributions were getting smaller after 1997—and relatively more retirees were withdrawing them and doing so in increasing amounts.

The result of the diverging trends in RRSP investments and withdrawals is that the growth in RRSP assets increasingly came to rely on holding gains rather than on contributions over the period. As shown in Figure A7.2, net RRSP contributions (contributions less withdrawals) made little difference in the growth of RRSP assets from the early 2000s to 2015. Nearly all of the growth during that period, except during the financial crisis of 2008, came from investment income on the plans' holdings and from revaluations and other non-investment gains.

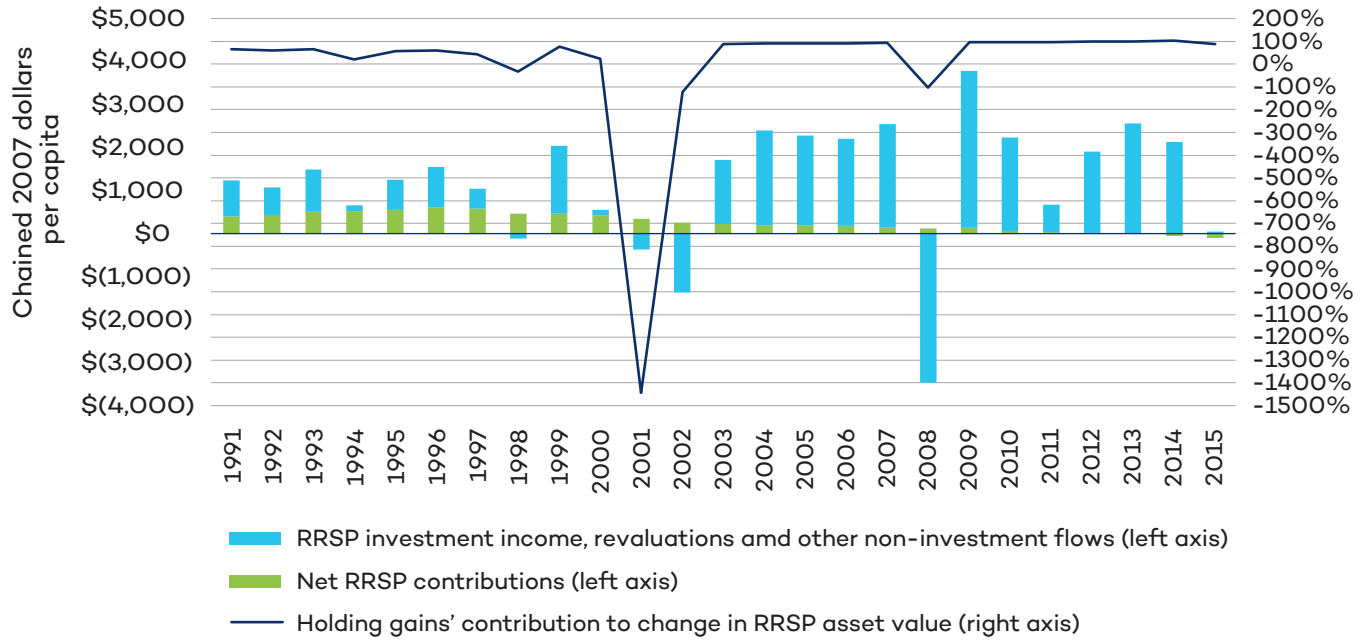

Figure A7.2. Change in RRSP assets by source of change, 1991–2015

Using data from Statistics Canada's periodic *Survey of Financial Security*,[207] it is possible to look at trends in the accumulation of RRSP savings and other financial assets by age group in greater detail for the period 1999–2016. What these data show is that the average Canadian under the age of 55 decreased his/her holdings of financial assets other than mandatory pension assets from 1999 to 2016. Other than mandatory pension assets, real financial assets per capita for those under the age of 55 were $133,000 in 1999 and $128,600 in 2016 (an annual average decline of 0.2 per cent). Only holdings of tax-free savings accounts (TFSA) increased significantly, nearly doubling and accounting for 67 per cent of all growth in assets other than mandatory pensions. The biggest declines were in stocks and bonds, both of which fell by more than half between 1999 and 2016 and accounted for 57 per cent of total losses. RRSP assets owned by the average Canadian under 55 fell by 4.9 per cent in real terms from 1999 to 2016 (an annual average decline of 0.3 per cent).

In contrast to those under 55, the average Canadian aged 55–64 increased his/her real financial assets (other than mandatory pension assets) considerably from 1999 to 2016 (growing from $107,500 to $136,800 for an annual average increase of 1.4 per cent).

The divergence in saving outside of mandatory pension plans between older and younger working-age Canadians suggests that saving habits changed after the late 1990s, consistent with the observation that Canadians are investing more of their savings in real estate and consumer durables and less in financial assets. As younger Canadians moved through their working years in the last two decades, they generally held fewer savings than those older than them (outside mandatory pension plans) and relatively more of their saving has been through tax-free savings accounts.

This raises the question of how younger workers see their TFSA: as a tool for retirement saving or more as a place to temporarily hold savings intended for use on an as-needed basis. A tentative answer to this question is provided by Statistics Canada's *Canadian Financial Capability Survey* (Uppal, 2016). Among

[207] CANSIM Table 205-0002.

other things, this survey assesses Canadians' financial literacy and their efforts to prepare financially for retirement. The survey provides breakdowns by a number of socioeconomic characteristics, including age of respondent, so it is well suited to studying changes in retirement planning behaviour across age groups.

If younger Canadians see the TFSA as tool for retirement saving, it would be reasonable to expect that the number of younger Canadians reporting they are preparing for retirement would have grown or, at worst, remained stable after the introduction of the TFSA in 2009. This is not the case, however. Among those under 35 years old, 75.0 per cent reported they were preparing for retirement in 2009 but only 66.3 per cent said the same thing in 2014.

When asked what they expect their *primary* source of retirement income to be, younger Canadians were just as likely as older Canadians to name their RRSP. Unfortunately, the survey did not permit respondents to name their TFSA specifically as a primary source of retirement income, though it did include an "other" category that respondents would have, presumably, chosen if they intended to retire primarily on their TFSA. As a primary source of retirement income, "other" fell from about around 7 per cent of overall workers in 2009 to about 4 per cent in 2014; younger Canadians were less likely than older workers to respond "other" in 2014 (no 2009 breakdown is available). The number of respondents who listed "other" as a *possible* source of retirement income, primary or not, in 2014 was less than 1 per cent, down from about 3 per cent in 2014.

Another sign that TFSAs may not be seen by many as retirement saving vehicles is that, according to analysis from the Royal Bank of Canada, most Canadians (65 per cent) in 2013 were choosing to hold their TFSA in relatively liquid investments like cash and guaranteed investment certificates (Marr, 2013). This behaviour is consistent with the view of the TFSA a as a place to keep funds that will be needed in the near term rather than as a vehicle for long-term saving. Whether that behaviour has changed since 2013 is uncertain.

While these results do not rule out the possibility that Canadians, young or otherwise, view the TFSA as retirement saving tool, neither do they provide evidence supporting that idea. Answering this question more definitively is important since the TFSA is clearly growing in popularity and the accounts do seem to be absorbing savings that might have otherwise gone into traditional RRSP accounts.

A7.3 Trends in Key Household Debt Ratios

A7.3.1 Debt-to-Disposable Income Ratio

Household sector debt as a share of disposable income increased steadily from 87 per cent in 1990 to 166 per cent in 2015, an average annual rate of 2.6 per cent (Figure A7.3). The ratio had never been higher since Statistics Canada began reporting it.

In real per capita terms, household mortgage debt rose by 168 per cent from 1990 to 2015 (from $11,300 to $30,300). Real per capita consumer credit (non-mortgage) debt rose by 156 per cent (from $6,300 to $16,200). In total, the average Canadian owed nearly three times as much in 2015 ($46,500) as in 1990 ($17,600) in real terms.

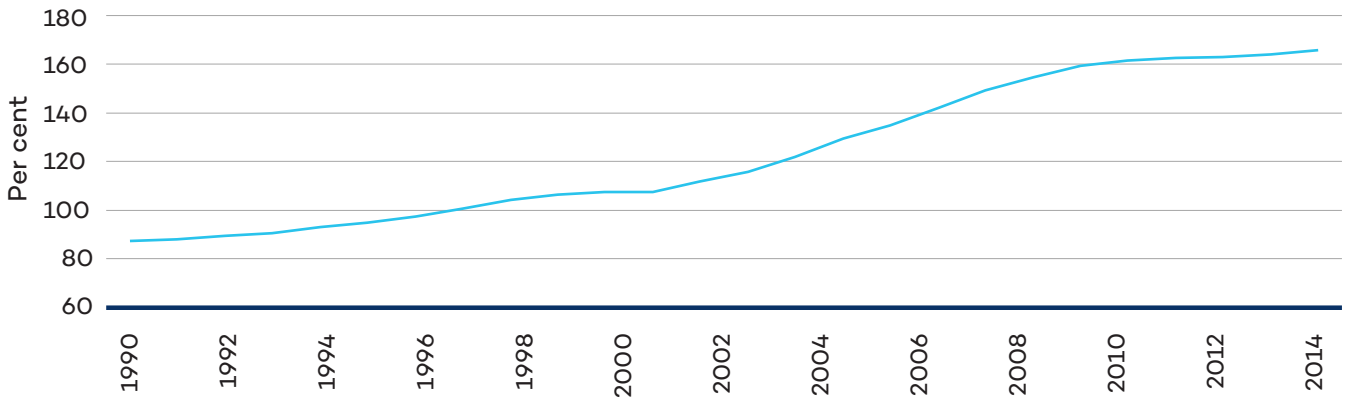

Figure A7.3. **Household debt-to-disposable income ratio, Canada, 1990–2015**

A7.3.2 Debt Service Ratio

In spite of households' continually mounting levels of debt, their cost to service that debt rose only modestly relative to their income from 1990 to 2015. The ratio of total debt payments to household disposable income was 12.4 per cent in 1990; by 2015, it had risen to just 13.8 per cent (peaking in 2007 at 14.6 per cent). This was thanks to substantial declines in interest rates over the period.

The Bank of Canada prime interest rate, which stood at 12.29 per cent in January 1990, was at an historically low level of 0.75 per cent in December 2015. As a result, the total cost to households of servicing their debt rose much more slowly—1.45 per cent annually—than the level of debt itself (which, as noted above, rose at 2.6 per cent annually). Still, in spite of the most advantageous trend in interest rates in the country's history, the average Canadian's annual debt repayment obligations increased from $2800 in 1990 to $4000 in 2015.

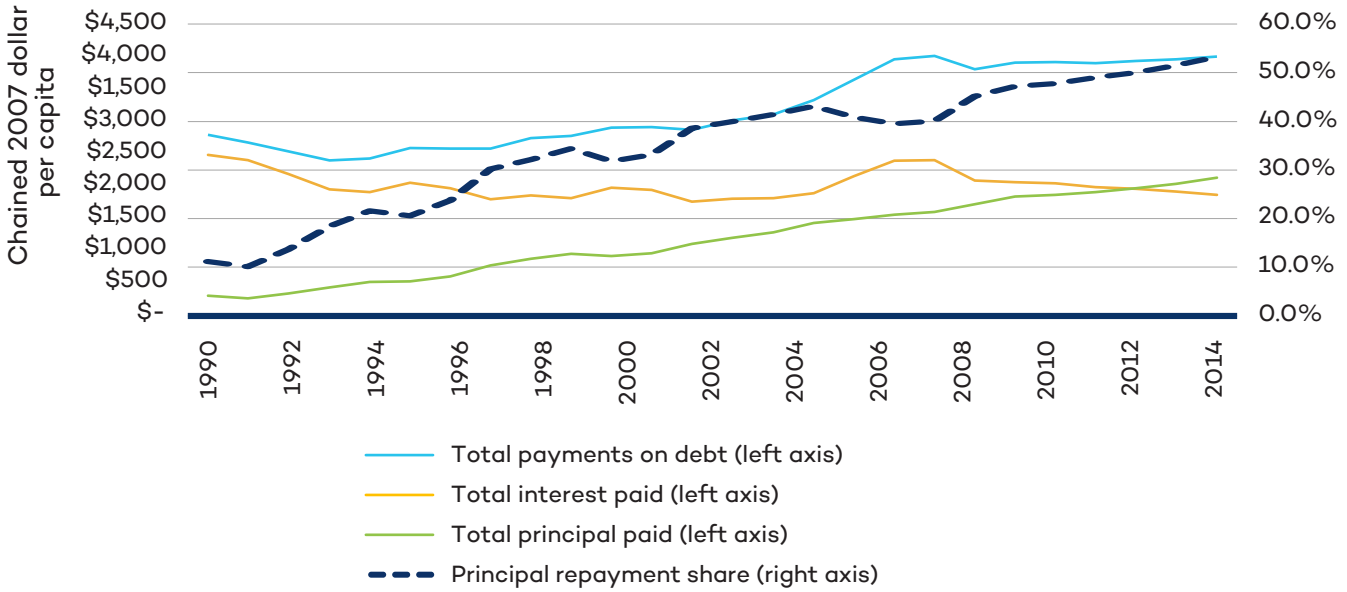

Figure A7.4. **Household debt repayment obligations, Canada, 1990–2015**

The falling interest rate regime seen since 1997 has been a double-edged sword. On one side, it has made it much easier for households to carry their debt loads. As a share of total annual debt payments, principal repayments rose from just 11 per cent in 1990 to 53 per cent in 2015 (Figure A7.4). Other things equal, households would be paying down their debt much more quickly today than in the past with such a favourable trend. Other things have not been equal however. Low interest rates combined with rising house prices have encouraged households to take on the unprecedented levels of debt—both mortgage and non-mortgage—discussed above. As a result, they find themselves more indebted today than ever before and, as noted, at financial risk from rising interest rates and/or falling housing prices. According to a 2016 report from the Office of the Parliamentary Budget Officer (2016), the household debt service ratio is likely to continue rising as interest rates climb back to more normal levels. The PBO expects the ratio to climb an historically high level of 15.9 per cent by 2020.

A7.3.3 Debt to Net Worth Ratio

As a share of net worth, household debt remained relatively constant from 1990 to 2015, beginning and ending the period at about 20 per cent. In other words, even though debt was growing rapidly over the period, net worth was growing just as quickly.

It is worth noting again (see the discussion earlier this annex), however, that growth in the value of household assets—and therefore net worth—in recent decades has been driven in large part by holding gains rather than by actual investments (Figure A7.5). In 1990, holding gains on all household assets (financial and non-financial) contributed about 60 per cent of the growth in net worth; by 2015, that figure was about 89 per cent. As noted earlier, households have been steadily divesting in bonds and equities and the contribution of these assets to the change in net worth has become increasingly negative over time as a result. Investments in life insurance and pensions have been positive, though they too have played a decreasingly important role in the growth of net worth. The only investments to have played a positive and growing role in increasing net worth are non-financial assets (real estate and consumer durables).

Thus, although the household sector's debt to net worth ratio did not change much from 1990 to 2015 in spite of the large increases in debt, the forces at play in the numerator and denominator of that ratio were very different. On the one hand, households were continually borrowing and adding to their unavoidable debt repayment obligations. On the other hand, they were net divesting in relatively liquid financial assets and heavily investing in relatively illiquid real estate assets, giving them less flexibility to manage through financial difficulties (houses being much harder to sell than financial assets in the event that cashflow is required). Holding gains on the sector's remaining financial assets and on real estate kept net worth growing but less sustainably than would have been the case had financial asset divestment not been so significant.

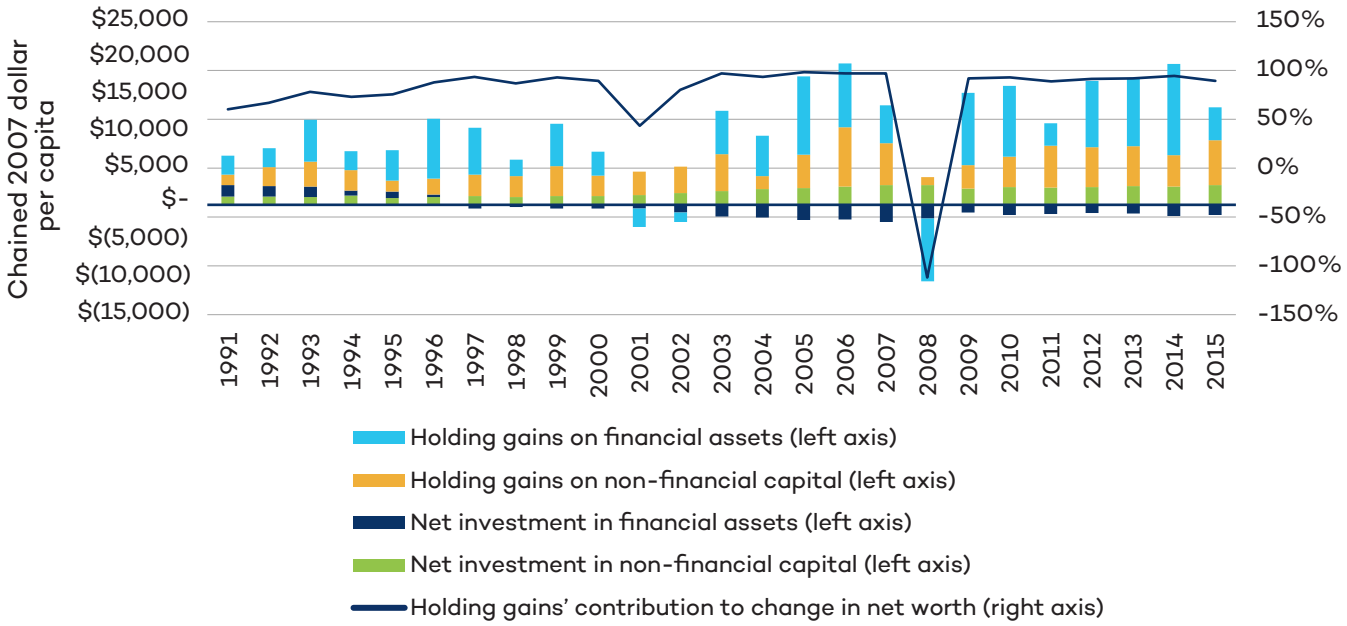

Figure A7.5. Change in household net worth by source of change, Canada, 1991–2015

A7.4 Home-ownership Lines of Credit and Household Credit Risk

One trend in household debt that experts are watching particularly closely is the increase in a relatively new form of household debt known as home equity lines of credit, or HELOCs.

HELOCs are lines of credit provided by banks to homeowners where the loan is secured against equity built up in the creditor's home. Though similar to mortgages in many ways, some unique features of HELOCs increase the risk of rising interest rates for the homeowners who use them. HELOCs usually allow borrowers to pay only the interest on the loan each month, leaving the principal amount unchanged. Traditional mortgages, in contrast, oblige homeowners to pay down principal with each payment. According to the Bank of Canada, about 40 per cent of HELOC borrowers were not regularly paying down their principal in 2017 (Poloz, 2017).

Another unique HELOC risk is that the interest rates charged on them float along with prime rates. Whenever banks increase their prime lending rates, as they began doing in 2017 after a long period of stable and historically low rates, HELOC interest rates immediately follow suit. In the case of mortgages, homeowners are sheltered from the immediate effect of interest rate increases so long as they have opted for a fixed-rate mortgage. Of course, even fixed-rate mortgages eventually come up for renewal. If they do at a time when interest rates are rising, as they are now, homeowners with both HELOC and mortgage debt will face a double threat.

According to a recent report, about 20 per cent of households have a HELOC, and their use of them accounts for about 40 per cent of outstanding non-mortgage consumer debt, outstripping credit cards, which represent about 15 per cent of non-mortgage debt (McFarland, 2018).

There is evidence that not all HELOC loans are used to finance home improvements, their ostensible purpose. A survey conducted by the *Globe and Mail* found that 23 per cent of respondents with outstanding HELOC loans said they borrowed to cover living expenses, fund vacations and pay for education. Seven per cent said they used their HELOC to buy a vehicle and 16 per cent said they used it to pay off or consolidate other debts (McFarland, 2018). The Bank of Canada has expressed concern over such risky uses of HELOCs, including down payments on investment properties intended for flipping (Poloz, 2017).

A7.5 Trends in post-1997 lending: The atypical roles of non-financial corporations and non-resident lenders

Non-financial corporations (that is, those outside of the financial sector where banks and other financial institutions are found) also played a role in meeting the shortfall of investment funds after 1997. This was out of character for the sector, as non-financial corporations normally borrow funds from other sectors and use those funds to finance investment in produced capital. Despite this traditional role, non-financial corporations acted as net lenders to the rest of the economy consistently from 2000 to 2011, doing so even during the financial crisis in 2008.

Another unusual feature of non-financial corporations' behaviour during the 2000s was how companies chose to hold on to their extra savings. Rather than invest them directly in other industries, the sector as a whole dramatically increased its holdings of cash in bank deposits. In real terms, the sector held about $151 billion in bank deposits in 1999. By 2011, this had more than doubled to $331 billion. It continued to rise until 2014 before falling slightly in 2015. This swelling of corporate bank accounts was one of the factors that permitted commercial banks to increase their mortgage and other lending to households during this time. Corporate cash accumulation, thus, played a role in supporting the housing boom.

There has been much discussion of corporations' decision to hold on to excess cash, as it is difficult to explain in standard economic terms. Earnings on bank deposits are poor, so holding onto so much cash would appear to be a lost opportunity to earn investment income. Some have argued that the cash accumulation was a rational decision by firms wanting to bring greater balance to their financial assets and liabilities and to have cash on hand to capitalize on investment opportunities as they arose.[208] Others have been critical of the move. Most famously, Mark Carney, when he was Governor of the Bank of Canada, declared the mountain of cash to be "dead money," exhorting companies to either put the money to work or give it back to shareholders (Carmichael, Blackwell, & Keenan, 2012). The debate on the issue continues to this day—and so does the mountain of cash.

[208] See, for example, Poschmann (2014).

After 2012, when declining oil prices began to hurt earnings in several important industries, the non-financial corporations sector returned to its traditional role as a net borrower.[209] At the same time, the household sector continued in its new role as a net borrower. The government sector had, as already noted, returned to net borrowing following 2008's financial crisis. This left financial corporations as the only Canadian sector lending money after 2012. It was able to pick up some of the slack in the supply of investment funds, more than doubling its net lending in real terms from 2011 to 2014. It could not meet all of the demand, however, leaving foreign lenders to provide the majority of the investment funds in Canada for the first time since the mid-1960s. Of Canadian lending between 2012 and 2015, foreign lenders provided 71 per cent on average compared with just 28 per cent on average from 1961 to 2011. This uncharacteristically large role for non-resident lenders added considerably to net foreign ownership of Canadian financial assets and, other things being equal, worsened Canada's international investment position.

[209] Another factor in the return of corporations to net borrowing was the fact that interest and dividend payments remained high even as earnings were falling, driving saving down proportionally more than the decline in earnings. Why dividends remained high in the face of declining earnings is not clear.

ANNEX 8 COMPREHENSIVE WEALTH INDEX METHODOLOGY

The national and domestic comprehensive wealth indexes (Indicator CW1) reported in this study are chained Törnqvist volume indexes of per capita produced, natural, human and, in the case of the national index, financial capital. The details of the calculation are as follows.

First, Statistics Canada estimates of the nominal values of produced (non-residential[210], residential[211] and inventories[212]), natural,[213] human capital[214] and, in the case of the national index, financial capital[215] for the period 1980–2015[216] were converted to per capita terms by dividing by population[217] for the appropriate year.

Using the nominal per capita values as weights for the per capita asset volumes,[218] the series were then aggregated into chained volume indexes following the Törnqvist formulation as in Equation 9 for the national index and Equation 10 for the domestic index:

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210 Statistics Canada, *Flows and Stocks of Fixed Non-Residential Capital*, by Industry and Asset, CANSIM Table 031-0005.

211 Statistics Canada, *Flows and Stocks of Fixed Residential Capital*, CANSIM Table 031-0008.

212 For 1990–2015, nominal values of inventories were taken from Statistics Canada, *National Balance Sheet Accounts*, CANSIM Table 378-0049. For 1980–1989, nominal values were taken from Statistics Canada, *National balance sheet*, CANSIM Table 378-0049. A consistent 1980–2015 timeseries of nominal values was created by adjusting the 1980–1989 nominal value estimates by the average ratio of the estimates from the two sources for the years 1990 to 1996.

213 For minerals, fossil fuels and agricultural land, an updated version of the natural capital volume index found in Islam (2007) was provided on special request by Statistics Canada (Islam, personal communication). For timber, nominal value data were taken from Statistics Canada (*Value of Selected Natural Resource Reserves*, CANSIM Table 153-0121). For built-up land, the same approach to estimating nominal values as applied to inventories was used (see Footnote 212 above).

214 An updated time series of the nominal and real human capital estimates found in Gu and Wang (2010) data was provided on special request by Statistics Canada for use in this study (Gu, personal communication).

215 For 1990–2015, nominal estimates of the market value of financial assets and liabilities were taken from Statistics Canada, *International investment position, book and market values*, CANSIM Table 376-0142. For 1980–1989, nominal estimates of book value assets and liabilities were taken from Statistics Canada, *International investment position, book value* CANSIM Table 376-0141. A consistent 1980–2015 timeseries of nominal market value estimates was created by adjusting the 1980–1989 book value estimates by the average ratio of the market to book value estimates from the two sources for the years 1990 to 1996.

216 The time period was chosen because it reflects the earliest and most recent years for which data are available on natural capital.

217 Statistics Canada, *Estimates of population for July 1*, CANSIM Table 051-0001.

218 In the case of non-residential and residential fixed assets and human capital, the volume measures used were Statistics Canada's estimated real values of these assets (*Flows and Stocks of Fixed Non-Residential Capital, by Industry and Asset*, CANSIM Table 031-0005 and *Flows and Stocks of Fixed Residential Capital*, CANSIM Table 031-0008 respectively). In the case of inventories and financial assets/liabilities, neither of which are estimated in real terms by Statistics Canada, volume estimates were constructed for this study by deflating Statistics Canada's nominal estimates (see Footnotes 212 and 215 above for sources) using the implicit price index for final domestic demand (*Price indexes, gross domestic product*, CANSIM Table 380-0066). In the case of timber, volume data were estimated by extending Statistics Canada's time series of commercial timber volumes (*Timber Assets*, CANSIM Table 153-0030), which ended in 2003 (see Annex 9 for further details). For built-up land, volume data were taken from a timeseries of land-use data compiled by Agriculture and Agrifood Canada (see Annex 9 for further details).

$$Q_{t-1} = Q_t / \left[\left(\frac{q_{P,t}}{q_{P,t-1}}\right)^{0.5(\$C_{P,t-1}/\sum \$C_{CW,t-1} + \$C_{P,t}/\sum \$C_{CW,t})} * \left(\frac{q_{Inv,t}}{q_{Inv,t-1}}\right)^{0.5(\$C_{Inv,t-1}/\sum \$C_{CW,t-1} + \$C_{Inv,t}/\sum \$C_{CW,t})} * \left(\frac{q_{Res,t}}{q_{Res,t-1}}\right)^{0.5(\$C_{Res,t-1}/\sum \$C_{CW,t-1} + \$C_{Res,t}/\sum \$C_{CW,t})} * \left(\frac{q_{Timber,t}}{q_{Timber,t-1}}\right)^{0.5(\$C_{Timber,t-1}/\sum \$C_{CW,t-1} + \$C_{Timber,t}/\sum \$C_{CW,t})} * \left(\frac{q_{N,t}}{q_{Nt-1}}\right)^{0.5(\$C_{N,t-1}/\sum \$C_{CW,t-1} + \$C_{N,t}/\sum \$C_{CW,t})} * \left(\frac{q_{Bu,t}}{q_{But-1}}\right)^{0.5(\$C_{Bu,t-1}/\sum \$C_{CW,t-1} + \$C_{Bu,t}/\sum \$C_{CW,t})} * \left(\frac{q_{H,t}}{q_{H,t-1}}\right)^{0.5(\$C_{H,t-1}/\sum \$C_{CW,t-1} + \$C_{H,t}/\sum \$C_{CW,t})} * \left(\frac{q_{FA,t}}{q_{FA,t-1}}\right)^{0.5(\$C_{FA,t-1}/\sum \$C_{CW,t-1} + \$C_{FA,t}/\sum \$C_{CW,t})} * \left(\frac{q_{FL,t}}{q_{FL,t-1}}\right)^{0.5(\$C_{FL,t-1}/\sum \$C_{CW,t-1} + \$C_{FL,t}/\sum \$C_{CW,t})} \right]$$

Equation 9 – National Comprehensive Wealth Index

$$Q_{t-1} = Q_t / \left[\left(\frac{q_{P,t}}{q_{P,t-1}}\right)^{0.5(\$C_{P,t-1}/\sum \$C_{CW,t-1} + \$C_{P,t}/\sum \$C_{CW,t})} * \left(\frac{q_{Inv,t}}{q_{Inv,t-1}}\right)^{0.5(\$C_{Inv,t-1}/\sum \$C_{CW,t-1} + \$C_{Inv,t}/\sum \$C_{CW,t})} * \left(\frac{q_{Res,t}}{q_{Res,t-1}}\right)^{0.5(\$C_{Res,t-1}/\sum \$C_{CW,t-1} + \$C_{Res,t}/\sum \$C_{CW,t})} * \left(\frac{q_{Timber,t}}{q_{Timber,t-1}}\right)^{0.5(\$C_{Timber,t-1}/\sum \$C_{CW,t-1} + \$C_{Timber,t}/\sum \$C_{CW,t})} * \left(\frac{q_{N,t}}{q_{Nt-1}}\right)^{0.5(\$C_{N,t-1}/\sum \$C_{CW,t-1} + \$C_{N,t}/\sum \$C_{CW,t})} * \left(\frac{q_{Bu,t}}{q_{But-1}}\right)^{0.5(\$C_{Bu,t-1}/\sum \$C_{CW,t-1} + \$C_{Bu,t}/\sum \$C_{CW,t})} * \left(\frac{q_{H,t}}{q_{H,t-1}}\right)^{0.5(\$C_{H,t-1}/\sum \$C_{CW,t-1} + \$C_{H,t}/\sum \$C_{CW,t})} \right]$$

Equation 10 – Domestic Comprehensive Wealth Index

where:

Q_t = chained Törnqvist volume index for year t

$Q_{x,t}$ = volume of capital type x in year t

$\$C_{x,t}$ = nominal per capita value of capital type x in year t

$\sum \$C_{CW,t}$ = Sum of the nominal values of all capital types in year t

P refers to non-residential produced capital

Inv refers to inventories

Res refers to residential produced capital

Timber refers to commercial timber natural capital

N refers to mineral, fossil fuel and agricultural land natural capital

Bu refers to built-up land

H refers to human capital

FA refers to net foreign financial assets, and

FL refers to net foreign financial liabilities.

The Produced Capital Index (Indicator PC1), Natural Capital Index (Indicator NC1), Human Capital Index (Indicator HC1) and, in the base of the national index, International Investment Position Index (Indicator FC1) are just the relevant sub-indexes of the aggregate indexes.

Timber Volume and Built-up Land Area Estimation Methodologies

ANNEX 9
TIMBER VOLUME AND BUILT-UP LAND AREA ESTIMATION METHODOLOGIES

A9.1 Timber Volume Estimation Methodology

Until 2003, Statistics Canada published an annual time series of commercial timber stock volumes as part of its *Natural Resource Stock Accounts*.[219] Publication ended because a key data source Statistics Canada had relied upon to produce its estimates was replaced and the new source did not offer the detail required to permit continuation of the time series.

In order to include timber in the comprehensive wealth indexes and compiled for this study, it was necessary to extend Statistics Canada's timber volume series from 2003 to 2015. This was accomplished using data on annual allowable cut (Canadian Council of Forest Ministers, n.d.) to move the volume series forward.

As shown in Table A9.1, the ratio of the annual allowable cut (AAC) to Statistics Canada's estimates of commercial timber volumes from 1990 to 2003 is quite constant at about 1.85 per cent. This share was applied to the average AAC for 2013 to 2015 to estimate the timber volume for 2015. The years 2004 to 2015 were then filled in using linear interpolation.

Table A9.1. Annual allowable cut and timber volumes, 1990–2015

Year	Annual allowable cut (AAC)	Commercial timber volume	AAC as a share of volume
1990	249.6	13,276,208	1.88
1991	246.8	13,224,545	1.87
1992	242.4	13,184,110	1.84
1993	239.1	13,127,030	1.82
1994	239.2	13,099,983	1.83
1995	235.6	13,001,332	1.81
1996	236.3	12,934,019	1.83
1997	238.7	12,874,517	1.85
1998	238.1	12,826,804	1.86
1999	238.7	12,765,677	1.87

[219] Statistics Canada, *Timber Assets*, CANSIM Table 153-0030.

Year	Annual allowable cut (AAC)	Commercial timber volume	AAC as a share of volume
2000	234.7	12,726,149	1.84
2001	236.9	12,680,889	1.87
2002	237.7	12,618,653	1.88
2003	238.8	12,647,058	1.89
2004	245.9	12,607,649	n/a (volume estimated by interpolation)
2005	244.1	12,568,241	n/a (volume estimated by interpolation)
2006	246.2	12,528,832	n/a (volume estimated by interpolation)
2007	250.7	12,489,424	n/a (volume estimated by interpolation)
2008	249.5	12,450,015	n/a (volume estimated by interpolation)
2009	240.0	12,410,607	n/a (volume estimated by interpolation)
2010	234.9	12,371,198	n/a (volume estimated by interpolation)
2011	228.6	12,331,790	n/a (volume estimated by interpolation)
2012	225.9	12,292,381	n/a (volume estimated by interpolation)
2013	223.7	12,252,972	n/a (volume estimated by interpolation)
2014	226.9	12,213,564	n/a (volume estimated by interpolation)
2015	226.0	12,174,155	n/a (volume estimated by interpolation)

A9.2 Built-up Land Area Estimation Methodology

The area of built-up land was estimated for this study by interpolation of a set of point estimates of the area covered by roads and buildings for the years 1990, 2000 and 2010 prepared by Agriculture and Agrifood Canada (AAFC) (n.d.b). The 1990–2000 growth rates in the AAFC data were used to interpolate for the years 1980–1989 and 1991–1999; the 2000–2010 growth rates were used to interpolate for the years 2001–2009 and 2011–2015 (Table A9.2).

Table A9.2. Estimates of built-up land area, Canada, 1980–2015

Year	Area under buildings	Area under roads	Total built-up area	Comment
	square kilometres			
1980	18,794	26,687	45,481	interpolated
1981	19,185	26,694	45,879	interpolated
1982	19,584	26,701	46,285	interpolated
1983	19,991	26,708	46,700	interpolated
1984	20,407	26,715	47,123	interpolated
1985	20,832	26,722	47,554	interpolated
1986	21,265	26,730	47,995	interpolated
1987	21,708	26,737	48,444	interpolated
1988	22,159	26,744	48,903	interpolated
1989	22,620	26,751	49,371	interpolated
1990	23,091	26,758	49,848	AAFC estimate
1991	23,571	26,765	50,336	interpolated
1992	24,061	26,772	50,833	interpolated

Year	Area under buildings	Area under roads	Total built-up area	Comment
1993	24,562	26,779	51,341	interpolated
1994	25,073	26,786	51,859	interpolated
1995	25,595	26,793	52,388	interpolated
1996	26,127	26,800	52,927	interpolated
1997	26,671	26,807	53,478	interpolated
1998	27,225	26,814	54,040	interpolated
1999	27,792	26,822	54,613	interpolated
2000	28,370	26,829	55,199	AAFC estimate
2001	28,687	26,924	55,611	interpolated
2002	29,008	27,019	56,027	interpolated
2003	29,332	27,115	56,448	interpolated
2004	29,660	27,211	56,872	interpolated
2005	29,992	27,308	57,300	interpolated
2006	30,328	27,405	57,732	interpolated
2007	30,667	27,502	58,168	interpolated
2008	31,010	27,599	58,609	interpolated
2009	31,356	27,697	59,054	interpolated
2010	31,707	27,795	59,502	AAFC estimate
2011	32,062	27,894	59,956	interpolated
2012	32,420	27,993	60,413	interpolated
2013	32,783	28,092	60,875	interpolated
2014	33,149	28,192	61,341	interpolated
2015	33,520	28,292	61,812	interpolated

Source: Current study based on Agriculture and Agrifood Canada data.

ANNEX 10 ADDITIONAL DETAILS OF ECOSYSTEM INDICATORS METHODS

Natural Capital: Ecosystems

Time Series: 2000–2011

Frequency: Intermittent

Description: The ecosystem indicators in this report address ecosystems from two perspectives:

- Change in extent of ecosystems between 2000 and 2011
- Pressure on ecosystems as of 2015 from the cumulative development of human land uses.

The ecosystems covered in the report (forests, wetlands, surface freshwater and grasslands) were selected given their relative importance in Canada. Forests are the primary land cover across Canada and a source of much market and non-market wealth. Wetlands are widespread, rapidly disappearing in some parts of the country and also a source of considerable wealth. Grasslands are widespread in the southern Prairies and under extreme threat from development. Fresh water is essential to life and changes in the distribution and amount of fresh water are becoming increasingly important with climate change. Other ecosystems that could have been included but were not are:

- Tundra, which shows very little change from 2000–2011 and is currently under little pressure from cumulative development
- Coastal zones, for which change in extent is difficult to measure, and
- Agricultural land, which shows very little change from 2000–2011 and is, by definition, completely impacted by human land use.

Method of calculation and data sources: The primary data source for the terrestrial ecosystem indicators is the *Land Cover Time Series 2000–2011* spatial dataset compiled by the Canada Centre for Remote Sensing of Natural Resources Canada (Canada Centre for Remote Sensing, 2012). The LCTS 2000–2011 is the most current, publicly available land-cover dataset that provides complete coverage of Canada. It is derived from 250 metre spatial resolution satellite imagery that is designed to be temporally consistent. For the purposes of this study, the 25 land cover classes in the LCTS were generalized to seven terrestrial ecosystem classes (forests, grasslands, tundra, wetlands, agriculture, "disturbance,"[220] and urban) to conduct analysis. The LCTS raster layers were re-projected to the Canada Albers Equal-Area projection and intersected with Statistics Canada's 2011 cartographic provincial boundary file[221] to calculate provincial land cover values. A basic analysis of land cover change was conducted using the years 2000 and 2011 to provide a basis for examining the loss or gain in each type of ecosystem.

Statistics Canada's digital boundary files (Statistics Canada, 2012) were used to determine the area of surface freshwater ecosystems in Canada. The area of freshwater lakes and rivers was taken directly from the Hydrographic Reference Layer and the extent of rivers was derived from the length of rivers present in Statistics Canada's River Water Layer, both using the Canada equal-area conic projection.

To determine the impact of cumulative human development on ecosystems, a spatial dataset of human land uses was created by Global Forest Watch Canada (GFWC). GFWC combined numerous spatial datasets to create a cumulative picture of human access features (such as roads) and combined this with various datasets of land disturbance. The resulting cumulative development dataset includes roads, railways, pipelines, powerlines, oil/gas wells, seismic lines, settlements (point locations), mines, dams, forest clearcuts, water reservoirs, urban areas (built-up extent) and agricultural areas. Linear features were converted to a 1-square kilometre grid and large point features such as mines, dams and settlements were assigned to a 10-square kilometre grid.

To assess the pressure on ecosystems from human development, the cumulative development dataset was intersected with the LCTS (terrestrial ecosystems) and hydrographic (surface freshwater) datasets. For terrestrial ecosystems, this was a simple matter of overlaying the two spatial raster (grid) datasets. For surface freshwater, the cumulative development dataset was first converted to a vector (polygon based) format and then area values were calculated based on the Canada equal-area conic projection.

Limitations: The LCTS dataset is intended to be used for national to regional modelling and assessment studies where information on land-cover dynamics are needed; provincial values will have a higher degree of uncertainty as a result.

GFWC's cumulative development dataset is a compilation of numerous different datasets, all of which were created for different purposes for different regions and using different methodologies. Thus, the extent, accuracy, resolution and reference periods of each of the original data sources are not consistent. The dataset does not represent the extent of development at any one point in time but rather a cumulative picture of development over time. As such, not all areas indicated as "developed" may presently have a physical human footprint and some areas may have returned to a natural state. To account for the ecological effects of human disturbance, a conservative ecological buffer of 500 metres is applied to linear disturbances (since disturbances are assigned to a 1-square kilometre grid). Ecological

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220 "Disturbance" includes the "burned forests" and "shrubland/low vegetation cover" land-cover classes in the *Land Cover Time Series 2000–2011*.

221 Statistics Canada, *Boundary Files*, available at https://www12.statcan.gc.ca/census-recensement/2011/geo/bound-limit/bound-limit-eng.cfm.

buffers differ for different species, however, and other human footprint studies have extended buffers as far as 15 km (Sanderson et al., 2002), so the buffer here may underestimate the degree of "development" for some ecosystems.

Reliability: Overall, the ecosystem indicators are considered reliable.[222]

The LCTS dataset is obtained from Natural Resources Canada and has been published in the peer-reviewed scientific literature (Pouliot et al., 2014) and was used in a Statistics Canada (2013a) report on measuring ecosystem goods and services. This dataset should be considered very reliable.

Statistics Canada's *Hydrographic Reference Layer* is a standardized product and should be considered very reliable.

The GFWC cumulative development dataset is compiled from a variety of publicly available datasets of varying quality that do not provide consistent spatial or temporal coverage across Canada. The data should be considered acceptable.

[222] See Footnote 78 for details of the reliability scale used in this report.

Published by the International Institute for Sustainable Development.

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