



Fostering
international
raw materials
cooperation



Canada
**Contextual analysis of the
reference countries**

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Abstract

The principal objectives of the INTRAW project (<http://intraw.eu>) are the mapping of best practices and boosting of cooperation opportunities related to raw materials between the EU and 5 technologically advanced non-EU countries (Australia, Canada, Japan, South Africa and the United States). Each of these five "Reference Countries" is subject to similar global challenges. This report presents the contextual analysis of Canada in order to explain the country's historical economic development during the 20th and 21st century in general, and in relation to development of primary raw materials in particular. Three reports focussing specifically on: raw materials research and innovation; education and outreach; and industry and trade in the Reference Countries will be the next outputs from the project to be published. These will underpin the development of a better understanding of the achievements made in these 5 countries in relation to raw materials research & innovation, educational and skills programmes, trade, exploration, exploitation, processing, recycling and substitution.

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Disclaimer

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1. Introduction

1.1 General

One objective of INTRAW is to characterise the contextual environment of the five Reference Countries for the project (Australia, Canada, Japan, South Africa, and the United States) in relation to raw materials research & innovation, educational and skills programmes, trade, exploration, exploitation, processing, recycling and substitution. This, together with the mapping of corresponding policies and practices for each of these domains, will facilitate the comparative evaluation and cross impact analysis of the raw materials domains between the Reference countries and the EU.

1.2 Introduction to Contextual Analysis (WP1, Task 1.1)

The objective of Task 1.1 of the INTRAW project is to map the contextual environment of the reference countries (Australia, Canada, Japan, South Africa and the United States of America) against the contextual environment in the EU, leading to a better understanding of the achievements made in these countries in relation to raw materials research & innovation, educational and skills programmes, trade, exploration, exploitation, processing, recycling and substitution. This WP will also map the corresponding policies and practices of each of these domains. The data will be centrally processed, which will facilitate the comparative evaluation and cross impact analysis of the raw materials domains in each of the Reference countries and the EU.

1.3 Scope of this report

This report is the **Country Report for Canada, prepared as part of Task 1.1: "Contextual analysis of the Reference Countries"**. It is part of the deliverable for Work Package 1 of the INTRAW project (D1.2). This report on the contextual analysis for Canada is presented in 4 main sections after this introduction:

- **Chapter 2:** An Executive Summary
- **Chapter 3:** A historical overview on raw materials
- **Chapters 4 to 8:** Analysis of the contextual environment, covering 49 explanatory factors, grouped into five main categories:
 - Geo & Environmental (6 factors – Chapter 4);
 - Socio-Cultural (11 factors – Chapter 5);
 - Economic (14 factors – Chapter 6);
 - Political and Legal (14 factors – Chapter 7); and
 - Technological (4 factors – Chapter 8).
- **Chapter 9:** Conclusions.

The description of the analysis of the contextual environment in each of the main sections, Chapters 4 to 8, first describes general economic growth and change drivers associated with each of the explanatory factors, and then draws out findings that are specific to the non-energy raw materials sector. The conclusions section follows a similar pattern, with a general overview followed by conclusions specific to raw materials, arranged under the headings "*Industry and trade*", "*Education and outreach*", and "*Research and innovation*" thus integrating three sides of the 'knowledge triangle': higher education, research and business, that are reflected in the themes of the sector specific reports being prepared as deliverables from WPs 1.2¹, 1.3² and 1.4³.

The report is supported by three appendices:

- **Appendix A1:** Presentation of the method employed to construct a multi-factor matrix and associated radar charts. The multi-factor matrix and radar charts were the tools used to carry out initial organisation and analysis of the information collected and to inform discussions within

¹ Transactional analysis on Research and Innovation

² Transactional analysis on Education and Outreach

³ Transactional analysis on Industry and Trade

the work package team and with members of the expert panel. They are considered as *work-in-progress input* and are included here for completeness.

- **Appendix A2:** Presentation of summary findings via the "multi-factor matrix" and five- and 12- axis "radar charts",

and preliminary discussion of the comparative importance of the explanatory factors based on the analysis.

- **Appendix A3:** Presents the references quoted in this document.

2. Executive summary

Canada is the 16th largest economy in the world (if measured by Gross Domestic Product purchasing power parity) and ranks 29th if Gross Domestic Product (GDP) is measured on a per capita level. Canada ranks 8th in the United Nation's Human Development Index, its citizens enjoy high living standards and its mining industry has become a global leader in exploration, mine development and operation, financing, and site remediation.

This economic development was accelerated after the Second World War when the growth of Canadian manufacturing, mining, and service sectors transformed the nation from a largely rural economy into one that is primarily industrial and urban. After Confederation (1867), large-scale external immigration, followed by internal re-distribution and settlement to the West coupled with new technology and foreign investment unleashed the productive capacity of the Prairies. This was first manifested in the "wheat boom", followed by the other "staples" or commodities (natural and mineral resources-based commodities such as wheat, timber, fur, fish, pulp and paper, minerals, oil and gas), all of which have robustly contributed to Canadian export balances. Both the settlement of the West and the construction of the transport network (railways, roads, ports) were guided under the National Policy. During much of the 20th century this policy guided the creation of a national domestic market which achieved a relatively large spending power, to a large degree based on deficit-spending (which involved an increasing federal gross public debt, particularly after 1960), and favourable terms of trade.

Throughout the 20th and 21st century Canada has developed its economy to become a resource "trading nation" heavily dependent on trade for its economic prosperity. Since most of that trade is with the United States of America (USA from now on), this report finds that Canada's geo-political location next to the USA and

its bilateral trade policies (initially with the British and later with the Americans) and its shifting policies towards other international trading partners, explain a large part of its success in the export of numerous commodities such as pulp and paper, timber, oil, gas and mineral exports, in the automobile and automobile parts industry, among others. The USA-Canada border is the longest in the world and both countries share the world's largest and most comprehensive trading relationship. Based both on its geographical location next to the USA and also on the similarity of cultural and language backgrounds, the Canadian economy has become highly integrated with that of the USA. Moreover, a well-established transport infrastructure network enabled the transportation of commodities from the origins towards the Canadian ports, and a high level of integration with the USA's transport infrastructure.

The high participation of US capital in Canada's growth is demonstrated by the high level of American investments in Canada (by 1930 two-thirds of foreign investments in Canada were of US origin). Sustained high levels of US investments in Canada have played a role in ensuring a high rate of technological change and technology transfer with the U.S. Inward investments into Canada were provided at first by savings of foreigners, but since the end of WWII the domestic economy provided the major proportion of savings need to sustain the high level of investment demand.

Canada's natural resources (forest, fish, timber, fur, water), mineral resources (energy and non-energy) and manufacturing industries have continuously been the backbone of the country's economic growth. The services sector, which currently dominates the economic structure, is inextricably linked to the natural and minerals resources sectors as the latter rely on a range of goods and services such as financial, business, transportation, insurance and wholesaling services.

The Canadian mining industry's success can be explained by the interrelation of two major factors: **mineral endowment** and a **political-institutional environment** that has been consistently attractive for mining investment.

The **mineral endowment** is closely related to prospecting and exploration activities which render mineral occurrences into discovered deposits.

- **Discovery momentum and entrepreneurial reward:** most recent new "mineral endowments" in **Canada** only came to light as a result of the entrepreneurship (risk-taking culture) of modern exploration; drawing its impetus for risk taking from the extrapolation of rewards to explorers in the past to potential rewards in the future ("success breeds success");
- **Availability of public and reliable geoscience data:** Canada's federal government (and the provinces too) have traditionally provided funding for public geoscience information on the premise that good economic government policy requires a sound knowledge of Canada's mineral potential. The public availability of up to date bedrock geological maps, regional geochemical, geophysical and geospatial data (in a repository) and reports, reduce the cost and risk of exploration by allowing companies to identify areas of high mineral potential, reducing the need to spend time and money exploring less prospective ground. In addition, geoscience information also informs government policy decisions in respect of land use planning, infrastructure development and environmental protection. This information is critical to reduce the financial risk associated with exploration decisions and attract investments. For instance, in 2013 Canada announced the renewed support of (Canadian dollar) \$ 100 million over seven years (2013-2020) for the Geo-mapping for Energy and Minerals (GEM) programme, which advances geological knowledge

in the North to support increased exploration of natural resources and inform decisions on land use that balance conservation and responsible resource development.

The **political-institutional environment** fostering a successful mining industry has been enabled by (no order of priority):

- **Political and institutional stability:** this guarantees a high respect for the rule of law, provides the conditions for a legal framework that guarantees the security of tenure and the ability to repatriate profits. All these are necessary conditions to attract investors. As an example, Canada as a country and most of its provinces have consistently been placed very high in the Fraser Institute's ranking for the most attractive locations for mining investment (considered a low-risk environment for investing);
- **Access to land, energy and water**
- **Access to reliable transport infrastructure**
- **Access to risk finance:** Canada's capital markets providing funding for mining investments are well-developed. The Canadian mining industry has become a global leader in mining financing, exploration, development, and mine site closure and rehabilitation. Canada-tailored policies such as the Canadian Mineral Exploration Credit and flow-through shares allowed the creation of a successful exploration cluster in Vancouver (world's largest junior companies exploration cluster) enabled by the world-leading financing cluster in Toronto. Canada is also a world-leader in raising equity for mineral exploration and development;
- **Access to a skilled workforce**
- **Access to a developed and competitive services industry (mining equipment, technology and services sector)**
- **Low and efficient permitting procedures:** the Canadian permitting procedure for mining is considered

stringent but very effective with a permitting delay of around two years, similar to Australia, and lower than that for the USA (average of ten years). Delays for unforeseen reasons, or delays to the expected process are serious problems for the industry, with a typical mining project losing a significant proportion of its value as a result of unexpected delays in receiving the numerous permits needed to begin production;

- **Granting of the social licence:** Canada's mineral sector has seriously considered the issue of the social licence and understands that dealing with this issue requires ongoing dialogue between the agencies in government that issue the mineral tenure and control the land use management regime and industry (which conducts the activities on the ground) and local communities and other agencies of government to ensure all stakeholders understand at all stages the nature of the work and possible outcomes of the mining investment. The "free-entry" system has given rise to conflicts between the mining industry and First Nations, it has now been established that a duty to consult applies to the free-entry regime. In recent years, in order to avoid conflicts, a system has been established requiring mining companies to sign Impact and Benefit Agreements (IBAs) with First Nation peoples. These include provisions for economic and business opportunities, employment and training, socio-cultural community support, environmental protection, and post-mine closure;
- **Government support for the mining industry:** government support has enabled the development of publicly available geoscience data and of transport infrastructure alongside the discovery and development of mines. For instance, government funding for many large regional infrastructure projects has opened up areas that could otherwise not have been developed for mining

(e.g. rail line to Pine Point mine, rail lines to the iron ore fields in Labrador, hydro power for Yellowknife Gold mines, etc.). In the 1950s and 1960s the Federal Government introduced the "Emergency Gold Mining Assistance Act" to aid gold mines throughout the country struggling with the low fixed price of gold in the inflationary period from 1950 – 1971. This programme enabled numerous towns in northern parts of the provinces to survive until a new wave of base metal mines replaced the ageing gold mines (e.g. Kidd Creek in Timmins);

- **Research & Innovation:** the Canadian mining industry has played and still plays a key role in Canada's economy as one of the most innovative sectors across all industries. The mining industry has continuously invested in research and innovation (R&I), even during bust times and including high risk projects, and has become a driving force in Canada's new knowledge-based economy. By innovating, Canada has transformed potential resources into discoveries and actual proven resources and reserves. Examples are discoveries of deposits in the 1970s using airborne geophysics or, more recently, the usage of unconventional technologies to extract oil from oil sands in Alberta. New technologies in mining have created a circle of growth and innovation, that benefit both mining and the wider economy. In 2013 investment in mining surpassed investment in the motor vehicles and parts sector, and in the wood products and paper sector (both individually and when these other two sectors are added together). Moreover, in 2012 the mining industry employed over 4,700 people in research and development (R&D), which is more than the pharmaceutical and forestry sectors.

3. Historical overview on raw materials

Canada's usage of raw materials dates from the times of the First Nations who based their economy on hunting, farming and trading. With the arrival of the Europeans in the 16th century, settlers introduced commercial fisheries, and the Atlantic cod fisheries. They also established the fur trade (mainly with aboriginal peoples in exchange for guns, textiles and other products). Fisheries and fur were the leading economic sectors during the early settlement period in Canada until the late 18th century. During the 19th century, timber became the dominant (staple) commodity.

At the turn of the 19th century into the 20th century, a rapid economic and population growth period was driven by the "wheat boom" (1896-1913). This was a period of remarkable transformation of the economy, and expansion of wheat exports, to a large extent related with the western settlements in the Prairies provinces. In the 1920s, besides the expansion of wheat production, the greatest areas of growth were the "new" commodities (staples): minerals and pulp and paper. These commodities were boosted after 1913 and production of mineral pro-

ducts such as copper, nickel and lead were driven by rising demand during World War I (WWI), both domestically and through trade with USA and Britain. In relation to newsprint, Canada profited from a combination of natural advantage (i.e. an excellent supply of timber) and the availability of low cost hydropower (Green, 2000). By the end of the 1920s Canada was supplying 40% of the world's trade in wheat, and the links between the western farming regions and the eastern manufacturing provinces had made it a strong and productive national economy.

The first three decades after the end of WWII represented a resource boom period. The resource boom was associated with a dramatic change in the relative prices of outputs and inputs and an unprecedented appreciation of the Canadian dollar (Baldwin and Macdonald, 2009). Gold was the only metal produced in Canada in the early 20th century, reaching a peak between 1900 and 1940.

After 1945, although wheat and other Prairie agricultural products remained important, the export value of pulp and paper, iron ore, and non-ferrous metals

(copper, nickel, zinc, etc.), increased considerably along with the rapid expansion of USA industrial capacity. Forest products responded to the post-war housing expansion in both Canada and the U.S, pulp and paper expanded rapidly with the growth of newspaper circulation, and by 1950 Canada supplied over half of the world's newsprint (Baldwin and Macdonald, 2012a). Non-ferrous metals also expanded, with Ontario growing in the production in iron ore, nickel, cobalt, copper, uranium and gold, Saskatchewan in uranium and Quebec in asbestos, gold, copper, lead and zinc. The building of new infrastructure in the St. Lawrence Seaway facilitated the transportation of the new Canadian supply from Labrador's mines to the steel industry. All these industries were enabled by the rapid expansion of water powered electrical capacity. In 1956, five of the top ten Canadian exports involved minerals, aluminium, nickel, copper, iron ore and asbestos (Power, 2002).

Also, energy became a new staple for Canada after WWII. Until then, Canada had relied on coal imports, but the major discovery of large reserves of oil and natural gas near Leduc, Alberta, ignited a wave of investments in the expansion of oil fields, increasing reserves, and a new network of pipelines (e.g. the interprovincial pipeline, trans mountain pipeline, among others). Likewise, the 1970s saw a boom in the discovery of deposits related to innovation in exploration which started using airborne geophysics for exploration (Minalliance, 2012). Through the 1980s, production of new minerals such as uranium and potash increased.

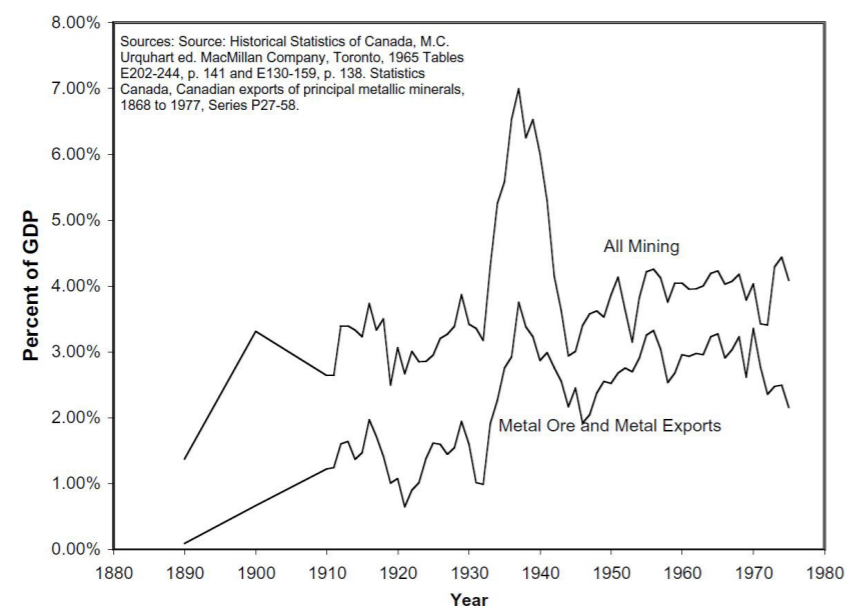
Strong gold prices, which weakened at an annual average around USD 600 an ounce in 1980, stimulated investment in gold and brought about rapid increases in production. From August 1980 to August 1990, gold production in Canada increased by 327%.

The 1990s also saw the expansion of energy production outside Alberta, as offshore deposits on the East Coast came online and energy production rose in British Columbia, particularly of natural gas. The resource boom after 2000 led to a resurgence in energy production investment in Canada and expansions of ener-

gy production in all provinces with energy reserves (Baldwin and Macdonald, 2012a). In 2013 the extraction of minerals and metals (mining and quarrying) contributed to 3.4% of the national GDP, rising to 7.2% if the oil and gas industry is considered (Marshall, 2014).

The forestry industry has traditionally been a powerful driving force in the Canadian economy, and has been particularly important in stimulating the development of other manufacturing and service industries (Madore and Bourdages, 1992). In 2013 production in the forestry sector contributed around 1.2% of Canada's real GDP. Since forestry product imports are minimal, it is not surprising that Canada has the world's largest forestry products trade balance (NRCAN, 2015a). Main subsectors in the forestry business are: i) solid wood product manufacturing (the largest subsector, including softwood lumber and structural panels, millwork and engineered wood products); ii) pulp and paper product manufacturing, and iii) forestry and logging. In the last few decades the forestry sector has been facing structural and cyclical crises. More recently, Canada's forest industry has undergone an especially deep cyclical decline, coupled with structural changes in world markets (e.g. decline for paper-based communication products due to the rise of electronic media). This has led the industry to transform itself along four lines: market development, operational efficiency, business process change and new product development. This has been achieved partly via the government-funded IFIT programme, which has supported development of new building materials, biofuels that can substitute for fossil fuels, and biochemicals that can be used to produce bio-based pharmaceuticals, bio-degradable plastics, etc. (NRCAN, 2015a). Canada's rate of deforestation is virtually zero and has remained at this level for more than two decades. 94% of Canada's forests (spruce-dominated) are publicly owned, of which 90% belongs to provinces and territories, 2% to aboriginal peoples, and the remaining 2% to the Federal government. The other 6% is privately owned by more than 425,000 private landowners.

Figure 1: Canadian mining output and metal exports as a percent of GDP (1890-1975).



Source: Power (2002)

4. Geo and environmental factors

4.1 Geographical situation

Canada is located in the Northern part of North America and shares its borders with the USA to the south (longest shared border in the world) and in the northwest (Alaska, state of the USA). The country has access to both the Atlantic Sea as well as the Pacific Ocean which enabled the country to have a good port infrastructure. Canada's geo-political situation has favoured the country's economic development during different periods. During the 19th century, Canada benefited from trade with Britain, e.g. timber trade and the transport of immigrants in timber boats providing capital and labour. During WWII Canada also benefited from its position by becoming an important supplier of military provisions for the British economy, while being distanced from the actual war zone. More recently, its strategic location next to the USA has enabled long-standing free-trade commercial agreements (Auto Pact in 1965, general FTA in 1989, NAFTA agreement in 1994 and Trans-Pacific Partnership in 2012) which have largely benefited Canada's economy, nowadays highly integrated with that of the USA. In 2014 Canada's exports to the USA represented 75% of its total exports (STATCAN, 2015a). The geographic location of Canada immediately north of the USA, and with coastlines facing Europe and Asia has also enabled Canada's mining industry to focus on all three markets for mineral exports depending on demand. Generally there has been a shift from a euro focus (Newfoundland and St Lawrence Seaway to Europe) followed by more of an emphasis on exports to the USA and thence to Asia over time. Canada's distance to tidewater (access to ocean ports with international maritime services for commodities trade) has been an important factor enabling the trade, e.g. with low value commodities (e.g. British Columbia or Yukon with zinc).

4.2 Natural and mineral resources

Canada's vast natural (forests, cod fisheries, rich soils) and mineral resources (energy and non-energy minerals) endowment has been essential to the country's economic development. The export of natural resources, commonly known as "staples" (commodities that need little change prior to export), has underpinned the economic growth during its history and it is an enduring theme in any explanation of long-run growth (Green, 2000). In other words, resource endowment "explains much of the particular structure of the Canadian economy, including the continuing importance of natural resources which makes the economy more responsive to external demand changes and more unstable than most industrial nations" (Pomfret, 2013:202). Wheat, forests and wood products, alongside minerals have been the most important resources.

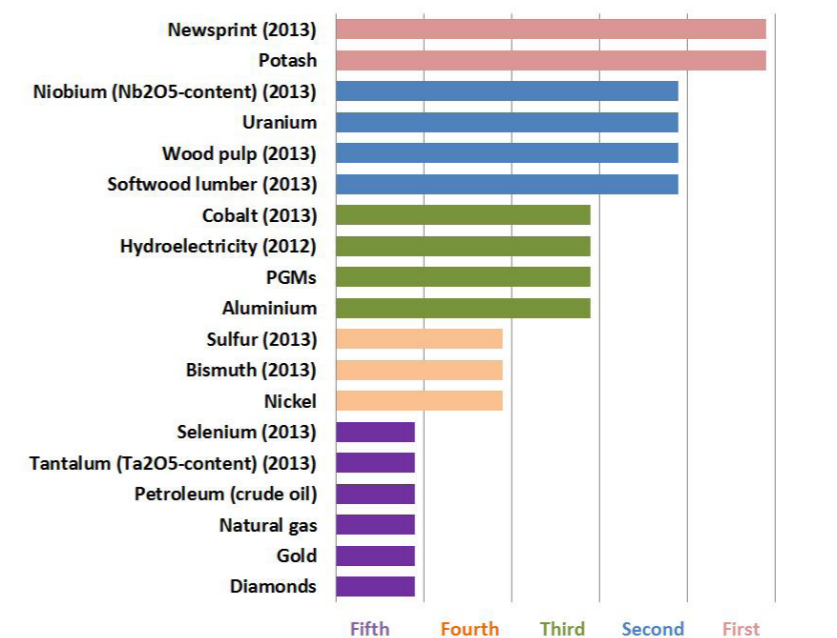
Wheat production in Canada dates back to the early 17th century, spreading to the West and reaching Manitoba in the early 19th century. The country flourished in the production during the wheat boom (1896-1913), later production declined and has remained relatively important in Canada. Currently Canada ranks as the 7th largest wheat producing country in the world.

Forests are intrinsically linked with Canada's history, long before the arrival of European settlers and during Canada's economic development in the last centuries (Mockler and Robichaud, 2011). Canada's forests cover 3.48 million km², namely, 35% of the country land area (9.98 million km², 2nd largest country in the world after Russia with 17 million), much more than South Africa (7.6%), Australia (19%) or the USA (33%) but much less than, e.g. Japan (68.6%) (World Bank, 2015). Canadian forests represent about 9% of the world's forest cover, and while other natural resource sectors are often regionally concentrated, the forest sector is widely distributed. Canada's has tradi-

tionally led the production of pulp and paper (e.g. newsprint for the U.S) and nowadays remains as the world largest pro-

ducer. Likewise, Canada ranks as the 2nd largest producer in the world of softwood lumber and wood pulp (NRCAN, 2015b).

Figure 2: Canada's global production rank (2014).



Source: NRCAN (2015b); for niobium, cobalt, sulphur, bismuth, selenium and tantalum Reichl et al., (2015)

Besides forestry, Canada holds enormous reserves of metals and minerals and is a globally important player in the production of metals and minerals. The large and diverse natural mineral endowment of Canada (and the discovery of economically viable mineral deposits via ongoing exploration and deposit appraisal investments) has been a major factor in driving the growth of Canada's mining sector. One of the key factors that led to the early development of several mining camps in Newfoundland, Northern Ontario, Quebec, Manitoba, and British Columbia was the abundance of rock outcrop that enabled the discovery of several major mines using simple prospecting techniques (e.g. Hollinger Gold Mine in Timmins, Home Mine in Quebec, and Sullivan in British Columbia). The geological work on and around these deposits increased the understanding of the formation of the deposits and geological setting so that when the new geophysical and geochemical exploration techniques were introduced in the 1950s a number of large mines were discovered under cover often in close proximity to outcropping

deposits (Kidd Creek, GECO, Brunswick Mines etc.). Geological mapping by the Geological Survey of Canada (part of the Natural Resources Canada –NRCAN-department) and then the various Provincial Surveys provided the ground work for the prospectors and mining companies to work from. More recently focused multi-disciplinary geoscience research work has been used to identify new opportunities in mature mining camps (the various EXTECH projects in North Saskatchewan, Yellowknife, and Snow Lake – Flin Flon). Canada's exploration efforts led to the discovery and successful exploitation of copper in Newfoundland, gold in Yukon, nickel in Sudbury, gold and base metals in Abitibi-Greenstone, iron and nickel in Labrador, uranium in Athabasca, potash in Saskatchewan, copper in British Columbia, diamonds in the North Western Territories, and more recently chromite deposits in Northern Ontario (Ring of Fire).

These new mineral "endowments" only came to light by the entrepreneurship of modern exploration that drew from reward to the finders in the past as impetus for risk taking and potential reward to

others. Discovery momentum is the power of individual and company reward for risk as a direct driver for others to do the same and lead to more discovery. This has been considered a key driver of Canada's mining industry success.

Canada is nowadays the world's largest producer of potash with the province of Saskatchewan hosting the country's epicentre of global potash production. Canada produces 32% of all potash production globally, making it the world's largest potash producer and exporter (KPMG, 2014). Also, Canada ranks as the world's the second-largest producer of uranium after Kazakhstan, and third largest producer of cobalt, PGMs and aluminium. Canada also ranks as the world's fifth largest producer of petroleum (crude oil), and virtually all of its crude oil exports are directed to USA refineries (Canada is USA's largest supplier of foreign oil). In 2014, 58% of Canada's oil production came from oil sands in Alberta, and the rest from resources in the broader Western Canada Sedimentary Basin and offshore oil fields in the Atlantic Ocean. Oil sands represent 97% of Canada's proven reserves, and due to this, Canada houses the 3rd largest

oil reserves in the world behind Venezuela and Saudi Arabia (CIA, 2015a).

4.3 Water resources

Canada is generally considered a relatively water-rich country. It hosts 20% of all the world's freshwater (but much of it is locked up in polar ice, mountain glaciers and deep underground aquifers not readily accessible), and has more lake area than in other country in the world (Canada West Foundation, 2010). However, Canada has a great variability in water availability across regions and provinces, and has some areas with a water availability threat, such as southern Ontario, southern Alberta, southern Saskatchewan, southwestern Manitoba and the Okanagan Valley in British Columbia (Government of Canada, 2013a). Some of the highest threats are located in the cities where most of the urban population reside.

Water availability is very important for Canada's thermal power generation sector (largest consumer), for municipal and manufacturing uses (e.g. food and beverage industry), for agricultural production, and mining. Even though the thermal power generation sector consumes

the most by far, most of the water used is returned to the water body from which it was taken. By contrast, agriculture only circulates back a small proportion of the water withdrawn (Government of Canada, 2013b). Hydraulic fracturing, a technology rapidly expanding in Canada to extract unconventional gas, is also a water-intensive industry. Oil sands are also a water-intensive industry, for instance oil sands fresh water use in 2012 was approximately 187 million m³, about 40% of Toronto's annual water consumption (CAPP, 2015). All in all, the importance of well-watered regions has been quite important for the country's economic development, particularly for the energy sector (thermal power plants and hydroelectricity generation - Canada is the second largest hydroelectricity producer in the world after China -), forestry-based industries, the mining industry, the energy sector industry, and the agricultural sector.

4.4 Climate

Canada's most extreme weather events in history have involved winter-related events such as snowstorms, ice storms, blizzards, snowfalls, and other events such as floods, forest fires, hurricanes. Canada has been negatively impacted at times by climate change. For instance, the same as the USA, during the 1930s the Prairie Provinces became a giant dust bowl, with prolonged droughts and high winds carrying away the rich topsoil that had been the source of the high wheat yields. This resulted in smaller crops (lower yields), which gave way to the exodus of thousands of farmers heading east and west in search of work (Green, 2000); such drought in the Prairie occurred again in 1979, 1980, 1984, 1988 and 1989. Other important and expensive events were the 1950 flood in Winnipeg, 1998 ice storm, 1996 Saguenay flood or the 2001-2002 nation-wide droughts (NRCAN, 2014a). Canada's extreme weather conditions in the northern part of the country (freezing temperatures in the Arctic front) make exploration, deposits appraisal and exploitation of discovered deposits much challenging with different challenges (e.g. overcooled engines, ice roads, etc.) for

each stage of the mining cycle. This has driven the industry to become more efficient and effective. Also, climate change is considered a medium to low-level risk in Canada for mining operations requiring engineering and infrastructure upgrades to mitigate risks (Delphi Group, 2014), e.g. warmer conditions might endanger existing ice roads to access the diamond mines.

4.5 Geological Factors

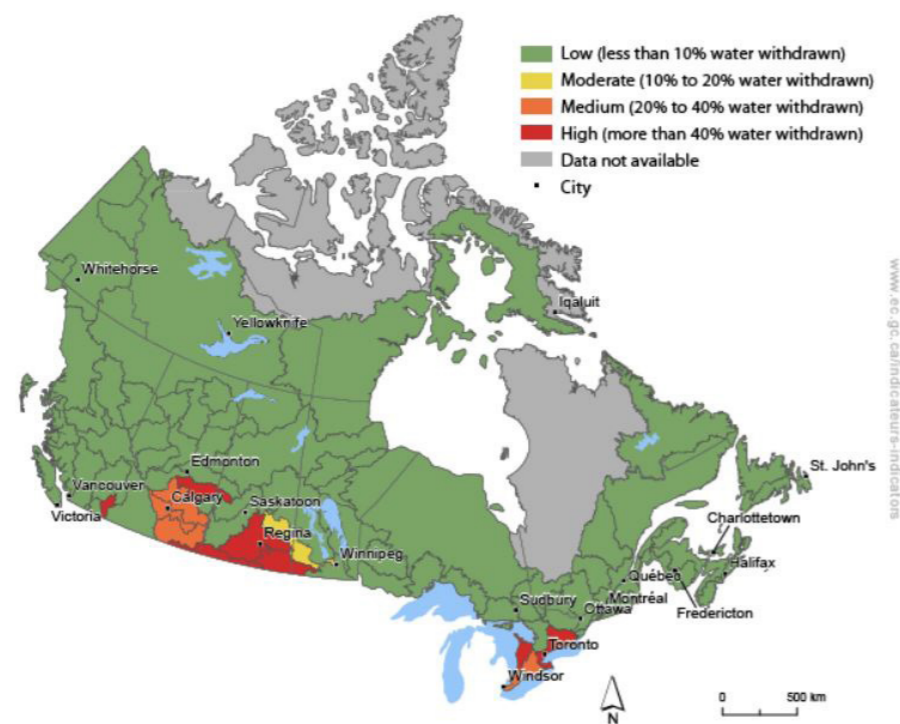
Geologically active volcanoes in Canada are found along the Canadian Cordillera in British Columbia and the Yukon (part of the Pacific Ring of Fire). These volcanoes however are in the remote parts of the country and are comparatively less active than other volcanoes in the Pacific Ocean area. Each year, more than 3,500 mostly small earthquakes are recorded in or near Canada, 50 of which can be felt. Canada has a history of very few destructive earthquakes (largest in 1949 in the Queen Charlotte Islands) (Etkin and Dotto, 2010).

4.6 Ecologically sensitive areas

In Canada environmentally sensitive areas are places that have special environmental attributes worthy of retention or special care. These areas are critical to the maintenance of productive and diverse plant and wildlife populations. Examples include rare ecosystems (such as the Garry oak and associated ecosystems found in southwestern British Columbia), habitats for species at risk (such as sagebrush grasslands), and areas that are easily disturbed by human activities (such as moss-covered rocky outcrops). Some of these environmentally sensitive areas are home to species which are nationally or provincially significant, others are important in a more local context. Some provinces like British Columbia have a sensitive ecosystem inventory in place which identifies and maps at risk and ecologically fragile ecosystems. Some mining projects in the past and in the present (e.g. Ring of Fire chromite deposits in northern Ontario) (Chong, 2014) need to deal with the impacts on ecologically sensitive areas.

Canada's protected areas are also of

Figure 3: Threats to water availability in Canada per sub-drainage area (2009).



Source: E. C. Government of Canada (2013)

importance as they cover (by 2013) 10.4% (1,036,645 km²) of Canada's terrestrial area (land and freshwater), and about 0.9% (51,485 km²) of its marine territory. In the past 20 years, the total area protected has nearly doubled. Around 94%

of the protected areas in Canada are in categories 1 to 4 and that means these are strictly protected and there will be no harvesting, mining or development activities in these areas.

Figure 4: Canada's protected areas (2013).



Source: Government of Canada, (2014).

5. Socio-cultural factors

5.1 Historical Background

Canada's history during the 20th and recent 21st century can be divided broadly into five periods. First, a period of rapid growth from 1896 to 1929 with the development of western settlement, the emergence of wheat as Canada's primary export commodity (staple), and the creation of an integrated national economy (Green, 2000). This period was characterized by Canada's National Policy, introduced in 1879, which remained a government policy for a long time and was important during Canada's economic development process. The policy, understood in a broad sense, aimed to create a strong national economy (market) and consisted of: i) the building of the transcontinental railway (CPR); ii) a strong immigration policy to fill and colonize the West, and to build the railway; and iii) the protection of the infant Canadian (manufacturing) industry via high tariffs. The second period encompasses from 1930 to 1950, a period of disruption including the Great Depressions of the 1930s and the World War II which involved the collapse of international commodity markets. The third period goes from 1950 to 1973, a rapid economic growth period. From 1973 until nowadays economic growth decelerated and went through recessions in 1981/82, 1991 and 2009.

As Canada developed its modern economy, mining indeed played an important role, among other important sectors. It was agriculture, especially wheat, and manufacturing focused on both domestic and USA markets, that led Canadian growth in the early 20th century. During the remaining 20th century mining contributed importantly to economic growth with around 4% and 5% of the GDP. Nowadays the mining industry's goods exports represent around a 20% of Canadian total exports (Marshall, 2014).

5.2 Human geography

5.2.1 Demographics

Aboriginal peoples occupied North America for thousands of years before European explorers first arrived on the shores of the continents in the 11th century and established the short-lived L'Anse aux Meadows colony. In 1500 Europeans returned to establish settlements, and by 1600 the British had established several colonies, which soon established informal trade system with First Nations. Colonies developed during the following centuries occupying more land.

Canada's population had reached 2.4 million in 1851. It doubled 40 years later (1891, 4.8 million), and more than doubled again by 1931 when it reached the 10.4 million. From 1861 until 1891 Canada experienced massive net emigration, with many Canadians moving to the USA in the lack of a defining export commodity in Canada. Canada's historically highest annual average growth rate was in the 1901-1911 decade (rate of 3%), particularly due to a massive immigration peaking in 1913. During the first quarter of the 20th century the population growth rate declined, and considerably resumed growth during WWII and after it due to natural (post-WWII baby boom) and a large inward migratory increase. Annual average growth rates were then between 2% and 2.6%. However, in the subsequent decades, population growth has slowed down with average annual growth rates declining and passing from 1.6% in the 1961-1971 decade to around 1% in the 2001-2011 decade (STATCAN, 2012). In the last decade and a half, most of the growth is attributed to migratory increase. Projections estimate that by 2050 Canada's population (estimated at around 44 million) will have multiplied the current one by 1.2. Population nowadays is around 35 million.

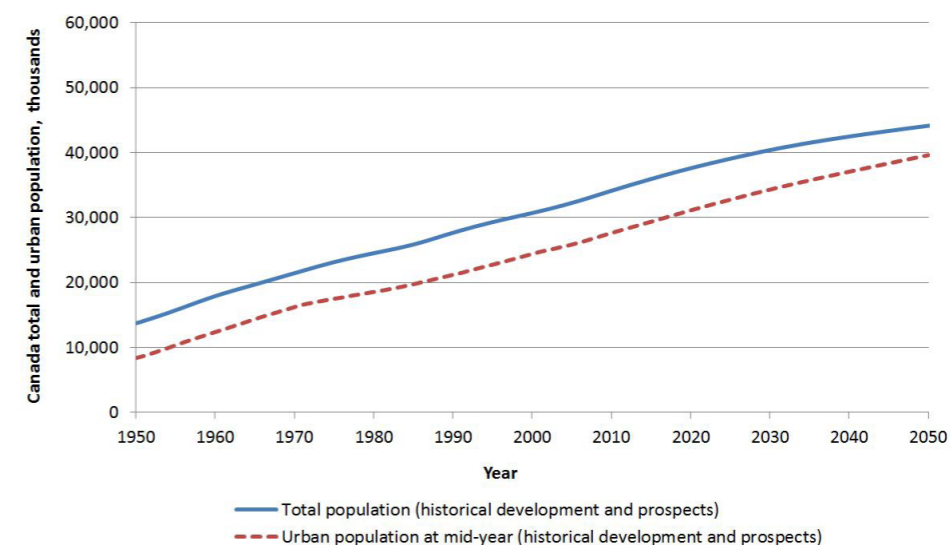
Internal (or inter-provincial) migration has been an important factor in Canada. It was important during the first quarter of

the 20th century as it allowed the rapid process of western settlement and population expansion (particularly for bilingual speakers who were not limited). Inter-provincial migration is currently lower than in the 1970s or 1980s, and it has kept fairly steady around a sizeable 1% of the popu-

lation since the 1990s (Gauthier, 2011).

Canada has had an urban population for long: by 1931 the urban population was a 54% of the total, by 1951 a 62% and by 1971 76%; since then it has increased gradually and nowadays it is around 81%. The majority of the population lives close

Figure 5: Canada's total and urban population (thousands, 1950-2050).



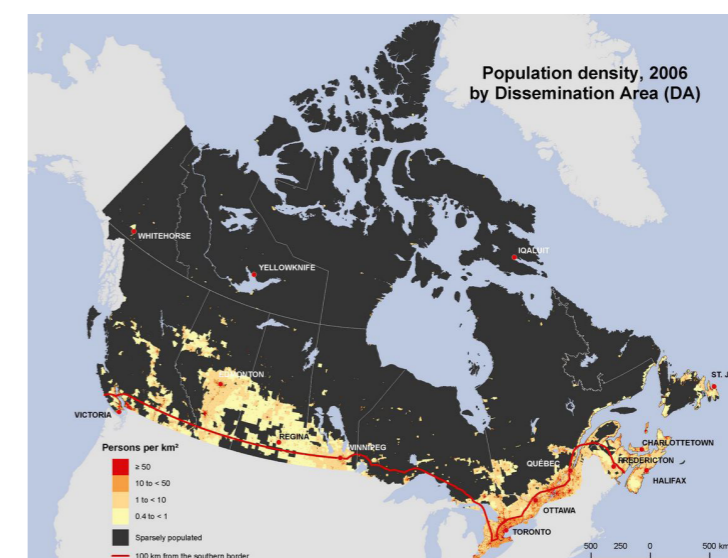
Source: United Nations, (2015a), medium variant for prospects and mid-year estimates for urban

to the border with the USA with the four largest provinces (Quebec, Ontario, British Columbia and Alberta) accounting for 86% of the total population. Although the territories, Northwest Territories, Nuna-

mut and Yukon account for more than one-third of the total area, only 0.3% of the population lives there.

With regards to external immigration policy, Canada remained open to immi-

Figure 6: Canada's population density by dissemination area (2006).



Source: STATCAN, (2006)

gration throughout the 20th century (in contrast to the USA which closed its immigration door in 1924 and only opened it in great extent in the 1990s), except during years of high unemployment and WWII (Green, 2000). During such years, severe restrictions had been placed on the number and composition of immigrants allowed into the country. The whole stance changed in the late 1940s, and the immigration policy addressing Europeans was resumed in response to the need of labour force, and the fact that there was sufficient availability of labour in Europe.

During the 1950s the demand for foreign labour intensified, and only in 1962 did Canada adopt a universal admission policy based on immigrant's skills (employment-based immigration policy) and not country of origin (Green, 2000). Nowadays, Citizenship and Immigration Canada defines economic immigrants as people selected for their skills and ability to contribute to Canada's economy, including skilled workers, business immigrants, provincial and territorial nominees, and live-in caregivers. From 1986, out of the total number of permanent residents in the country, the majority of them formed the "economic immigrants" class, e.g. immigration to staff Alberta's oil sands projects. In 2012 Canada's foreign-born population represented a 19.8% of the total, a high proportion among OECD countries (lower than Australia with 27.3%, but higher than the USA with 13%) (OECD, 2014a).

Canada's acceptance of successive wave of immigrants was beneficial to the growth of the mining industry. In particular after the Second World War large scale immigration of skilled trades people needed by the industry were readily accepted. In some ways as Europe's traditional mining industry declined Canada was a beneficiary of skilled carpenters, machinists, mechanics, and miners willing to relocate to remote northern communities. This also resulted in a strong support for mining investments in these areas. While this has declined in recent years (as mines have increasingly mechanized) many towns still have strong historic ties to the mines that they were built on.

5.2.2 Ethnic composition

Canada is a multicultural society whose ethno-cultural structure has been shaped over time by a mix of Aboriginal peoples' descendants, immigrants and their descendants. Aboriginal peoples have many distinct cultural groups, including 630 communities and approximately 60 different languages. In the 2011 NHS, 1,400,685 people self-identified as Aboriginal (4.3% of the total Canadian population), of which 851,560 reported having First Nations ancestry, while 451,795 reported Métis (collective of cultures mixed between First Nations and European people) and 59,445 reported Inuit (formerly Eskimo) (NCCAH, 2013). The vast majority of the immigrant population lives in the provinces of Ontario, British Columbia, Quebec and Alberta. Seven out of 10 lived in the three largest urban centres: Toronto, Montréal and Vancouver. Historically most immigrants came from Europe (mainly from Britain, Italy, Germany and the Netherlands), but more recently, and similar to for instance Australia, the largest group has come from Asia (Philippines, China) and the Middle East. More than 200 ethnic origins were reported in the 2011 National Household Survey (NHS). In 2011, 57.9% of the population reported one ethnic origin and the rest, 42.1%, reported more than one origin. Currently, the three largest visible minority groups - South Asians, Chinese and Blacks - accounted for 61.3% of the visible minority population in 2011. They were followed by Filipinos, Latin Americans, Arabs, Southeast Asians, West Asians, Koreans and Japanese (Chui, 2013). All ten of Canada's provinces have some form of multiculturalism policy. Six of the ten provinces (British Columbia, Alberta, Saskatchewan, Manitoba, Quebec, and Nova Scotia) have enacted multiculturalism legislation. Some evidence exists that such cultural diversity has yielded economic benefits to Canada (e.g. Sze, 2012).

5.2.3 Languages

Since the enactment of the Official Languages Act (1969), Canada's official languages are English and French and all federal institutions must provide their ser-

vices in either language. These are also the two languages most widely spoken, for work and education, and mother tongues of 56.9% and 21.3% of Canadians respectively (2011). However, Canada's linguistic diversity is illustrated by the fact that more than 200 languages are used as a home language or mother tongue, with a 17.5% of the Canadian population speaking at least two languages at home. Based on data from the 2011 National Household Survey (NHS), 98.7% of workers in Canada reported using English or French at work either most often or on a regular basis. In all provinces outside Quebec, English largely dominates as the language of work, with 98.4% of the population reporting using it in 2011. Of all of the languages other than English or French used at work, the family of Chinese languages ranked first in 2011. The number of responses mentioning the use of a Chinese language on a regular basis at work was around 224,000, or 27.8% of the nearly 807,760 references to a non-official language (STATCAN, 2014a).

5.2.4 Religion

According to the NHS (2011), two-thirds of Canada's population (over 22.1 million people), are affiliated with a Christian religion. Roman Catholics (roughly 12,728,900) are by far the largest Christian group, with adherents to the United Church the second largest group (about 2,007,600). Slightly over 1 million individuals identified themselves as Muslim, representing 3.2% of the nation's total population. Hindus represented 1.5%, Sikhs 1.4%, Buddhists 1.1% and Jewish 1.0%. More than 7.8 million people, nearly one-quarter of the population (23.9%), have no religious affiliation (Chui, 2013).

5.2.5 Cultural Norms, Values & Conflicts

Canada's demographic composition is ethnically heterogeneous, in the sense that its citizens have come from many countries of origin and cultural backgrounds, and multiculturalism best defines Canada's cultural spectrum (minorities are encouraged to maintain their unique cultural backgrounds while sharing in the national character). It has been found

that for Canada, as well as for other countries, cultural factors affect economic growth (and vice versa in a complementary way). Some features of culture have been found to promote economic growth, in particular achievement motivation (Granato et al., 1996).

If examined by the Hofstede's model, Canada has subtle differences between the Anglophone and Francophone Canadians. However, in the overall, Canada ranks low in power distance which means that its culture is marked by interdependence among its inhabitants and a high value on egalitarianism (at work superiors are always accessible, information is shared freely, and straightforward exchange of information is valued). However, Canada scores high on individualism, similar to the USA, which indicates a loosely-knit society in which people look after themselves and their families, in business employees are expected to be self-reliant and pro-active, hiring and promotion are based on merits or evidence. Also, the model evidences a moderate score in masculinity which suggests a moderately competition-driven society (school, work life), i.e. in comparison to the USA the overall cultural tone is more subdued with respect to achievement, success and winning. In terms of long-term orientation, Canada is a normative society in which people have a strong concern with establishing the absolute truth (normative thinking), exhibit great respect for traditions, and has a high score on indulgence which translates into a positive attitude (tendency towards optimism) and a high degree of importance on leisure time (The Hofstede Centre, 2015). The achievement motivation, strong tradition of innovation and competitive culture of Canadians can be observed as important underlying driving factors of the traditional pioneer prospecting and exploration activities in search of a big project which may return millions in profits for investors and the junior exploration company leading exploration drills.

5.2.6 Civil society & environmental awareness

Civil society organisations play an important role in Canada's economy and

communities through their involvement in a range of public benefits. Approximately 175,000 CSOs in Canada provide community and social services; organise cultural, educational and recreational activities; and lobby for social, political and economic change (Embuldeniya, 2001).

Similar to the USA and other countries, the environmental movement rose from the 1960s onwards. During those years the federal Department of Forestry was created in response to growing concerns about the activities of the logging industry, and attention was drawn to other problems such as the pollution of the Great Lakes or the environmental problems associated with large-scale projects in the north part of the country ("opening up of the North"). Also as a response to environmental issues the federal government was reorganized with the creation of new ministries include Energy, Mines and Resources (1966), Indian Affairs (nowadays Aboriginal Affairs) and Northern Development (1966), among others, and the Department of the Environment (1971) as the central environmental ministry. Also the rights of native's people became matters of national and international concerns, particularly associated with two distinct projects: the James Bay Development in northern Quebec (launched without any consideration of its impacts on the local population of Cree First Nations) and the Mackenzie Valley pipeline (Tanner, 1997). Ever since, lands claims and self-government are recurring topics in the cooperation efforts between the Government of Canada and First Nations. Rights pertaining to land and self-government are recognised under Section 35 of the Constitution Act (1982) so-called 'Treaty Indians' have land rights recognised in existing historical treaties. The Constitution Act also recognises that Aboriginal people have an inherent right to self-government, a right to manage their own affairs. Under federal policy, Inuit and First Nation groups may negotiate self-government arrangements for different things such as government structure, land management, health care, child welfare, education, housing and economic development. Conflicts between mining companies, Aboriginal communities, private

landowners and other stakeholders are ongoing (Christmas, 2014; Halley, 2013), a fact that, to a certain extent, undermines Canada's reputation for low-risk resource developments.

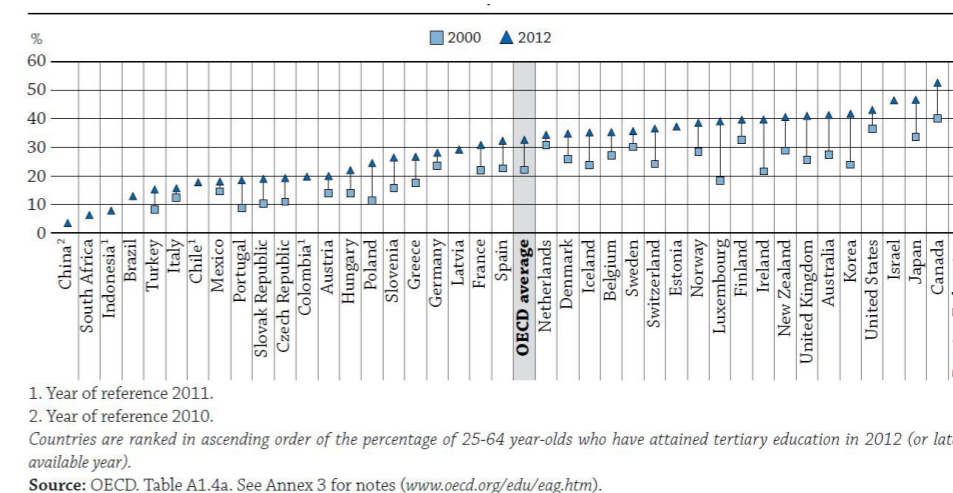
Canada's active civil society, inclusive of the First Nations, may represent an impediment to mining investments, e.g. in the access to land, if the perception of few or no benefits, or actually only detrimental effects, are expected out of a mining investment. In Canada in the last twenty years or so uncertainty over whether or not mineral development would be welcomed in a particular area has been a key factor with many projects proceeding to very advanced stages only to be faced with numerous legal and regulatory challenges related to conflicts over land use goals. It is not an easy issue to resolve, especially as at the green fields exploration stage when sub surface mineral tenure is initially acquired over a larger area with no clear idea of where a mineral deposit may ultimately be discovered. Dealing with this issue requires ongoing outreach by government (which may issue the mineral tenure and control the land use management regime) and industry (which conducts the activities on the ground) with local communities and governments to ensure they understand at all stages the nature of the work and possible outcomes. Lack of information can lead to over optimism as communities anticipate the benefits of a mine that is never found or negative blow back as people anticipate the impacts of a mine that may never materialise.

5.3 Education

5.3.1 Education system

The Canadian education system covers elementary, secondary (high-school) and post-secondary education (Career College or vocational school, community college, university and grad school). Education in Canada usually starts with kindergarten followed by grades 1 to 12 (K-12 education encompassing elementary and secondary education). By law, children must go to school starting at the age of 5 or 6 and until they are between 16 and 18, depending on the province or ter-

Figure 7: Percentage of tertiary-educated adults in 2000 and 2012 (25-year olds).



Source: OECD, (2014b). Statlink: <http://dx.doi.org/10.1787/888933114951>

ritory. Since Canada is a bilingual country, English-language and French-language schools are available. Public education is provided free to all Canadians who meet various age and residence requirements. Postsecondary education is available in both government-supported and private institutions, which offer degrees, diplomas, certificates, and attestations depending on the nature of the institution and the length of the programme.

In Canada, education is governed by each provincial and territorial government. In the 13 jurisdictions (10 provinces and 3 territories) education is almost entirely decentralised: departments or ministries of education are responsible for the organisation, delivery, and assessment of education at the elementary and secondary levels, curriculum standards, education financing, teacher education, assessment, and other related issues for technical and vocational education, and for postsecondary education (Van Pelt and Emes, 2015).

Canada has a highly educated population, due in large part to high attainment rates at the college level. In 2012, 53% of Canadian adults held a tertiary qualification, the highest share among OECD countries (OECD average: 32%), and on an upward trend if compared to the 42% achieved in 2011.

This nation-wide increase was also mirrored in the provinces (CESC, 2014). The percentage of adults who had attained

at least upper secondary education (for 25-64 age group, 2012) was 89%, at the same level that the USA, and much higher than Australia (76%), or the OECD average (75%) (OECD, 2014b, Table A1.2a). If the percentage of adults who have attained tertiary education is considered (25-64 age group, 2012) Canada boasts the largest in the OECD with 53%, much higher than Japan's (47%), Australia's (41%), or the USA (43%) (average OECD: 32%) (OECD, 2014b, Table A1.3a). In Canada, education is seen as the most desirable route to earning a decent living and to enhancing personal growth. Educated people not only earn higher incomes but also contribute disproportionately to business innovation, productivity, and national economic performance. It is believed that there is a strong and direct relationship between investments in education, educational attainment, and economic growth (Conference Board of Canada, 2015a).

Public spending on education in Canada is close to the OECD average, with a relatively high share of private funding and around 40% of the spending allocated to the tertiary sector. The quality of the education is also good, as evidenced for instance by the last results of the 2012 PISA examination in which Canadian 15-year-old students scored very high with only five countries in the world (among them China, Korea and Japan) surpassing Canada's average score. However,

within Canada there exist marked variations between provinces, with students in Quebec performing above the Canadian average and the Prince Edward Island performing below the OECD average (Brochu et al., 2013).

Although Canada and the OECD averages reveal similar relative differences between starting salaries and those at the top (ratios of 1.6 for Canada and the OECD at each level of education taught), Canada's teachers reached the top of their salary scales much sooner than their OECD counterparts (CESC, 2014). As in other OECD countries, highly skilled workers are rewarded in the labour market, i.e. employment prospects increase with educational attainment. The role of education as a cause and a consequence of economic growth has been researched and acknowledged. Thus, it has been determined that educational attainment but also, importantly, the cognitive skills of the population, greatly contribute and are related to the quality of the labour force, earning capacity (individual and national), productivity, distribution of income and economic growth (Firestone, 1967; Hanushek and Wößmann, 2007).

5.3.2 Education infrastructure

5.3.2.1 Basic education

In Canada there are approximately 15,500 schools, of which 10,100 are elementary, 3,400 are secondary, 2,000 & mixed elementary and secondary, with an overall average of 343 students per school (considering 5,315,686 students enrolled in public and other elementary and secondary schools, 2010/2011) (STATCAN, 2013a).

5.3.2.2 Higher education

Canada has 163 recognised public and private universities (including theological schools) and 183 recognised public colleges and institutes, including those granting applied and bachelor's degrees. In addition to the recognised institutions, there are 68 university-level institutions and 51 college-level ones operating as authorised institutions, at which only selected programmes are approved under provincially established quality assurance

programmes. Tuition costs at universities averaged (Canadian dollars) \$ 4,524 in 2007–08, with international student fees for an undergraduate programme averaging about \$ 14,000 annually. Education is also funded through the money that governments transfer to individual students through loans, grants, and education tax credits. All across Canada there exists a number of post-secondary institutions offering a full range of mining-related education and training spanning from geology, environmental sciences, and geomatics engineering to mining technology and engineering, metallurgical engineering. For instance, mining engineering programmes are available at the Universities of British Columbia, Saint Mary's University, University of Alberta, Queen's University, and McGill University.

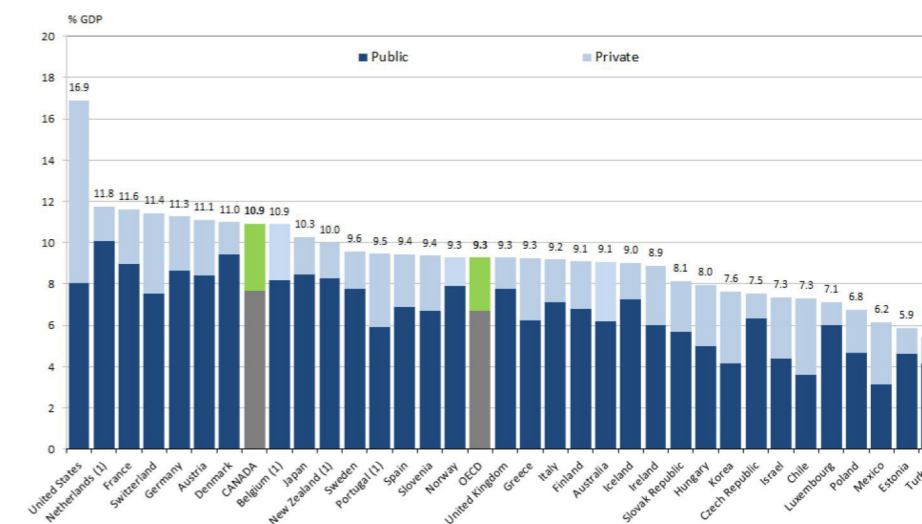
5.4 Health

5.4.1 Health system

After the enactment of the Canada Health Act (1984), Canada has had a working universal health care system called "Medicare", which guarantees that all Canadian citizens and permanent residents may apply for public health insurance. The governance, organisation and delivery of health services is highly decentralised, with the provinces and territories responsible for administering Medicare and planning health services. However, government health insurance plans give you access to basic medical services, but some supplementary services need to be paid privately, such as prescription medications, dental care, physiotherapy, among others, which may be covered by employers to a certain degree. Presently, about two-thirds of Canadians take out private, supplemental insurance policies (or have an employer-sponsored plan) to cover such supplementary services. Thus, Canada's expenditure is 70% public (derived from general tax revenues of the federal, provincial and territorial governments) and 30% private, similar to OECD average levels (73% and 27%).

After a period of spending restraint in the early to mid-1990s, government expenditures on health have grown rapidly, a rate of growth exceeded only by

Figure 8: Health expenditure (public and private) as a share of GDP (2012).



Source: OECD, (2014c)

private health expenditure. Most public revenues for health are used to provide universal Medicare and to subsidize the costs of outpatient prescription drugs and long-term care. Canadian health expenditure is nowadays mostly destined to hospitals (30%), drugs (16%) and physician services (15%). Canada's public expenditure as a share of GDP (10.9%, 2012) is on the slightly higher end of OECD countries. On a per capita expenditure, Canada is above Australia but below the USA.

Canada's population is generally healthy (STATCAN, 2013b). It has large variations in health care use across provinces and territories, for instance in MRI and CT exams or in knee replacement indicators (OECD, 2014d). First Nations people and Inuit face some serious health-related challenges, such as high rates of chronic and contagious diseases (heart disease, type 2 diabetes, tuberculosis) and shorter life expectancy. Life expectancy in Canada has continued to increase since 1980, especially for males, ranks 15th in the world (CIA, 2015b), and is relatively high compared with most OECD countries (Marchildon, 2013). However, infant mortality and maternal mortality rates tend to be worse than those in the USA, Australia, France and (especially) Sweden (CIA, 2015c). The two main causes of death in Canada are cancer (malignant neoplasms) and cardiovascular disease, both of which have occupied the top

positions since 2000 (Marchildon, 2013). The population is aging and obesity is a contributing factor to many chronic conditions. For the period 2000 to 2011, the age-standardized mortality rate for all causes combined declined 20.6%, from 615.5 deaths per 100,000 populations to 489. The largest reductions occurred from 2005 to 2006 mainly because of the substantial reduction in the rates for heart disease and, to a lesser extent, because of the decline in the rates for stroke and cancer (STATCAN, 2014b).

5.4.2 Health infrastructure

On an international basis, Canada's health infrastructure ranks below OECD average and relatively high in the world. Although improving between 2000 and 2012, in terms of numbers of doctors and beds (per 1000 population) Canada ranks quite low in the OECD, in position 27th and 30th respectively. Considering number of nurses, it ranks medium in the OECD (OECD, 2014c). Canada ranks 16th in the world, below Japan (15th) but above Australia (21st) under the indicator "Health infrastructure (2014)" which measures if the health infrastructure meets the needs of the society (Institute for Management Development, 2014). Total health expenditure accounted for 10.9% of GDP in 2012, slightly higher than the OECD average (9.7% in 2012) (OECD, 2014c).

6. Economic factors

6.1 Economic Geography

6.1.1 Economic structure

Canada's economic structure has shifted during history in the transition towards a services economy. Canada's economy had been growing based on timber exports, some minerals and wheat during the 19th and early decades of the 20th century, until a major inflection point took place in the period 1930-1950. During these two decades Canada underwent structural changes in the economy, to a large extent related to Canada's role in WWII as a supplier of military goods to Britain. In these years the share of agriculture fell from 20% of total output to 10% by early 1930s, i.e. the Depression ended the dominant role played by the wheat industry since the opening of the west for settlement (Green, 2000).

Another important change took place since the 1970s as this decade marked a change in the orientation of the economy from one influenced by growth in the resource sector to an economy where the service sector played a more dominant role and where the influence of the government became more pervasive. In 1900, 55% of total Gross National Product (GNP) was generated in the commodity-producing sector, by 1990 its share had fallen to 25%. The share of services increased only slightly after 1960, but its big increase occurred during the 1980s when its share increased from 69% to 75%. Main reasons behind the growth in the service sector are health (in the 1960s introduction of the universal health care assistance) and education expenditures. By the end of the 20th century Canada had shifted to an industrial-urban base (Green, 2000).

Nowadays, the Canadian economy is dominated by the services industry, which makes up 72% of Gross Domestic Product (GDP) and employs 78% of Canada's workforce. The services sector includes accommodation, business, cultural, education, financial, food, health care, infor-

mation, professional, retail, transportation, wholesale and a range of other services. The sub-sectors that contribute the most to GDP include finance, insurance and real estate services (29% of total services), health care and social assistance (9.3%), retail trade (8.6%), public administration (8.2%) and wholesale trade (8%). Manufacturing also makes up a sizable portion of the Canadian economy, representing 13% of GDP and employing just over 10% of the workforce. This sector includes the production of food and clothes, as well as everything from machinery and electronics to transport equipment. Canada also has a robust natural resources sector, which includes mining, forestry, agriculture, fisheries, oil and gas and makes up roughly 7% of GDP and employs close to 4% of Canadians (Government of Canada, 2013c). The services and manufacturing sectors are inextricably linked to the natural resources sector. The latter relies on a range of goods and services such as financial, business, transportation and wholesaling services, as well as machinery and chemical products (Government of Canada, 2013c).

The Toronto Stock Exchange (TSX) is the dominant financial market for global mining, and a leader in global mining equity financings in comparison to other stock exchanges around the world. The TSX is the 7th largest stock exchange in the world by market capitalization, the 3rd largest financial centre in North America (after New York and Chicago), and is the main exchange venue for Canada's capital markets (banks, insurance companies, pension funds). The Toronto Stock Exchange (TSX) and TSX Venture Exchange were home to 57% of the world's publicly-listed mining companies and traded more than \$ 200 billion of mining stock in 2013. Together, the two exchanges handled 48% of global mining equity transactions in 2013, and accounted for 46% of global mining equity capital that year (Marshall, 2014), and are the most important markets for junior mining companies.

Lately, there have also been an increasing number of junior issuers listing on the recently rebranded Canadian Securities Exchange (CSE). TSX features a high concentration of precious metal companies especially gold, as well as uranium and potash miner. The Canadian market is characterised by a high concentration of small capital companies and an investor community willing to evaluate exploration assets, including many international projects. Canada is also a world-leader in raising equity for mineral exploration and development. In 2011, almost 40% of the world's equity financing for mineral exploration and mining was raised by companies listed on Canadian stock exchanges (NRCAN, 2013).

Each of Canada's 13 provinces and territories has its own securities commission or equivalent authority which oversees the regulation of securities - the largest being the Ontario Securities Commission- and its own set of laws, regulations, rules and policies. However, provincial and territorial regulators work closely to coordinate capital markets through the Canadian Securities Administrators, and there exists a mandatory national mineral reporting standard for companies in the mining sector, the National Instrument 43-101.

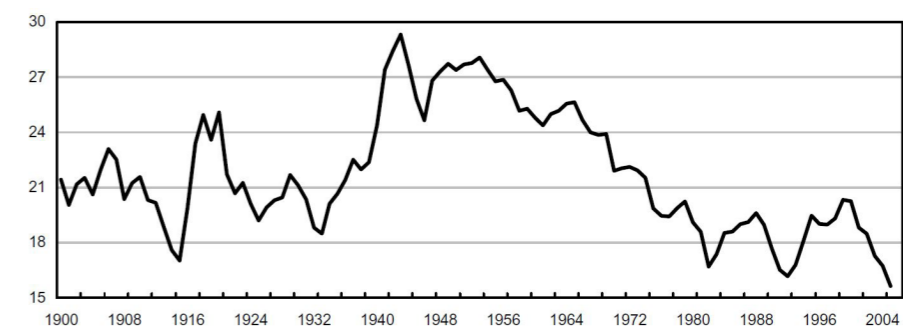
The cities of Toronto and Vancouver are global mining centres with outstanding expertise and depth of experience (KPMG, 2014). Vancouver features the world's leading cluster of exploration companies, while Montreal is home to major aluminium and iron ore firms. Edmonton (Alberta's capital) has become a global centre for oil sands expertise and Saskatoon for uranium and potash

(Marshall, 2014). Toronto hosts the PDAC Convention which is the largest in the exploration industry. Calgary houses the nation's energy cluster and it is a large centre for capital-raising activities for investment in mining activities outside Canada. Sudbury (home of former Inco Ltd, now part of Vale, and of Falconbridge, nowadays merged within Glencore) is another traditional centre of mining expertise and a cluster of mining innovation (e.g. see the Centre for Excellence in Mining Innovation -CEMI or the Northern Centre for Advanced Technology - NOR-CAT). Sudbury's emerging mining supply and technology cluster is the "mining superstore" of Ontario, with potential to become a global leader (The Canadian Chamber of Commerce, 2013).

6.1.2 Industrial Geography

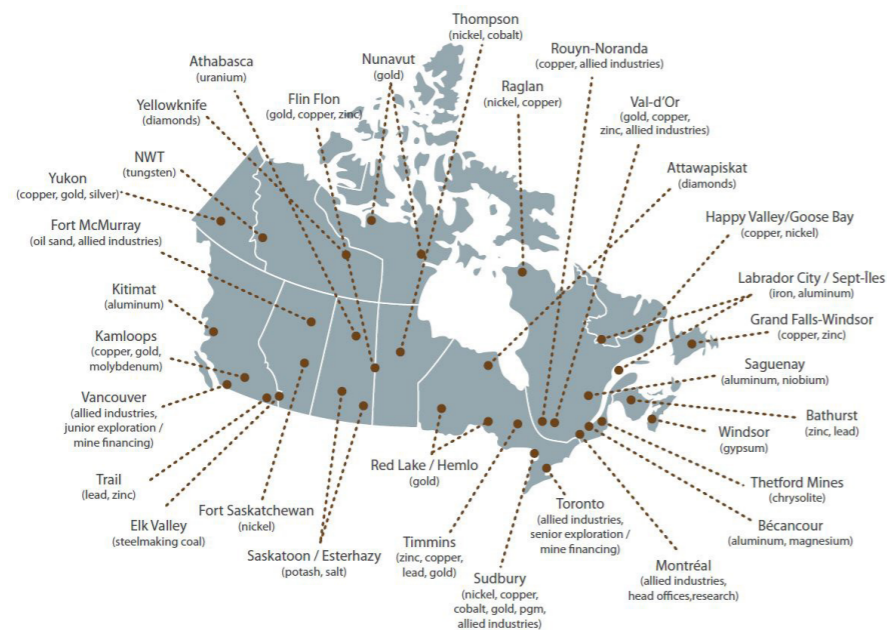
During the long period of western settlement (1870-1929) manufacturing growth in Canada approximated that of agriculture. In 1951 the share of manufacturing output was 73.3%, and that of agriculture 26.7%. By 1961 manufacturing's share had increased to 84.9% and by 1991 to 89.2% (Green, 2000). The WWII had a significant effect on boosting manufacturing in Canada when the country was called upon to provide a wide range of sophisticated war equipment, from tanks and armoured vehicles to airplanes and ships. This left a legacy of advanced manufacturing techniques and management organisation that served as a base for the development of a manufacturing sector in the ensuing decades (Green, 2000). The manufacturing industry has been concentrated in Ontario and Quebec.

Figure 9: Manufacturing's share of nominal GDP (percent, 1900-2005).



Source: Baldwin and Macdonald (2009)

Figure 10: Canadian mining clusters.



Source: Marshall (2014)

Canada's largest manufacturing industry is transportation equipment (followed by chemical, food and beverage), and automobiles assembly and automobile parts play a major role. By the early 1960s the Canadian automotive industry was in decline, but as a result of the Auto Pact with the USA in 1965, the industry re-balanced the trade. The Auto Pact reoriented export flows toward manufactured products and strengthened Canada's manufacturing base. However, Canada continued to import large quantities of vehicles; only in the 1980s did the trade balance on motor vehicles and parts become positive (Baldwin and Macdonald, 2012a). Nowadays, Canada is the 9th largest vehicle producer in the world. The auto sector is Canada's second biggest contributor to manufacturing Gross Domestic Product (GDP) and its largest manufacturing employer. The industry directly supports over 550,000 jobs in 11 light duty and 3 heavy-duty assembly plants, over 540 Original Equipment (OEM) parts manufacturers, 3,949 dealerships and many other directly related industries. This industry has changed its location more recently towards a concentration of plants between Windsor and Toronto.

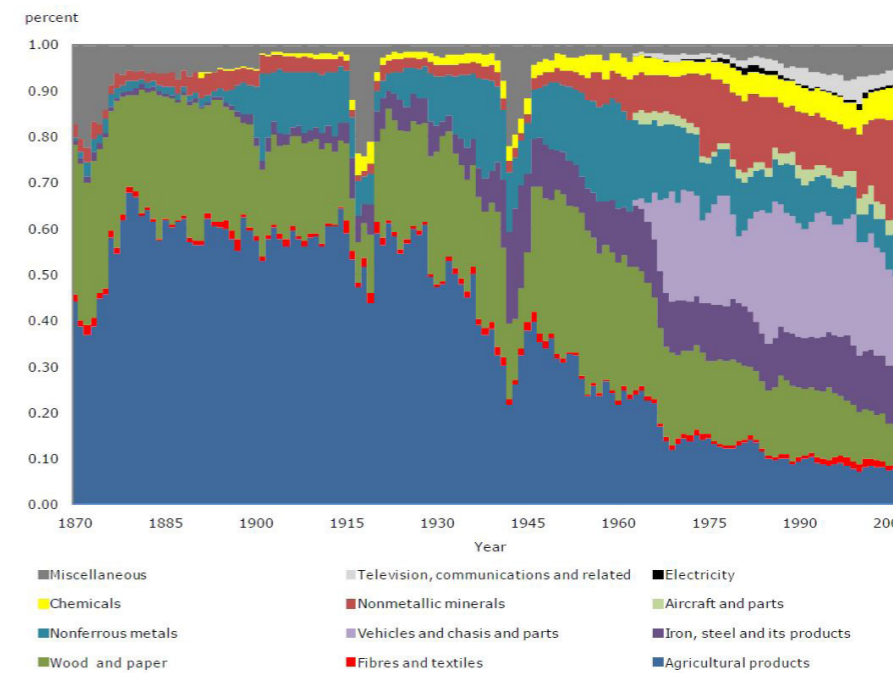
The share of the value of GDP accounted by manufacturing has been

declining since 1961. This is explained mainly due to relative prices decline (prices increase but to a lower rate than other economic sectors like service and goods) and not relative volume declines (the volume of manufacturing output is essentially unchanged since 1961). However, looking at long-and short-term influences on manufacturing, the picture that emerges is not one of large-scale deindustrialization in Canada (Baldwin and Macdonald, 2009). In the years since the technology bubble burst in 2001, manufacturing growth averaged 0.4% per annum between 2002 and 2007.

With regards to the mining industry, in 2010 the country had a total of 968 mining establishments, with 71 metal mines and 897 non-metal mines. Canada has the world's second-largest mining supply sector after the USA, with 3,215 mining suppliers (KPMG, 2014). The extraction and processing of minerals is an important part of Canada's industrial sector, jobs and government revenue. Canada's mining industry is a global leader in exploration, mine development and operation, and financing (The Canadian Chamber of Commerce, 2013).

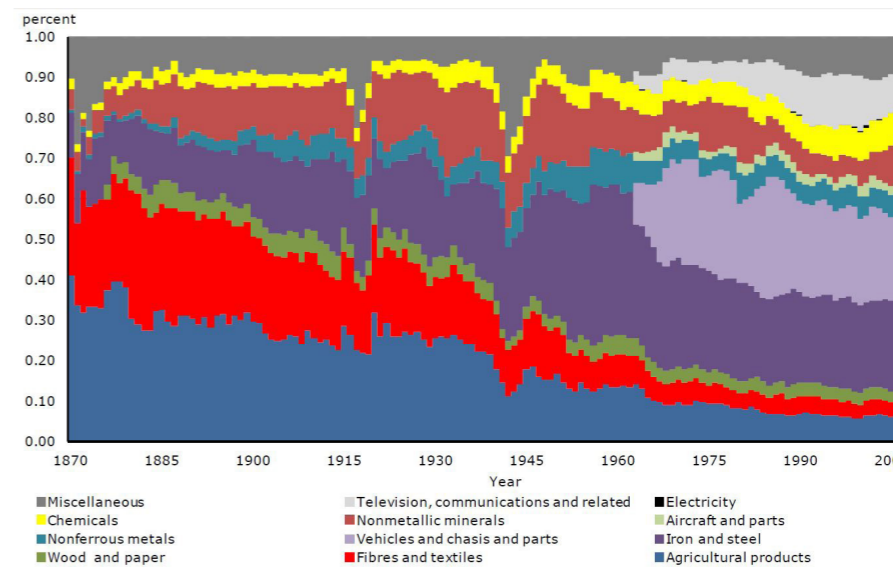
Canada has obtained a clear advantage in the mining sectors of exploration and finance. Canada has been particu-

Figure 11: Share of exports in Canada, 1870-2010.



Source: Baldwin and Macdonald, (2012a)

Figure 12: Share of imports in Canada, 1870-2010.

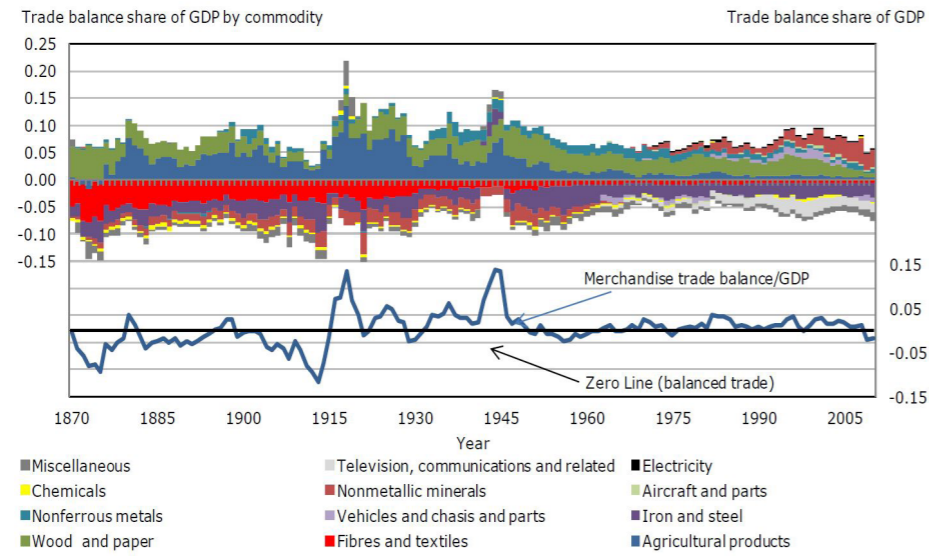


Source: Baldwin and Macdonald, (2012a)

larly successful in fostering the development of junior mining firms that focus on exploration, and this contingent of junior firms (based in Toronto or Vancouver) has created a number of key advantages for the Canadian mining sector as a whole. Calgary is also of importance with a highly skilled talent pool and a strong capital market, extensive networks

of tax treaties and investment protection agreements, especially for investment in mining activities outside Canada (KPMG, 2012). The mining industry is represented at the provincial, territorial, and federal levels by a number of organisations such as: Alberta Chamber of Resources, Association of Mining Exploration of Québec (AEMQ), Canadian Aboriginal Minerals

Figure 13: Canada's balance of trade (1870-2010).



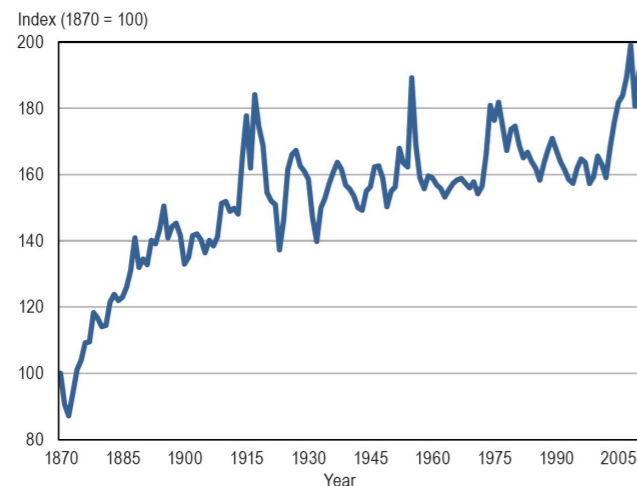
Source: Baldwin and Macdonald, (2012a)

Association, Canadian Association for Mining Equipment and Services for Export (CAMESE), Canadian Council of Professional Geoscientists, Canadian Diamond Drilling Association, Canadian Institute of Mining, Metallurgy and Petroleum, Canadian Mining Industry Research Organisation, Coal Association of Canada, Mining Associations in British Columbia and Nova Scotia, the Mining Association of Canada (MAC), Northern Prospectors Association, NWT & Nunavut Chamber of Mines, Ontario Mining Association, Prospectors and Developers Association of Canada (PDAC), among others.

6.1.3 Commercial Geography

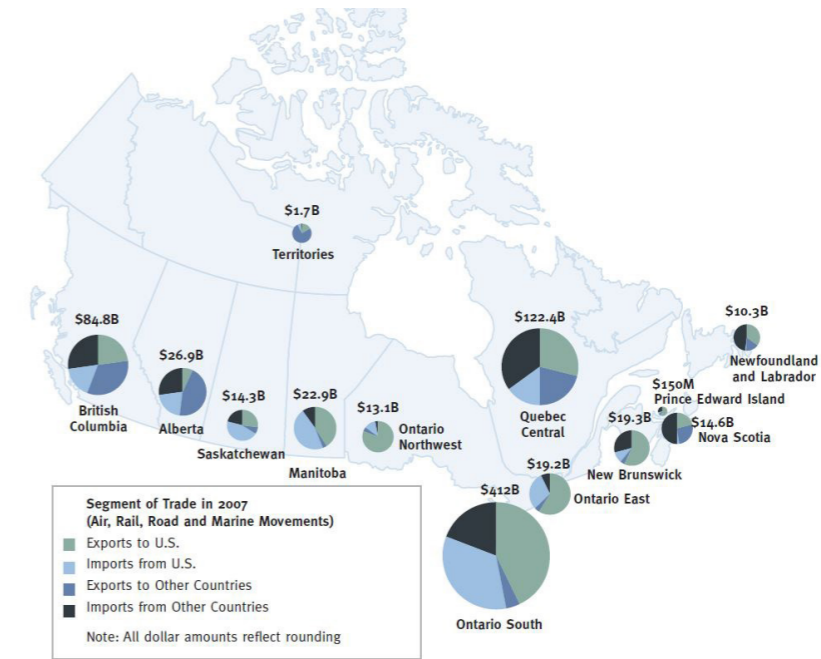
International trade makes up a large part of the Canadian economy. Exports amount to more than 45% of its GDP. The USA is by far its largest trading partner, accounting for about 76% of exports and 52% of imports as of 2013 (Cameron and Vesselovsky, 2014). Natural resources have played an important role in Canadian export balances since Confederation. While their importance has fallen over time, it remained dominant until 1960, when agriculture, forestry, non-ferrous metals and non-metallic minerals accounted for over 80% of all exports. Only

Figure 14: Canada's terms of trade (1870-2010).



Source: Baldwin and Macdonald, (2012b)

Figure 15: Geographic concentration of Canadian trade by value and entry and exit points via air, rail, road and marine modes (billions, \$, 2007).



Source: Government of Canada (2009)

after the Auto Pact (1965) and the North American Free Trade Agreement (NAFTA) - with the growth in exports of iron and steel, autos and auto parts and aircraft - did the resource share fall to its lowest point on record, 36% in 1999. The mining boom during the 2000s reversed this long decline, raising the share of natural resources in exports to 53% in 2010 (Baldwin and Macdonald, 2012a). In 2009, agricultural, energy, forestry and mining exports accounted for about 58% of Canada's total exports.

Imports have predominantly involved agricultural products, fibres and textiles, iron and steel (particularly after 1960), non-ferrous metals, non-metallic minerals, television, communications and related. The decline in agricultural products from the 1960s is explained by the increase in the imports of motor vehicles and parts. Canada has generally relied on natural resources to pay for investment and consumer goods from Confederation to the present. The balances for agriculture, wood and paper products, non-ferrous metals and, more recently, non-metallic minerals have been positive. The net balances for fibres and textiles, iron, steel and miscellaneous products (which include television, communications and

related products, electricity products) have been negative (Baldwin and Macdonald, 2012a).

Canada's balance of trade (depicted by the dark line in **Figure 13**) was largely negative until 1915, then became generally positive after the 1920s, until the 1950s when it fluctuated around the balance, until more recently. The balance of trade has largely run into deficits after the global financial crisis in 2008. So has the balance of payments. The balance of trade has been rising at times due to the trade surpluses in the energy sector but remains largely negative (reached a record high of \$ 3 billion in March 2015, i.e. around a minus 0.16% of the GDP).

An important benefit of Canada's resource-exporting economy was a general long-run upward trend towards increasing terms of trade.

As shown in **Figure 14**, from 1961, the terms of trade have cycled with resources prices. While peaks in the terms of trade are followed by pullbacks, there has been a steady increase in the overall terms of trade through time. As of 2010, the terms of trade in Canada had increased by 91% since 1870 (Baldwin and Macdonald, 2012b). The USA-Canada border is the longest in the world and both countries

share the world's largest and most comprehensive trading relationship, e.g. it is estimated that \$1.9 billion in goods and 300,000 people cross the border every day (Zuckerman et al., 2013).

6.1.4 Agricultural Geography

The agricultural sector (and currently also involving the agri-food system) has diminished its role in the economic structure of Canada. In the early development of the country, after Confederation and until the Great Depression, the sector was quite important. The wheat boom on the Canadian prairies in the west developed between 1896 and 1910. Wheat production grew 714% from 1880 to 1920. The boom was enabled due to rising wheat prices, falling water and land transportation costs, key innovations such as dry farming (summer fallowing), and an earlier maturing and hardier wheat cultivar (Ref Fife), and the closing of the American frontier which led many migrants towards Canada's "Last Best Frontier". By 1929 the share of agricultural products in the exports was 47%. However, after the 1930s with the climate crisis in the Prairies, the sector declined and by 1939 exports represented less than 20% of total exports, with wood products and minerals accounting for over 50% (Green, 2000).

Through the second half of the 20th century crop yields in Canada increased steadily from the lows of the 1930s, spurred on by research and development (R&D) improvements in seed varieties, fertilizers, pesticides and herbicides as well as farm equipment. Thus, R&D in agricultural mar-

kets has been instrumental in improving the volume and diversity of produced and exported agricultural commodities. The 1960s and 1970s saw expansions of Canada's agricultural export markets, as the USSR and China became important destinations for Canadian grains. Wheat and barley continue to be Canada's major grain commodities (Baldwin and Macdonald, 2012a).

6.2 Key Economic Figures

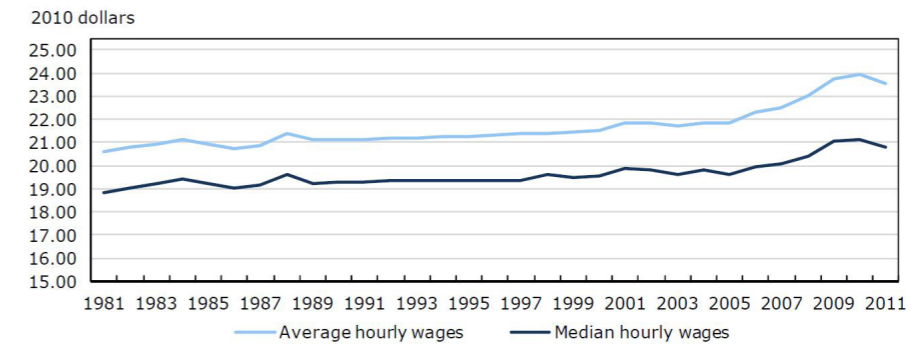
6.2.1 Economic diversity

Canada is unusual among developed countries in the importance of the primary sector, with the logging and oil industries being two of Canada's most important. Canada also has a sizable manufacturing sector, based in Central Canada, with the automobile industry and aircraft industry being especially important. Canada's economy managed to diversify greatly during the second half of the 20th century but in the last decades it has shown a return to a less diversified one by the increase of the primary sector. Investments are flowing toward the natural resources sector instead of the housing or the automobile industry (Mendleson, 2012).

6.2.2 Economic output

Canada is the 16th largest economy in the world (measured by GDP purchasing power parity) (CIA, 2015d) and ranks 29th if GDP is measured on a per capita level (CIA, 2015e). Canada's economic growth was relatively low during the last three de-

Figure 17: Real hourly wages of full-time workers aged 17 to 64 (1981-2010).



Source: Morissette et al., (2013)

cadecades of the 19th century (averaging 3%), but it was boosted at the turn of the 20th century by the emergence of wheat as a leading export ("wheat boom" period in the west, 1891-1913).

The main driving force of growth during the period 1906 to 1912 (the "wheat boom" years) was a high level of investment activity in housing and construction, manufacturing and railways during the years of rapid settlement (and immigration) to the west. The boom continued with interruptions until the 1930s when growth was slowed down considerably, with growth resuming in the beginning of the 1940s, and Canada entering a period of sustained high growth rates until the 1970s (total and per capita, low average unemployment, moderate price increases). The period after the 1970s saw slower overall growth, higher levels of unemployment, and periods of rapid growth in prices, with recessions in 1982,

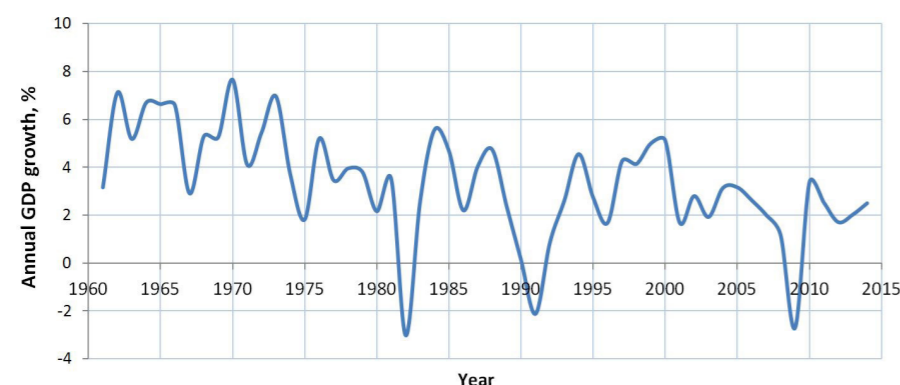
1991 and 2009. Canada's GDP annual growth has averaged 3.3% in the period 1961-2014.

6.2.3 Labour costs, mobility & employment

Real average hourly wages in Canada remained stable during the 1980s and 1990s, and have only grown slightly from 2001 onwards, and most of this growth can be attributed to workers on the higher end of the wage scale. The wages of those workers outside the top 50% of the income scale have been flat or falling all along. Average median wages for workers have not kept up with inflation since at least 2008.

The OECD has indicated that lagging productivity is one of Canada's most significant economic hurdles. Specifically, a recent study explains that Canada's multifactor productivity (MFP) has been

Figure 16: Canada's annual GDP growth rate (percent, 1961-2013).



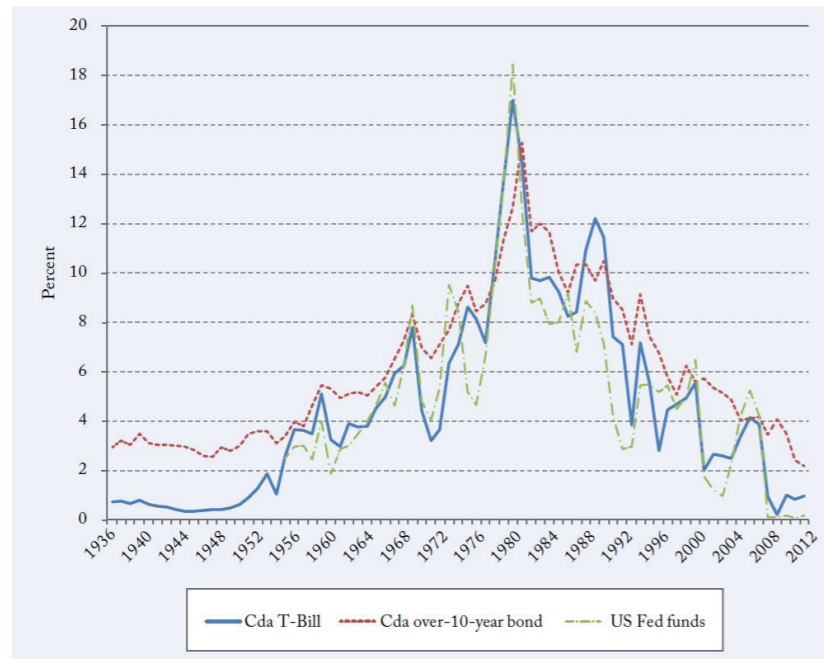
Source: United Nations, (2015b) based on World Bank indicators

Figure 18: Canada's unemployment rate (percent, 1966-2015).



Source: Trading Economics, (2015a)

Figure 19: Canada and USA's interest rates (1936-2012).



Source: Masson (2013)

stagnant for decades, and has been declining since 2002. Since 1980, the United States has improved its MFP by 40%, while Canada's has decreased by 4% (Marshall, 2014).

Unemployment in Canada was very high during the Great Depression, passing from 4% in 1929 to 13% in 1930, and doubling by 1932 to 25%, with a higher incidence in agriculture, forestry and mining than in other branches such as food processing or textiles. WWII brought the prolonged period of high unemployment to an end (e.g. also by drawing women into the workforce). Unemployment rose again to high levels reaching again 13% in 1982 and 12% in 1993. Since then it has remained lower, fluctuating between 8% and 6%. Forest industry direct employment in Canada has been falling in the last decade, from around 350,000 in 2003 to nowadays slightly over 216,000 people (indirectly 321,000), i.e. around 1.1% of the Canadian labour force (Madore and Bourdages, 1992; NRCAN, 2014b).

The natural resources sector (forestry, mining, energy) is a leading employer for Aboriginal people. It employs about 30,000 Aboriginal people, representing 7% of all Aboriginal people employment (NRCAN, 2015b). The mining industry itself

is, proportionally, the largest private sector employer of Aboriginal peoples in Canada (around 10,300 people in 2012) and employment is poised to increase (Marshall, 2014).

The mining industry employs more than 380,000 workers across the country in mineral extraction, smelting, fabrication and manufacturing. Beyond contributions to governments, the average annual pay for a mining worker in 2013 exceeded \$110,000, which surpassed the average annual earnings of workers in forestry, manufacturing, finance and construction by a range of \$31,000 to \$46,000 (Marshall, 2014). For more than a decade, the Canadian mining sector has been involved in a skills shortage process with fierce competition from companies in other countries recruiting Canadian graduates and workers. Already by the end of the 1990s the industry had voiced concerns and dissatisfaction with some aspects of training and shortage of certain categories (such as tool and die makers and computer aided-design), and many firms recognised they had an ageing workforce without concrete plans of how to overcome it and facing a lack of locally available training and apprenticeship programmes. Concern was also around

the image of the jobs in the sector as the prestige of blue-collar jobs had declined despite good employment and salary prospects (Minister of Public Works and Government Services Canada, 1998). More recently, estimates argue that the Canadian mining industry will need to hire 121,000 new workers over the next decade to 2024. This number represents more than half of the current workforce and stems from the need to replace retirees and fill new positions to meet baseline production targets. In Canada, the mining industry comprises 66 core mining occupations, and needs new workers for all of them. Among those required are geoscientists, metallurgists, mining engineers and geologists, as well as workers skilled in computer technology, information management, mechanical repair, heavy equipment operation and other areas. Because today's mining industry relies on advanced technologies, much of the demand is for highly educated and skilled workers (Marshall, 2014). The industry, educational institutions and governments are coordinating efforts to address this challenge in a number of ways (e.g. Canada Job Grant Programme by the federal government, the introduction of a Federal Skilled Worker category to recruit trained workers from abroad, etc.) but it is not yet clear whether efforts will successfully bridge the increasing shortage.

6.2.4 Interest rates

The Bank of Canada was created in 1935, is the sole issuer of legal tender, and it is responsible for conducting monetary

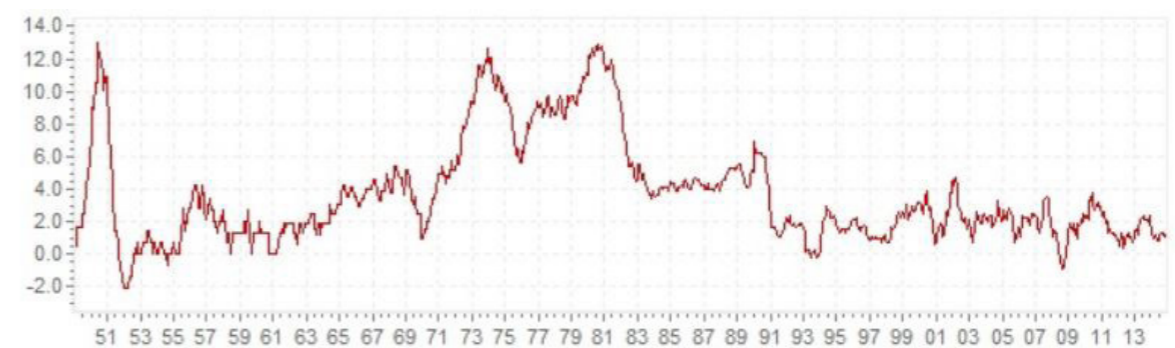
policy with one key instrument: the overnight interest rate. By announcing a specific interest rate (25 basis points above the target overnight rate) at which it is prepared to lend unlimited amounts to commercial banks and a second specific interest rate (25 basis points below the target overnight rate) at which it is prepared to borrow unlimited amounts from commercial banks, the Bank of Canada can keep the overnight interest rate within an announced operating band.

Canada's interest rates reached all-time highs in 1980s but in the last decades they have been declining. The interbank rate averaged 6.3% from 1975 until 2015.

6.2.5 Inflation rates

Inflation (of basic necessities such as food, clothing and fuel) was severe during the 20th century in the years of the WWI as a result of higher rates of growth of the money supply coupled with an increased tightness in commodity markets. Inflation was not accompanied by increases in nominal wages which led to confrontation between strikers and the army, with the Winnipeg strike of 1919 as one of the worst in Canadian labour history (Green, 2000). Yet, during the 1920s prices dropped a total of 20%; and during the worst years of the Great Depression (1930-1933) prices fell a total of 25%. However, from the 1950s onward, there was only one more episode of temporary deflation (2008). By contrast inflation has dominated the economy in the early 1950s, and in the 1970s. Inflation rates since the middle of the 1990s have remained within the Bank of Canada's target range

Figure 20: Canada's historic CPI inflation rate (yearly basis, 1950-2014).



Source: Inflation.eu (2015)

of 1–3%. In 1975, and due to the soaring inflation, it was announced that the Bank of Canada would conduct monetary policy¹ to control price changes.

6.2.6 Consumer liquidity and spending power

A characteristic of Canadian households are increasing household debts which hinder household savings and explain deficit-financed spending. Many Canadians use debt to finance the purchase of a new home, acquire goods and services, or invest in education. Recently, mortgage debt and consumer debt have increased. The indebtedness of Canadian households increased from \$147 billion in 1982 to \$1,454 billion by 2010 (current Canadian dollars). Two-thirds of the increase between 1982 and 2010 occurred between 1999 and 2010, a period described by relatively low interest and inflation rates. Residential mortgages accounted for two-thirds of overall household debt, with consumer debt account-

¹ The objective of monetary policy is to preserve the value of money by keeping inflation low, stable and predictable. Two key components are a flexible exchange rate and the inflation-control target, which is 2%. First introduced in 1991, the target is set jointly by the Bank of Canada and the federal government and reviewed every five years. To achieve the inflation target, the Bank adjusts (raises or lowers) its key policy rate. If inflation is above target, the Bank may raise the policy rate. Doing so encourages financial institutions to increase interest rates on their loans and mortgages, discouraging borrowing and spending and thereby easing the upward pressure on prices. If inflation is below target, the Bank may lower the policy rate to encourage financial institutions to, in turn, lower interest rates on their loans and mortgages and stimulate economic activity. In other words, the Bank is equally concerned about inflation rising above or falling below the target.

ing for the other third (Chawla, 2011). In 2012, the percentage of Canadian families with debt was 71%, up from 67% in 1999, with a median debt of \$ 60,100, up from \$ 36,700 in 1999 (in 2012 constant Canadian dollars). In 2012, 35% of Canadian families had a debt-to-income ratio above 2, i.e. their debt was at least twice the level of their annual after-tax income (Uppal and LaRoche-Côté, 2015).

The periods of the decade and a half preceding the WWI and the investment during the 1950s had in common a large capital formation driven by large-scale immigration, a massive shift from the farm to the city, and widespread household formation (e.g. new suburbs). However, during the 1950s, a much higher percentage of investment was financed from domestic savings. Thus, after WWII the domestic economy of Canada emerged as an important factor in shaping development, whereas earlier in the century the external sector dominated the process of change (Green, 2000). The urban sector has come into prominence as a source of economic growth, particularly linked to the rise of the service sector.

The historically rising terms of trade have had an important effect on the high-income or high spending power of Canadian citizens. The terms of trade are important as they determine the number of imports that each export can purchase, thus, when they rise, exports can be exchanged for more imports, thereby raising real incomes and boosting domestic spending (Baldwin and Macdonald, 2012a). Thus, the rising terms of trade

since the 1990s explain the increasing purchasing power of Canadians. Canada currently ranks globally 16th (in terms of purchasing power parity) (CIA, 2015d), and 29th in the world if the GDP per capita (PPP) is observed (CIA, 2015e).

6.2.7 Foreign investment

As a settler economy, Canada has strongly relied on foreign capital investments for its economic development. Sustained high levels of investments have played a role in ensuring a high rate of technological change. Investments were provided at first by savings of foreigners, but since the end of WWII the domestic economy provided the major proportion of savings need to sustain the high level of investment demand. With regards to foreign investments, by the 1930s the USA already accounted for almost two-thirds in Canada (Green, 2000). Capital inflows in the post-WWII period were led by the USA (having replaced Britain as the chief source country), and a much larger percentage was in the form of direct versus portfolio investment (e.g. American corporations purchased direct equity interest in existing Canadian-owned firms), particularly targeted towards the resources industries. By the early 1970s 80% of foreign investment holdings in Canada were owned by USA interests (Green, 2000).

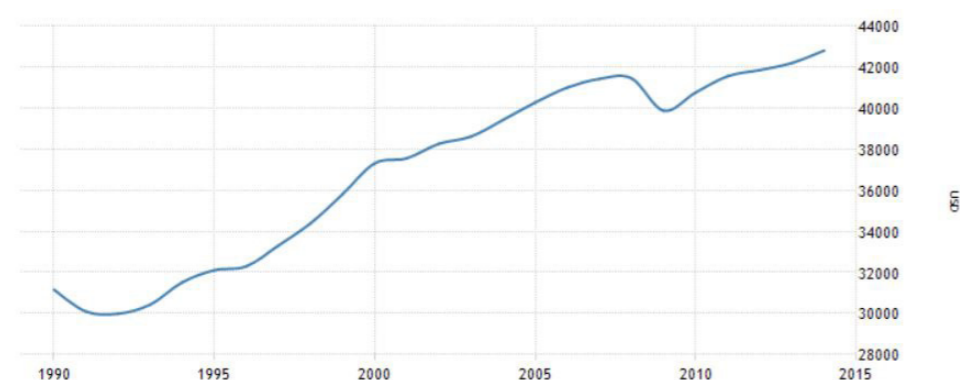
Canada is one of the world's most attractive foreign investment destinations. Factors such as low corporate taxes, advanced R&D capabilities, duty-free manufacturing tariff regime, liberal policies encouraging foreign investment, NAFTA

and free-trade agreements with many countries, political stability and prudent fiscal policies contribute to the country's favorable investment climate (KPMG, 2014). Canada promotes FDI in the minerals sector by providing full access to geoscience information and statistics on minerals and metals, repatriation of profits, no currency restrictions, no import or export restrictions, and low withholding taxes. Canada also remains an important exploration investment country. Canada slipped from the world's top destination for exploration spending in 2012 to the second spot behind Australia in 2013. Canada's percentage of global mineral investment dropped from 18% in 2011 to 13% in 2013, which is indicative of the fierce competition for global mineral investment (Marshall, 2014).

6.2.8 Public finance situation

Over the period 1867-1974 the accumulated federal gross debt had remained flat and low reaching only \$ 21.6 million. But around 1974 the federal debt began to grow rapidly, to a large extent due to loans from the private sector. The Canadian expenditure in the 1920s was led by federal expenditures, but the share of federal and provincial expenditures has tended to balance, reaching a 50% each by the 1970s. From then on, the share spent by provinces has outgrown that of the federal government. Canada experienced many years of deficits, driving the federal debt quickly upwards until its peak in 1999. From then on debt declined until around 2007 but has been slightly ri-

Figure 21: Canada GDP per capita (purchasing power parity, \$, 1990-2015).



Source: Trading Economics (2015d)

Figure 22: Canada's federal public debt evolution (percent of GDP, 1988-2015).



Source: Trading Economics, (2015c)

sing again in the last years due to deficits. The federal (accumulated deficit) debt stands nowadays at around \$ 600 billion (most of it belongs to unmatured debt owed to external parties and consisting of outstanding marketable bonds, treasury bills, Canada saving bonds, Canada bills, and notes and loans issued by the federal government). Interest and other debt charges are a major component of the federal government's expenditures. Charges peaked in the mid-1990s at about 5.8% of GDP, and are currently at around 1.8% (Treff and Ort, 2013). In terms of federal gross public debt-to-GDP ratio, such ratio has been declining since 1996 and stands nowadays at around 90% of GDP².

6.3 Energy & Infrastructure

6.3.1 Energy system, consumption & access

Canada is a net exporter of most energy commodities and is an especially significant producer of conventional and unconventional oil, natural gas, and hydroelectricity. Canada is the world's fifth-largest oil producer, and virtually all of its crude oil exports are directed to USA

² It has been recently found that Canada's debt level still remains healthy: at low levels of public debt the impact on economic growth is positive, but after a debt turning point (estimated at between 90% and 94% for developed countries) a negative effect on economic growth prevails (Mencinger et al., 2015)

refineries. Also Canada is the world's 10th largest consumer of refined petroleum. It stands out as the largest foreign supplier of energy to the USA. Like the USA depends on Canada for much of its energy needs, so is Canada profoundly dependent on the USA as an export market (EIA, 2014). Canada houses the world's 3rd largest crude oil reserves (90% of which are oil sands). Calgary has become a major energy cluster: it is home to Canada's head office of nearly every major oil and gas company, the industry's major trade associations, major pipeline operators and manufacturers, oilfield service companies and drilling companies. Numerous regulators (e.g. NEB, Alberta Utilities Commission, Canadian Association of Petroleum Producers) and industry bodies are also located in Calgary (CED, 2012).

Canada's domestic primary energy production has been traditionally dependent on petroleum and gas. In 2013 it was led by petroleum (crude oil, including gas plant natural gas liquids) (52.8%), natural gas (33.4%), hydroelectricity (8.4%), nuclear energy and other minor sources such as nuclear energy and the renewables sector (wind, tidal, solar, etc.) (NEB, 2015a). On the demand side, Canada's energy consumption (2013) was dominated by refined petroleum products (38.8%), natural gas (32.6%) and electricity (20.9%) (STATCAN, 2015b). Canadians depend on the pipeline transportation system for

safe, reliable and efficient energy supply, now and in the future. The ability of this system to safely deliver natural gas, natural gas liquids (NGLs), crude oil, and petroleum products is also critical to Canada's economy (NEB, 2015b).

In a matter of a few years the landscape for natural gas in North America changed intensely, switching from a tight supply and demand balance to a market in which natural gas supplies are considerably more abundant at lower costs.

This reversal can be largely attributed to technological advancements in natural gas drilling and well completion methods. In particular, a combination of extended reach horizontal drilling, multi-stage hydraulic fracturing and pad drilling have allowed producers to recover gas from areas that were previously thought to be technically impossible or not profitable. These technologies have largely been applied in deep shale and tight gas plays with little or no previous development (NEB, 2013).

Unlike the USA, Australia, Japan or South Africa, the power sector in Canada is dominated by hydroelectricity which accounts for approximately 60% of the total output. Hydropower accounts for the chief form of energy in provinces such as Québec, British Columbia, Manitoba, and Newfoundland and Labrador, while nuclear energy is the major source in Ontario. Alberta, Nova Scotia, and Saskatchewan rely on coal (KPMG, 2014). After China, Canada is the world's largest hydroelectric producer with more than 13% of the global output.

6.3.2 Transport infrastructure

Canada is a vast country with large distances which have been overcome by an efficient transport infrastructure based on railways, roads, ports and hubs, and thus, Canada's transportation networks form the literal backbone of the country's economy (COMT, 2014). It is widely held that the right infrastructure allows Canada to fulfil its economic potential by connecting disparate regions, increasing productivity (by reducing the costs of doing business), moving people and goods safely and efficiently, and accessing new economic opportunities (COMT,

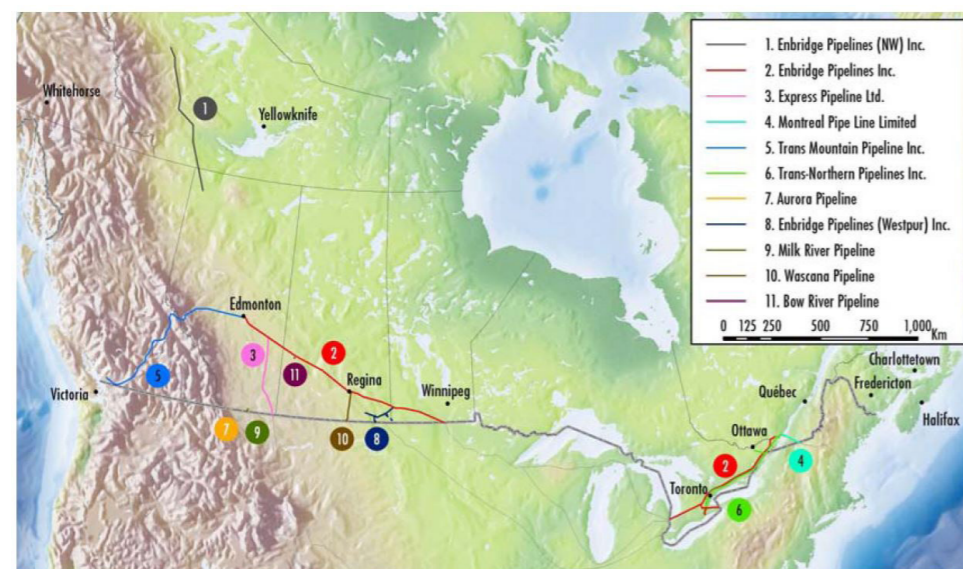
2014). Thus, transportation provides the underlying foundation for a strong and growing globally connected resources economy with the USA and the global marketplace (MPWGS, 2014). In 2011 the transportation services sector (including pipeline industry) represented 4.2% of the GDP (similar to 1993 with 4.5%) with the truck being the largest.

The lack of transportation infrastructure is often cited currently as an impediment for mineral exploration and development in remote areas of Canada but historically built and natural transportation routes contributed significantly to the development of the minerals industry. Initially the vast networks of river and lake routes pioneered by the fur industry were used to great effect by prospectors to access the remoter regions of provinces (often guided by local First Nation peoples). Exploration of these waterways also led to the development of Canada's hydro power potential used to great advantage in the development of the aluminium industry and smelters in general. The rail network that was built initially to facilitate the transport of wheat from the interior to ports has more recently facilitated the development of the huge Potash industry in central Canada. The development of ice road technology since the 1960s has had a huge impact on mine development, particularly north of the 60th parallel throughout the Territories.

6.3.2.1 Railway infrastructure

Most of the freight is transported by railway, followed by trucks and marine vessels (marine is the dominant mode for international traffic). Canada's truck, air and rail services are fully integrated with USA networks, providing efficient access to consumers and suppliers throughout North America. There is also easy access to Canada's major ports and to interior communities through truck-rail intermodal service. Moreover, Canada has the world's longest inland waterway open to ocean shipping, the Great Lakes/St. Lawrence Seaway System. The Seaway provides a direct route to the industrial heart of North America. The mining industry is a major contributor to Canada's St. Lawrence Seaway: shipments of iron ore,

Figure 23: Major oil pipelines regulated by the National Energy Board.



Source: NEB (2009)

coke and coal represented nearly 40% of total Seaway traffic in 2011 (KPMG, 2014).

6.3.2.2 Road infrastructure

Canada's transport infrastructure and the flow of people and mineral commodities is spatially distributed in an east-west range along the border with the USA (e.g. the Trans-Canada highway system following the population's concentration). Passenger domestic intracity travel is dominated by automobiles and buses (Canada is as much of an automobile society as the USA), whereas intercity transport is led by ferry and air. In contrast to this strip of land where the transport network infrastructure is well-developed, the massive northern territories – where most mineral discoveries are made – are light on basic transportation and energy infrastructure such as roads, railways, ports, electric power corridors, oil & gas delivery systems. Roads and railways can be built to service mine sites, but often at great capital expense because distances are long, terrain is rugged and climate variations are severe (KPMG, 2014); for example, ice roads are required to access and service diamond mines in the North Western Territories.

6.3.2.3 Ports infrastructure

Major Canadian ports include Vancouver, Montréal, Halifax, Port Cartier, Sept Iles/Pointe Noire, Saint John and Québec City. The Port Vancouver is Canada's busiest, handling about half of the total containers to go through Canadian ports (more than 2.31 million container), followed by the ports of Montreal and Halifax. Products from mining contributed nearly 41% to all traffic in and out of the port of Vancouver in 2006. Toronto's Pearson International airport is Canada's busiest, handling around 51% (value) of international air cargo and 45% of total international passenger traffic (Government of Canada, 2009). The Windsor-Detroit corridor is Canada's busiest artery of trade. With the area handling almost 30% of total Canada-USA trade and more than 2.5 million trucks, an efficient and secure Windsor-Detroit corridor is essential to the Canadian economy (Government of Canada, 2009). Ports granting access to tidewater are very important for transport of low-value bulk commodities such as coal and ores (e.g. zinc ores).

7. Political and legal factors

7.1 Political factors

7.1.1 Administrative structure

Canada is a federal state, with 10 largely self-governing provinces and three territories which increasingly receive province-like jurisdiction and authority over health,

regulation of lands and resources (under “devolution” agreements to the territories which account for 40% of Canada’s land mass, represent approximately 3% of the population and are rich in natural and mineral resources). Quebec and Ontario are the largest provinces.

Figure 24: Canada’s political divisions.



Source: NRCAN (2015c)

7.1.2 Governmental stability & transparency

Canada is a parliamentary democracy and a constitutional monarchy based on a British-style parliamentary system. Queen Elizabeth II is the head of State, who is represented by a Governor General appointed by the Prime Minister (official head of the government). The cabinet members are selected by the prime minister usually from among the members of his own party sitting in the parliament.

Canada has a bicameral federal parliament. The legislative branch comprises the senate (the upper house, 105 members) and the House of Commons (the lower house, 308 members). The members of the senate are appointed by the Governor General on the advice of the prime minister, while the members of the lower house are elected directly by popular vote for a 4-year term (KPMG, 2014). Canada is considered a politically stable representative democracy with a very low risk of political instability, e.g. ranks 3rd

in the world after Norway and Denmark as one of the most stable political environments (The Economist, 2009). Canada ranks 18th in the list of 144 countries in the field of transparency of government policymaking (World Economic Forum, 2014) and ranks 10th (one position above Australia) in the world in the corruption perceptions index (2014) of Transparency International (Transparency International, 2015). Canada ranks 13th in the field of Public trust in Politicians, above all other reference countries (Japan 21st, Australia 25th, the USA 48th, South Africa 90th (World Economic Forum, 2014). Long-term national stability and security of tenure are considered top decision criteria for exploration and exploitation in the mining industry.

7.1.3 Fiscal policies

Prior to 1945 fiscal policy did not play a significant role in Canada’s government action regarding the economy because the government represented a relatively small component of the economy and because economists at that time considered that changes in the economy were small and self-correcting. After the Great Depression, in line with Keynesian economic thought and due to the government involvement in spending during WWII, government became a large component of the overall economy and expansionary fiscal policy a common tool. During the 1950s and 1960s, Canadian economic and fiscal policy continued to be guided largely by Keynesian fiscal principles. During the 1970s the federal government pursued both a stimulative monetary policy and an expansionary fiscal policy to cushion the oil price shocks, but the policy was not entirely successful and inflation followed. The Canadian government, similar to the USA, introduced wage and price controls, but the outcome of such policies was stagflation. Beginning in the late 1980s, Canadian federal economic policy was largely influenced by two goals: 1) eliminating the federal deficit and reducing the total debt relative to economic output, and 2) maintaining control over inflation. The federal government largely abandoned a Keynesian approach, particularly in the

1990s. Following the global financial crisis (during which there was some expansionary fiscal policy) Canada’s government has continued on the basis that healthy government finances are the key to long-term economic stability (Makarenko, 2009).

Revenue ratios (revenues as a percentage of GDP) have been declining in Canada since the 1990s, falling from around a 18% in 1991-92 to a 14.4% in 2013-14. This longer-term decline is due primarily to tax reduction measures (Department of Finance Canada, 2014). Canada’s tax-to-GDP ratio has increased in the past three decades (similar to most countries), passing from 31% in 1980 to 32.2% in 2008 and a lower 30.7% in 2012 (below 2012 OECD average 33.7%). Canada’s structure of tax receipts is characterized by higher revenues from taxes on personal and corporate income, payroll (employment insurance premium) and property, and a lower proportion of revenues from taxes on goods and services (GST) and social security contributions (OECD, 2014e). Such characteristics (high corporate, property and individual taxes) explain Canada’s uncompetitive tax scheme, i.e. it ranks 23rd in the International Tax Competitiveness Index, close to Japan (25th) (Pomerleau and Lundeen, 2014). Accordingly, traditionally and for the years 2013-2014, the largest source of federal revenues was personal income tax revenues, which accounted for 48.1% of total revenues. The second largest source was corporate income tax revenues at 13.5% (federal corporate tax rates have been recently lowered by the Canadian government to 15% to increase competitiveness).

With the exception of Prince Edward Island (no mining activity), each of the provinces and the territories also levies separate mining taxes or royalties on mining activities. In many respects, Canada’s tax environment is favourable to mining activities. Canadian tax policies effectively address each phase of the mining cycle ensuring the growth of the industry and a fair share to the public sector. Some of the advantages include a stable mineral taxation regime, a transparent consultative process and carry-forward scheme. These tax credits for exploration and mine

development expenses reduce the tax liability of corporations; such credits can be carried forward for a period of 20 years. Operating losses can be carried forward for 20 years, making it almost certain that a taxpayer will be able to use start-up losses if it does develop viable mining operations (KPMG, 2014).

Government Policy has until fairly recently been a major driver for Canada's mining industry as Government cost shared many large scale regional infrastructure projects to open up areas (e.g. rail line to Pine Point mine, rail lines to the iron ore fields in Labrador, hydro power for Yellowknife Gold mines etc.). In the 1950s and 60's the Federal Government introduced the "Emergency Gold Mining Assistance Act" to aid gold mines throughout the country struggling with the low fixed price of gold in the inflationary period from 1950 – 1971. This programme enabled numerous towns in northern parts of the provinces to survive until a new wave of base metal mines replaced the

aging gold mines (Kidd Creek in Timmins etc.). More recently Government fiscal policy mechanisms such as flow-through shares and loans from agencies such as Export Development Canada have become more important drivers than direct/indirect financial support to the industry.

Canada has also been successful in the collection of a cluster of around 2,000 junior mining exploration firms. A key reason for the establishment of this cluster has been the Canadian tax and finance system which has provided junior firms (via the Canadian Mineral Exploration Credit and the above mentioned flow-through shares), with capital that they could otherwise not obtain from banks, which tend to be averse to exploration given that it represents high-risk investment. "The Canadian Mineral Exploration Credit allows prospectors to place exploration expenditures into a special tax-deductible pool that has no expiry date, allowing firms to carry forward the credit until they have taxable income. The flow-through shares

provide benefits and children's benefits) and to other levels of government which means financing the Canada Health Transfer (CHT) and the Canada Social Transfer (CST) (post-secondary education, social programmes), the equalization and territorial formula financing and payments under the Gas Tax Fund. Public debt charges (interests) totalled 10.2%.

Regarding the mining industry, provincial government spending has been important for prospecting via the Prospectors Assistance Programme which provides direct financial support, through grants, to individuals (traditional "grass root" exploration), and supports eligible exploration costs for junior exploration companies, e.g. in Newfoundland and Labrador to conduct diamond drilling, ground and airborne geophysics and geochemical surveys.

7.1.5 National Security

Canada became a dominion of the British Empire in 1867 but London continued to have the final say on over most of Canada's foreign and defence policy until the passage of the Westminster Act in 1931. The WWII changed Canada's view on its defense policy and its position, mainly due to the idea that an attack on North America may be feasible. This made Canada enter into the USA's orbit of influence. The unique bilateral defence cooperation that exists today between the USA and Canada began in 1940 when President Roosevelt and Prime Minister King agreed to establish the Permanent Joint Board on Defence (PJBD) for the coordination of weapons production. During the early years of the Cold War the air forces of both the US and Canada expanded their cooperative air defence arrangement, culminating in the establishment of the North American Air Defence Command (NORAD) in 1958. Today, in the post 9/11 security environment, the two nations are working together in planning for continental defence (Stone and Solomon, 2005). In 2011 Canada and the USA made public the Declaration of a Canada-USA shared vision for perimeter security and economic competitiveness. Canada's military spending as a percentage of GDP has

fluctuated around the 1% and 1.3% in the last decade and a half.

7.1.6 Safety & crime

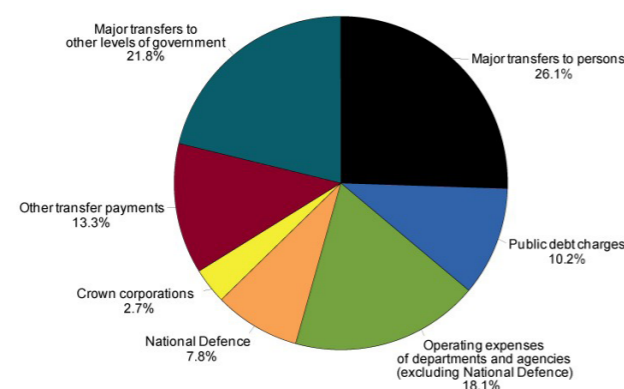
Canada is a safe country, and crime rates after peaking in 1962, have been falling, and there are currently growing concerns over unnecessary policing costs (Di Matteo, 2014). Toronto and Montreal rank as the 8th and 14th safest cities in the world (The Economist, 2015).

7.1.7 Trade policies

While shifting international demand for resource products and technological improvements are at the heart of the changing pattern of resource development since 1867, government trade policies have also shaped the growth of the resource economy in various ways (Baldwin and Macdonald, 2012a). In other words, trade policy has been one of the most important policy instruments used by Canadian governments to guide economic development (Hart, 2002). And much of the Canadian trade policy history is closely associated with Britain first, and then the USA, as these have historically been Canada's major trading partners.

After Confederation, Canada maintained a dual policy on tariffs. In general, tariffs on secondary manufactured goods were increased sharply in 1879 and remained almost unchanged from then until 1930, when they were increased even further as part of the government's policy to bolster employment in Canada during the Great Depression years. Under the revisions of that year, tariff protection on the bulk of imports increased by about 50%, with textiles and iron and steel products receiving the largest increases in duties (Green, 2000). However, Canada engaged in bilateral commercial agreements with the USA. In 1935 Canada signed the USA Trade Agreement through which duties were lowered on a wide range of products entering the USA and the USA was accorded a generally lower treaty rate on its exports to Canada. Furthermore, in 1938 Canada, the USA and Britain arranged a tripartite agreement to lower tariffs on goods traded between each other, shifting trade away from third countries towards trade among

Figure 25: Canada's composition of federal expenses, 2013-2014.



Source: Department of Finance Canada, (2014)

allow prospectors to pass the mineral exploration credit to an investor, who can take advantage of it immediately. In essence, flow-through shares reduce the risk to investing in mining exploration by guaranteeing some return in the form of lower taxes" (The Canadian Chamber of Commerce, 2013:30).

7.1.4 Government spending priorities & allocation

During Canada's recent history (period 1992-2001) the relative share of government spending on education, health, national defense, recreation and culture, housing and community services and income security have all declined (Kennedy and Gonzalez, 2003). Currently, most of the budget is destined to major transfers to persons (mainly elderly benefits or old age security fund, employment insu-

those three countries (Green, 2000). By 1939 over 90% of Canadian exports were already destined to USA's markets.

After WWII this protectionist policy was rapidly changed when Canada signed the General Agreement on Tariffs and Trade (GATT) in 1947, and Canada's development strategy changed from the protection of secondary manufacturing from low-cost foreign suppliers to a commitment to balanced growth. This set the country in a path of lower tariff levels, and made Canada enter multinational agreements putting Canadian tariff policy in a different context than the previous bilateral agreements. An important agreement in Canada's trade policy was the Automotive Agreement between Canada and the USA signed in 1965. Its main purpose was to rationalize motor vehicle production in North America, i.e. assign the production of particular lines to one country or the other, and sell the output throughout North America. Within a decade of signing, new automobiles and automobile parts were at the top of Canada's exports in value, displacing pulp and paper from their leading position. Driven by the success of the Auto agreement and slow negotiations in GATT (Kennedy and Tokyo rounds), Canada and the USA entered into further bilateral negotiations to create a free movement of goods and services, resulting in the Free Trade Agreement of 1988, an agreement later expanded to include Mexico and the signature in 1994 of the NAFTA (Chile was added later). In 1995 Canada entered the WTO. In hindsight it can be concluded that protection through high tariffs became inextricably tied to Canada's notion of nationhood, "a connection that was not broken until the end of the 1980s when Canada finally entered into an unrestricted reciprocity agreement with the United States, and the federal government told Canada's uncompetitive manufacturing sector to either adjust to global competition or lose its markets" (Hart, 2002:7).

7.1.8 Bilateral, Multilateral & International agreements

Canada participates in the Arctic Council, APEC, ASEAN, G7, G20, IDB, NATO, Order of Malta, OPCW, OECD, OAS, OSCE, UNESCO, and as a permanent mission to the United Nations. Canada has free trade agreements (FTA) in force with more Korea, Honduras, Panama, Jordan, Colombia, Peru, with the European Free Trade Association, Costa Rica, Chile, Israel, and with the NAFTA and the Canada-USA Free Trade Agreement (1989). Recently concluded FTAs involve Ukraine and a Comprehensive Economic and Trade Agreement (CETA) with the EU. Free Trade Agreements are currently in negotiation with the Caribbean Community (CARICOM), Guatemala, Nicaragua and El Salvador, Dominican Republic, India, Japan, Morocco, Singapore, the Trans-Pacific Partnership, and the modernization of the Canada-Costa Rica FTA. Exploratory discussions are ongoing with the Mercosur, Turkey, Philippines and Thailand. FTAs with mining countries, such as Peru, provide a stimulus for Canadian suppliers of mining equipment and services.

Canada has foreign investment promotion and protection agreements (FIPAs) in force with Argentina, Armenia, Barbados, Benin, China, Costa Rica, Croatia, Czech Republic, Ecuador, Egypt, Hungary, Jordan, Kuwait, Latvia, Lebanon, Panama, Peru, Philippines, Romania, Russian Federation, Serbia, Slovak Republic, Tanzania, Thailand, Trinidad and Tobago, Ukraine, Uruguay and Venezuela. Recently (during 2014 and 2015) new countries have signed FIPAs and negotiations are ongoing with others (Government of Canada, 2015).

7.1.9 Sustainable development policies

First steps towards sustainable development commitments were taken by Canada in 1995 with the amendment of the Auditor General Act requiring departments and agencies to develop their own sustainable development strategies. This decentralised scheme was not successful in measuring performance, goals

were vague and unfocused, and sustainable development planning and reporting was separate from the core goals of governments. Thus, in order to change the situation, the Parliament passed the Federal Sustainable Development Act in 2008 signalling a change in how the Government of Canada would fulfil its commitment to sustainable development. The Act called for a comprehensive approach through a Federal Sustainable Development Strategy (FSDS) which provides Canadians with a whole-of-government view of environmental priorities at the federal level, with goals, and implementation strategies. This approach is currently in its second cycle (2013-2016).

Being a major player in the forestry sector, Canada leads in certified management of resources. It has 161 million hectares of forest land that is independently certified as sustainably managed. This represents 43% of the world's certified forests, far more than any other country (e.g. the USA has 41 million hectares, around 11% of the world's certified forests). Likewise, Canada has one of the world's most respected fish inspection and control systems (NRCAN, 2015d).

With regards to mining, during the 1990s the Mining Association of Canada (MAC) launched the Whitehorse Mining Initiative (WMI) which was chiefly responsible for accelerating the development of a practical approach toward implementing sustainable development in the Canadian inland mining sector. The Initiative arose in part as a response to the increasing influence of powerful labour rights, aboriginal land claims and wilderness conservation forces in Canada. It was also a time of increasingly competitive economic conditions for the industry. More recently, in 2004, MAC laid down guiding principles, *Towards Sustainable Mining (TSM)*, which governs key activities of companies in all sectors of mining and mineral processing industry. This is a pioneering initiative in the field of corporate social responsibility that helps mining companies assess their environmental and social responsibilities. MAC makes the participation in TSM mandatory for all its members. The three benchmarks on which these companies evaluate themselves are: 1) communities

and people; 2) environment; and 3) energy and efficiency. The Canada Mining Innovation Council – a network of industry, government, and academic leaders – was established to promote research and innovation, leading to sustainable practices. The council aims to strengthen the strategy around tailing management, energy efficiency, and deep exploration activities (KPMG, 2014).

Canadian mining companies have not always had a good record for environmental and social responsibility abroad and have been subject to much scrutiny and criticism for their behaviour abroad (e.g. Butler, 2015; Deneault et al., 2008; Deneault and Sacher, 2012; Hill, 2014).

7.2 Legal Factors

7.2.1 Legal Framework

The Canadian legal system has its foundation in the English common law system with some influence from Scots Law, inherited from being a former colony of the United Kingdom and later a Commonwealth Realm member of the Commonwealth of Nations. The Constitution is the supreme law of Canada. It defines the powers of the different levels and branches of government. The federal government mostly deals with issues that affect all of Canada, such as international relations, inter-provincial trade, national defence, criminal law, immigration, divorce, and money. It is also responsible for Yukon, Northwest Territories and Nunavut. Laws made by Parliament apply to all of Canada and the provinces can enact laws about issues of a local or private nature within the provinces such as education, property, and the private rights of persons. Local governments are created under provincial laws and can make (bylaws) laws regulating local matters such as local land-use planning (zoning), smoking, pesticide use, parking, business regulations, and construction permits. The judicial branch in Canada consists of a national Supreme Court of Justice (the highest court of criminal law), the Federal Court of Canada, the Federal Court of Appeal, the Tax Court of Canada and smaller provincial/territorial courts. Judges of the Supreme Court are appointed by

the governor general on the recommendation of the prime minister (KPMG, 2014). Due to historical reasons, the federal law evolves in a dual system: bilingual and bisystemic (co-existence of civil law and common law systems in private law).

Canada has consistently ranked as the world's 2nd most secure location (low political risk) for mining investment in the Behre Dohlbear ranking in the period 2005-2013, having surpassed Australia in the last ranking as the world's most attractive country for investment in terms of political risk assessment (Wyatt and McCurdy, 2014). In the most recent Fraser Institute's report, five Canadian regions have ranked in the top ten of the world's most attractive locations for mining investment: Saskatchewan region ranked 2nd in the world after Finland, Manitoba 4th, Quebec 6th, Newfoundland & Labrador 8th and Yukon 9th (Jackson and Green, 2015). Other Canadian regions also fared well in the top 20 emphasizing the investor-friendly environment in Canada for mining investments.

7.2.2 Resources Ownership & Property Rights Law

In Canada public lands and mineral rights were given to the provinces at the time of Confederation. Thus, governments at provincial or territorial level assume ownership of the majority of mineral resources; the mineral rights on more than 90% of Canada's land are currently owned by governments and mineral rights are reserved from land that becomes privately owned through grant or sale. Only minerals located in offshore waters, the continental shelf and on federal lands are owned by the federal government. In the case of forest, about 90% of the forest land is publicly owned and managed by provincial and territorial governments, 4% by the federal government, and only 6% is privately owned.

Rights to unexplored land and the underlying minerals are granted by the Crown which owns them. In Canada, the same as in the USA, surface and mineral rights are separated, indicating that a mining company may obtain a lease to develop and exploit a mineral deposit without the need to own (purchase)

the land (surface rights). Mineral rights are government-owned and cannot be purchased, only leased by individuals or companies (via online staking – mineral claim). Mining leases in Canada are issued for a specific term that is renewable, subject to an annual rental charge and transferable with the prior written consent of the government. The Canadian permitting procedure for mining is considered stringent but very effective with a permitting delay of around two years, similar to Australia (SNL Metals & Mining, 2015). This is considered one of the key drivers of mining success in the country.

The rights are granted for certain tenure, on a first come, first serve basis (KPMG, 2014) under two systems: "free-entry" and "Crown discretion". Under "free-entry" regimes prospectors can apply to the Crown to register mining claims on Crown land. Once mining claims are registered, the regime authorises prospectors to subsequently carry out exploratory drilling on those claims. The regimes do not provide the Crown with any discretion in determining whether to register mining claims once a prospector has submitted an application, and no further Crown authorisation is necessary in order for the prospector to carry out exploration activities. The Crown discretion system permits the Province to refuse an application, or defer the acceptance of an application for a license where it believes the application is not in the best interests of the Province. Virtually the entire country operates using a variant of the free miner entry system which initially made it very low cost for prospectors to enter into the industry and move from province to province in response to discoveries. While this feature has been less of a driver in recent years it certainly helped in the pre, inter and immediate post WWII eras.

The separable ownership rights have been very important in activating the exploration sector as it has led to a pioneer exploration market, driven by junior companies supported by a scheme of financial incentives for mineral exploration and prospecting funded by federal and provincial and territorial governments (PDAC, 2015). Large Canadian companies account for the dominant share, by

far, of the value of all mineral exploration programmes planned worldwide, but junior companies have traditionally played an important role in the discovery and development of mineral projects in Canada (although this has changed more recently due to the downward cyclical fall of commodity prices).

Mineral exploration, development, conservation and management are controlled by the provincial governments, while jurisdiction in matters such as environmental and taxation is shared between the federal and provincial governments. Each jurisdiction has its own mining, environmental and occupational health and safety legislation. All jurisdictions have separate mining rights legislations (for acquiring mineral tenure) except Nunavut, which is regulated by the Department of Aboriginal Affairs and Northern Development, and the Northwest Territories which as of April 2014 fall under the Department of Industry, Tourism and Investment. Major regulations for the mining sector at the provincial/territorial levels involve the Mineral Act, the Mining Act, the Mineral Resources Act, and the Mineral Tenure Act.

Treatment of Canadian First Nations' land claims are governed by section 91(24) of the Constitution Act (1867), which gives the federal government jurisdiction over "Indians and lands reserved for the Indian" and section 109 which gives jurisdiction of land to the provinces. As with environmental regulation, this dual authority creates a need for negotiation and compromise (Dobra, 2014). Courts have required a legal duty to consult by the Crown whenever actions may affect Aboriginal rights or land. Should it be proved that the Crown failed to discharge its duty, mining companies risk having government approvals invalidated. The "free-entry" system has given rise to conflicts between the mining industry and First Nations, and now it is becoming established that duty to consult applies to the free-entry regime. Nowadays, and in order to avoid conflicts, mining companies sign Impact and Benefit Agreements (IBAs) with First Nation peoples which include provisions for economic and business opportunities, employment and train-

ing, socio-cultural community support, environmental protection and post-mine closure.

7.2.3 Business legislation

Business legislation has in general been favourable to promote investments. Canada ranks 16th in the world under the indicator "Ease of doing business", particularly driven by an easy access to starting a business, getting credit, protecting minority investors, paying taxes and resolving insolvency. Problematic factors include dealing with construction permits and getting electricity (World Bank, 2014). Business legislation is particularly favourable for the mining industry: there are more mining companies based in Canada than anywhere else (Drake, 2015).

7.2.4 Employment, Labour laws & Unions

Labour laws in the country are quite stringent and are well regulated by both the federal and the provincial/territorial governments. The constitution gives exclusive federal jurisdiction over employment in specific industries. Employment that is not subject to federal jurisdiction is governed by the laws of the province or territory where the employment takes place.

Local laws cover 90% of the workforce while federal laws cover only 10%. Minimum hourly wage rates are well defined by the local laws. The standard hours of work for an employee in a federally regulated industry are eight hours in a day or 40 hours in a week. Federally regulated employees are all entitled to one full day of rest each week, which usually falls on a Sunday. In most cases, the maximum number of hours worked in a week is 48. Mandatory retirement age has been relaxed by the federal government for people who wish to work beyond the retirement age. The Wage Earner Protection Programme Act (created in 2005) entitles Canadians to demand payment of their wages, vacation, severance, and termination pay in case their employer goes bankrupt. Employment in the mining sector is more volatile than in most other Canadian industries. The mining sector offers the highest wages among all indus-

trial sectors in Canada and the average retirement age in the mining industry over the last 20 years has been 59.5 years, lower than the current national average of 62 years (KPMG, 2014). The unionization rate in Canada has decreased gradually over time, falling from 33.7% in 1997 to 31.5% in 2012. Also the number of strikes and lock outs in the mining sector in the period 1998-2012 has decreased (Energy & Mines Ministers Conference, 2013).

7.2.5 Environmental regulations & their enforcement

The Canadian Environmental Protection Act (CEPA) (1999) is the federal government's primary environmental regulatory statute. It provides for broad federal regulatory authority over the management and control of toxic and prohibited substances and a range of other issues from environmental emergencies to the cross-border movement of wastes and recyclable materials. The CEPA also establishes the National Pollutant Release Inventory (NPRI). Another important regulation is the Fisheries Act by which federal authorities regulate water pollution and quality (Metal Mining Effluent Regulations), protection of commercial and recreational fisheries. Other relevant acts are the Pest Control Products Act, the Canadian Environmental Assessment Act (2012), the Canada Shipping Act, Marine Liability Act, Navigable Waters Protection Act, Canada National Marine Conservation Areas Act, Energy Efficiency Act, among others. Under CEPA, enforcement officers have broad powers of investigation. They may issue compliance orders to stop illegal activity, or require actions to correct a violation, carry out inspections and search and seizure (Blakes Lawyers, 2012).

The provincial legislatures are empowered by the Constitution Act (1867) to legislate with respect to a very wide range of environmental issues. In general, each province has developed a complex web of regulations and statutes which address matters such as waste management, waste disposal, air pollution, water pollution, fuel handling, contaminated site

remediation and environmental assessment. However, the regulatory environment for mining activities in Canada is complex and unclear when it comes to approval processes, timetables, and responsibilities (KPMG, 2014). In terms of emissions, Canada ranks 12th in the world in terms of CO₂ emissions (from energy consumption) and is responsible for 2% of the total cumulative global CO₂ emissions in the period 1850-2011 (Ge et al., 2014).

Regarding Greenhouse gas (GHG) emissions, Canada's economic development was enabled by the country being responsible for 2% of the global cumulative GHG emissions in the period 1990-2011 (Ge et al., 2014). Though GHG emissions have risen by 18% since 1990, Canada's economy grew much more rapidly, with the gross domestic product (GDP) rising by 71%. As a result, the emission intensity for the entire economy (GHG per GDP) has improved considerably, dropping by 31%. As inscribed in the Copenhagen Accord, Canada's current GHG emissions reduction targets are aligned with the USA, and commit Canada to an economy-wide target of a 17% reduction in emissions from 2005 levels. Recent examples of measures the Canadian government has taken to tackle climate change include steps to reduce GHG emissions from heavy-duty vehicles, regulations to reduce carbon dioxide emissions from the coal-fired generation of electricity, and, most recently, regulations governing the use of industrial boilers. As a component of these targeted actions, it is expected that regulations will be developed for both the oil and gas sector and the mining sector (Marshall, 2014).

Canada's managed forests have acted through most of the 20th century as a strong carbon sink, however, forest became a source (forests emit more carbon dioxide and other GHG gases than it removes from the air in a given time period) in 1995, 1998 and more recently between 2002 and 2004 mainly due to attacks by insects, despite Canada's strong hope of forests helping the country meet its Kyoto target.

8. Technological factors

8.1 Research and Development (scientific infrastructure)

8.1.1 Knowledge and resource base

Canada's science, technology and industry system is well established. The knowledge and resource base infrastructure in Canada ranks relatively high in the world. In terms of total R&D personnel nationwide and total R&D personnel in business per capita (full-time work equivalent per 1,000 people) Canada ranks 10th and 17th respectively in the world (2012). However, Canada is middling performer on public and private R&D spending among OECD countries, and ranks 19th in the world on a total expenditure on R&D per capita. The country ranks 6th in the world by the indicator "Researchers and scientists" (which measures if such professionals are attracted or not to a country). Industrial R&D activities across all industries tend to concentrate in Ontario (e.g. ICT, pharmaceuticals) and Quebec (aerospace, pharmaceuticals). In terms of (absolute) business expenditure on R&D, Canada ranks 9th in the world behind Australia (8th), Japan (2nd) and the USA (1st) (2012) but ranks 25th in the world regarding business expenditure on R&D as a percentage of GDP (Institute for Management Development, 2014). With regards to the availability of scientists and engineers, Canada ranks 12th in the

world, below Japan (3rd), the USA (5th) but above Australia (27th) and South Africa (102nd) (World Economic Forum, 2014).

R&D expenditure in Canada, like in most OECD countries and the EU-28, is dominated by business enterprises, followed to a lesser extent by higher education institutions (an unusually high proportion), and then by the government and private non-profit institutions. Canada, similar to Australia and Japan, provides a significant part of support to business investments in R&D indirectly via tax incentives. In contrast, the USA and South Africa provide most of the government support via direct funding (OECD, 2011). The current mix of R&D spending in Canada is the result of significant changes over the past 15 years. Beginning in the mid-1990s, major new investments in higher-education R&D by the federal government - in particular, through the creation of the Canada Foundation for Innovation and the Canada Research Chairs programme - contributed to a steady increase in higher-education R&D spending intensity, passing from 0.44% in 1996 to 0.71% of GDP by 2009 (Conference Board of Canada, 2015b).

Business R&D spending as a percent of GDP across all industries is low in comparison to other peer countries, with Japanese, American and even Australian firms investing over 1% of the GDP in R&D. The implications for Canada's innovation

performance are mixed. The increase in higher-education R&D spending ensures that Canadian scientists are well funded to contribute to basic research and to increase the stock of knowledge. But the higher-education R&D spending is less likely to produce tangible innovations (e.g., new products, services) than business R&D spending. This is because decisions about business R&D spending are driven by firms' objectives and needs, and businesses face greater pressure to produce tangible returns in terms of new or improved products, services, or processes (Conference Board of Canada, 2015b). The little investments in R&D also explain Canada's persistent record of relatively low productivity growth. However, despite the general trend, some industries have been found to be highly industrial R&D intensive by international standards (e.g. communications equipment manufacturing, office and computing machinery manufacturing, coke and refined petroleum product manufacturing, pulp and paper) (Council of Canadian Academies, 2013).

With regards to the minerals industry, one of Canada's strengths lies in the availability of geoscience data: the continuing public availability over time of new contemporary bedrock geological maps, new regional geochemical, geophysical and geospatial data in a repository. The federal government has traditionally provided funding for public geoscience information on the premise that good economic government policy requires a sound knowledge of Canada's mineral potential. Public geoscience maps, data and reports reduce the cost and risk of exploration by allowing companies to identify areas of high mineral potential, reducing the need to spend time and money exploring less prospective ground. In addition, geoscience information also informs government policy decisions in respect to land use planning, infrastructure development and environmental protection. This information is critical to reduce the financial risk associated with exploration decisions and attract investments. For instance, in 2013 Canada announced the renewed support of \$ 100 million over seven years (2013-2020) for the Geo-

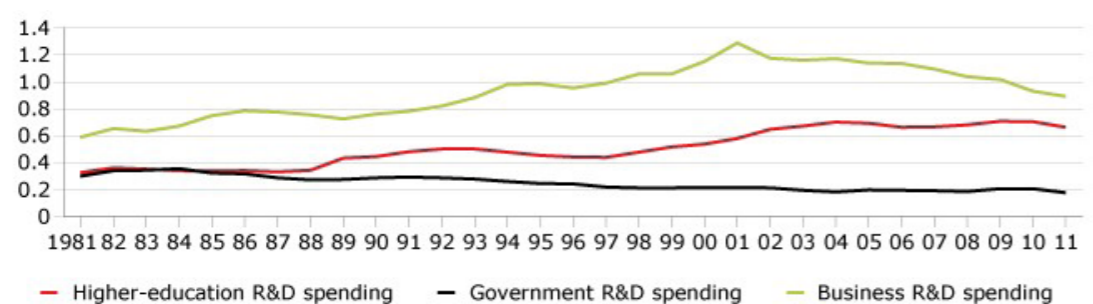
mapping for Energy and Minerals (GEM) programme, which advances geological knowledge in the North to support increased exploration of natural resources and inform decisions on land use that balance conservation and responsible resource development. The complementary Targeted Geoscience Initiative-4 (TGI-4) is a national programme that provides industry with new ore deposit models and innovative tools for discovery of deep deposits.

8.1.2 R&D culture

In general, Canada does not have a strong R&D culture. It has been recent found that, despite a decade or so of innovation agendas and prosperity reports, Canada fares poorly in innovation benchmark analysis, remaining near the bottom of its peer group on innovation, and ranking 13th among 16 peer countries. It ranks 22nd in the world under "Innovation" (World Economic Forum, 2014). Canada is well supplied with good universities, engineering schools, teaching hospitals, and technical institutes. It produces science that is well respected around the world. But, with some exceptions, Canada does not take the steps that other countries take to reach successful commercialization of innovation. Canadian companies are thus rarely at the leading edge of new technology and too often find themselves a generation or more behind the productivity growth achieved by global industry leaders (Conference Board of Canada, 2015c). University-industry collaborations are not well-developed. For instance, nearly half of Quebec companies do not see the relevance of collaborating with universities (in contrast to firms based elsewhere). Also, according to a recent survey, it has been found that most of the companies surveyed have been collaborating with universities for 10 years or less and that 37% of respondents claimed that University-Industry collaboration is not very relevant (Board of Trade of Metropolitan Montreal, 2011).

Unlike the general trend, the Canadian mining industry is a global leader in capital investment, financing and innovation. The mining industry has continuously invested in R&D, even during bust times and

Figure 26: Trends in R&D spending by type (percentage of GDP, 1981-2011).



Source: Conference Board of Canada (2015b)

high risk, like in the 1990s when the sector invested in new, automated technologies that enhanced the economic viability of projects by lowering production costs; the key in maximizing such investments has been a ready supply of skilled industry workers (Marshall, 2014). The sector has undergone a profound change to a high-tech industry, and it has become a driving force in Canada's new knowledge-based economy. New technologies in mining have created a circle of growth and innovation that circulates through two-way linkages between mining and the rest of the economy (Global Economics Limited, 2001). In 2013 the mining's investment surpassed that of the motor vehicles and parts sector, and the wood products and paper sector. Moreover, in 2012 the mining industry employed over 4,700 people in R&D, which is more than the pharmaceutical and forestry sectors (Marshall, 2014). Growth in labour productivity between 1961 and 2007 for the metals and minerals subsector was higher than that of the Canadian business sector as a whole, reinforcing the high labour productivity levels typically seen in that subsector (CSLS, 2012).

A large part of innovations in the mining industry takes place in the exploration sector. Vancouver is the global centre of expertise for mineral exploration. Some 1,200 exploration companies are located in British Columbia, most of which are in the greater Vancouver area. Canada's history is rich in periods of marked acceleration in deposit discovery and mining production correlating with the introduction of new methods such as GPS surveying, three-dimensional data maps, airborne technologies and low-impact down-hole seismic imaging and mapping. Such methods have enabled the discovery of deposits which could never have been found using traditional methods. An example is given with the debut of airborne geophysics in the 1970s which led to a boom in new discoveries across northern Canada (Minalliance, 2012). Also in exploitation innovation plays a central role. For instance, much of Canada's remaining base metals are likely located two kilometres or more beneath the surface. This situation presents cost

and operational challenges. In response, the industry is investing in remote-operated equipment, automated loading and transportation systems, robotics and seismic mapping. With these technologies, companies can mine at a greater depth and keep mines open that would otherwise close. Much of these innovations have been funded by the industry, whereas government-funded research mechanisms need to change as they are not aligned and do not provide support commensurate with the industry's innovation needs, priorities and contributions (Marshall, 2014). Moreover, Canada's minerals sector innovation continuum is fragmented due to a lack of national scale coordination of government and industry research, development and innovation (RDI) funding.

Canada's innovations are also of importance in the forestry industry. Canada's government has been funding since 2010 the Investments in Forest Industry Transformation (IFIT) programme to help move new technologies out of the laboratory and into the commercial mainstream. By the end of 2013 the IFIT programme had funded 14 projects, generating at least 10 new Canadian patents (NRCAN, 2014b). Other important programmes are the Expanding Market Opportunities and the Forest Innovation programme (NRCAN, 2014b).

8.2 Patents, products, technologies generated

Canada ranks 7th in the world (2011) in terms of scientific articles published by origin of author, below the USA (1st), Japan (3rd) and Australia (12th). Canada is responsible for 1.1% of patents filed in Europe, Japan, and the USA. Canada also accounts for a relatively large share of world patents in pharmaceuticals and medicines (drugs), and communications technologies (Council of Canadian Academies, 2013). In terms of patent applications (2012) Canada ranks 13th in the world behind the USA and Japan, but above Australia (21st) and South Africa (36th); regarding patent grants (average 2010-2012), Canadian applicants rank 14th in the world below Japan (1st), the USA (2nd) and above Australia (16th)

and South Africa (28th). If patents in force (2012) are considered Canada ranks 17th in the world below Japan (1st) the USA (8th), and above Australia (19th) and South Africa (34th) (Institute for Management Development, 2014).

8.3 Telecommunications & E-commerce

Telecommunications play an important role for Canadians. Canada ranks 23rd in the United Nations ICT development index which measures access, use and skills toward information and communication technologies (ITU, 2014). Canada has a high internet penetration rate: it ranks 7th in the world in terms of internet users

(2013) (per 1,000 people), and ranked 16th in terms of investment in telecommunications as a percentage of GDP (0.53% in 2012) (Institute for Management Development, 2014).

Canada ranks 18th in the world (2014) in the indicator "Communications technology", which indicates if the sector meets business requirements or not. In terms of computers in use (2013) Canada ranked 12th in the world with a global share of 1.7%, being 5th in terms of computers per capita (2013). Canada's e-market is relatively large: it ranks as the 11th large retail e-commerce market in the world (AT Kearney, 2015).

9. Conclusions

9.1 Overview of economic development – history and drivers

During the 20th and 21st century Canada clearly benefited from the advantages of being a relatively unsettled country, very well endowed in natural and mineral resources.

Since World War II, the growth of Canadian manufacturing, mining, and service sectors has transformed the nation from a largely home-based rural economy into one that is primarily industrial and urban, operating globally. During the early stages, large-scale immigration and settlement coupled with new technology and foreign investment, unleashed the productive capacity of the Prairies. The other “staples” or commodities (natural and mineral resources-based commodities such as wheat, timber, fur, fish, pulp and paper, minerals, oil and gas), came later and all have robustly contributed to Canadian export balances. The settlement of the West, the construction of the transport network (railways, roads, ports) guided under the National Policy all contributed to the creating of a national domestic market which achieved throughout the 20th century a relatively large spending power based on deficit-spending (increasing federal gross public debt) and favourable terms of trade.

Canada has become a resource “trading nation” heavily dependent on trade for its economic prosperity and most of that trade is with the USA. Thus, Canada’s geo-political location next to the USA and its bilateral trade policies explains a large part of its success in pulp and paper, timber, oil, gas and mineral exports, in the automobile and automobile parts industry, among others. The USA-Canada border is the longest in the world and both countries share the world’s largest and most comprehensive trading relationship. Sustained high levels of investments have played a role in ensuring a high rate of technological change. Investments were provided at first by savings of foreigners but, since the end of WWII, the domestic

economy provided the major proportion of savings needed to sustain the high level of investment demand.

9.2 Conclusions specific to the non-energy raw materials sector

9.2.1 Industry and trade

The mining industry has played and still plays a large economic role in Canada. There are more mining companies based in Canada than anywhere else, and Canada has managed to become a global leader in mining financing, exploration, development, and reclamation.

Canada’s mining success is explained, first, by its **mineral endowment**, which is closely related to prospecting and exploration activities which render mineral occurrences into discovered deposits. In Canada discovery momentum and entrepreneurial reward have been identified as key drivers of exploration. Most recent new “mineral endowments” in Canada only came to light as a result of the entrepreneurship (risk-taking culture) of modern exploration; drawing its impetus for risk taking from the extrapolation of rewards to explorers in the past to potential rewards in the future (“success breeds success”) Another key driver of exploration has been the **availability of public and reliable geoscience data**.

Exploration success, just like other phases of the mining cycle, is framed by a **political and institutional environment** which needs to guarantee a series of conditions to attract mining investments. Canada has consistently provided political and institutional stability, ensuring potential investors a high respect for the rule of law, security of tenure, and the ability to predetermine tax liability and environmental obligations (transparent and professionally managed regulatory framework). Accordingly, Canada as a country and its provinces has consistently ranked very high in the Fraser Institute’s ranking for the most attractive locations for mining investment, i.e. the country is considered a low-risk environment for investing.

Also Canada’s success in the mining industry is due to the emergence of smart policies that are tailored to the unique attributes of the mining industry. For instance, government shared the costs of many large regional infrastructure projects to open up areas (e.g. rail line to Pine Point mine, rail lines to the iron ore fields in Labrador, hydro power for Yellowknife Gold mines, etc.), and in the 1950s and 1960s the Federal Government introduced the “Emergency Gold Mining Assistance Act” to aid gold mines throughout the country struggling with the low fixed price of gold in the inflationary period from 1950 – 1971. This programme enabled numerous towns in northern parts of the provinces to survive until a new wave of base metal mines replaced the aging gold mines (e.g. Kidd Creek in Timmins). Nowadays the government is studying the best ways to promote mineral exploration in northern and remote Canada¹.

More recently, Canada-tailored policies such as the Canadian Mineral Exploration Tax Credit scheme or flow-through shares allowed the strengthening of a successful exploration cluster in Vancouver fostered by the world-leading financing cluster in Toronto (the Toronto Stock Exchange is the dominant financial market for global mining, listing 57% of the world’s public mining companies, and a leader in global mining equity financings in comparison to other stock exchanges around the world). Canada’s strong, diversified and well-funded financial system (capital markets) has been of great importance in explaining the access to capital behind the dynamic mining sector.

A more complete and detailed analysis of these issues will be found in the Transactional Analysis Report produced in WP1.4 (D 1.5 Report on transactional analysis of Industry and Trade).

9.2.2 Education and outreach

Canada’s mining education has a long-standing good reputation. Similar to other sectors, mining education is also funded mostly through the money that governments transfer to individual students

¹ http://mining.ca/sites/default/files/documents/Levelling_the_Playing_Field.pdf

through loans, grants, and education tax credits. All across Canada there exists a number of tertiary institutions offering a full range of mining-related education and training spanning from geology, environmental sciences and geomatics engineering to mining technology and engineering, and metallurgical engineering. For instance, mining engineering programmes are available at the Universities of British Columbia, Saint Mary’s University, University of Alberta, Queen’s University, and McGill University. Despite a good mining educational infrastructure, the Canadian mining sector has been facing a shortage of skills locally. There is dissatisfaction that locally available training schemes and apprenticeships do not always succeed in the successful transfer of knowledge from experienced workers to new comers. One of the main reasons behind it is an ageing workforce and the lack of sufficient graduates to replace them. Despite an increasing number of coordinated efforts between the industry, educational institutions and the governments (federal, provinces and territories) (e.g. Canada Job Grant Programme by the federal government, the introduction of a Federal Skilled Worker category to recruit trained workers from abroad, etc.), in general the sector is still involved in a skills shortage process with fierce competition from companies in other countries recruiting Canadian graduates and workers. Thus, it still remains open whether the country will manage to successfully address the critical shortage of skills.

A more complete and detailed analysis of this issue will be found in the Transactional Analysis Report produced in WP1.3 (D 1.4 Report on transactional analysis of Education and Outreach).

9.2.3 Research and innovation

Canadian investments in research and innovation (R&I) in the mining sector have traditionally maintained the sector in a competitive position on a global scale. The mining industry has continuously invested in R&I, even during bust times and high risk, like in the 1990s when the sector invested in new, automated technologies that enhanced the economic viability of projects by lowering production costs.

The sector has undergone a profound change to a high-tech industry, and it has become a driving force in Canada's new knowledge-based economy. New technologies in mining have created a circle of growth and innovation that circulates through two-way linkages between mining and the rest of the economy.

A large part of innovations in the mining industry takes place in the exploration sector. Vancouver is the global centre of expertise for mineral exploration. Some 1,200 exploration companies are located in the British Columbia, most of which are in the greater Vancouver area. Also in exploitation innovation plays a central role. For instance in the 1960s R&I in reliable transport infrastructure (e.g. development of the ice roads technology) granted access for exploration first, and development later, of diamond orebodies in the Northern Territories. A more recent example is given nowadays by much of Canada's remaining base me-

tals which are likely located two kilometres or more beneath the surface. This situation presents cost and operational challenges. In response, the industry is investing in remote-operated equipment, automated loading and transportation systems, robotics and seismic mapping. With these technologies, companies can mine at a greater depth and keep mines open that would otherwise close. Many of these innovations have been funded by the industry, whereas government-funded research mechanisms need to change as they are not aligned and it is claimed that they do not provide support commensurate with the industry's innovation needs, priorities and contributions (Marshall, 2014).

A more complete and detailed analysis of this issue will be found in the Transactional Analysis Report produced in WP1.2 (*D 1.3 Report on transactional analysis of Research and Innovation*).

Appendix CA1: Multi-factor matrix and radar charts

The multi-factor matrix

The information in the preceding sections of this report is summarised in a multi-factor matrix which is presented in Appendix A2. In each Country Report, the findings of the research (presented in Chapters 4 to 8 inclusive) have been used to develop a “multi-factor matrix”. The matrix for each Reference Country aims to both summarise the findings of the research and to represent the relative importance of each factor to the economic development of each country.

The weightings ascribed to factors in the matrices (and the ‘radar charts’ to which they give rise) are included for completeness in this report; this organisation of information and preliminary analysis of findings provides the basis for ongoing discussion within the WP1 team and between the WP1 team and the expert panels.

Each matrix has 6 columns as indicated below.

Category | Code | Subcategory | Weight | Justification of judgement | Source

Five main categories of factors have been considered (column 1), reflecting the main chapter headings in each of the country reports (see above).

These are further divided into subcategories, consistent with the sub-sections of each chapter (one for each of the 49 explanatory factors), and the codes ascribed to the sub-categories are the sub-section numbers (columns 2 and 3). The importance of each subcategory has been ascribed a numerical weight in column 4, using the following scale:

Table 1: Numerical weights for fulfilling the multi-factor matrix

Weight	Level of importance
5	Very high importance
4	High importance
3	Medium importance
2	Low importance
1	Very low importance

The assignment of weights for the multi-factor matrices has been a collaborative effort between WP 1 partners with input from the country experts. A short justification for the ascribed weighting is given in column 5 and the source(s) of information are given in column 6.

Sub-totals are given for the weighting scores at the end of the matrix section for each main category and, at the end of the matrix, an average score is created for each main category by dividing the sum of the weighting scores by the number of factors (subcategories) considered.

Radar charts

The information and weighting scores assigned in the matrix have been summarised via 5- and 12- axis “radar charts” (Figure 27 and Figure 28). The five axis charts depict the relative importance of the five main categories of factors considered, by plotting the average weighting score on the relevant axis. To further emphasise the relative

importance of the primary factors, the sizes of the points on the radar chart are proportional to the average scores.

To provide more detailed insight into the relative importance of factors in the multi-factor matrices, a more ‘granular’ radar chart has been produced for each country, with 12 axes, each representing one (or a group) of the subcategories in the matrix. The 12 factors selected are as follows (numbers in brackets are the codes (and sub-section numbers) relating to the 12 factors chosen):

Geo-environmental Factors (Chapter 4)

1. Natural and mineral resources (4.2)

Socio-cultural Factors (Chapter 5)

2. Demographics and immigration (5.2.1)
3. Cultural norms and values (5.2.5)
4. Education system & infrastructure (average of 5.3.1 and 5.3.2)

Economic factors (Chapter 6)

5. Economic output (6.2.2)
6. Foreign investment (6.2.7)
7. Energy system and consumption (6.3.1)
8. Transport infrastructure (6.3.2)

Political and legal factors (Chapter 7)

9. Resources ownership & property rights law (7.2.2)
10. Trade and trade policies (average of 6.1.3 and 7.1.7)

Technological factors (Chapter 8)

11. Knowledge and resource base and R&D culture (average of 8.1.1 and 8.1.2)
12. Patents, products and technology (8.2)

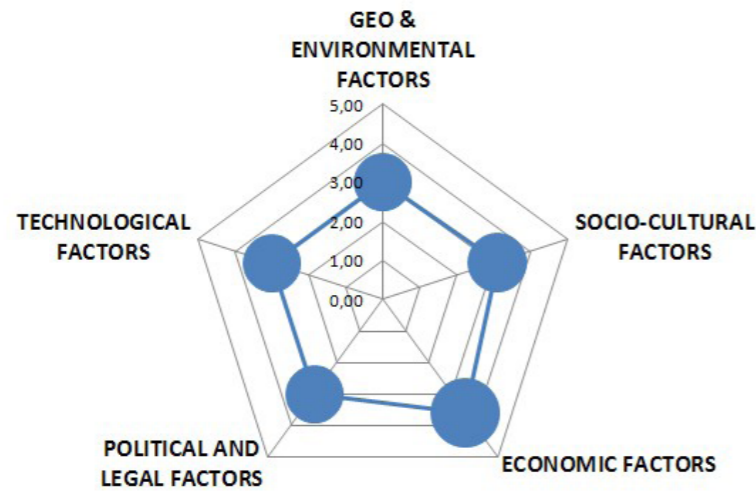
The choice of 12 factors and groups of factors from the 49 subcategories in the multi-factor matrix was subjective and the final selection was based on discussion within the WP1 team and with the country experts. These are intended to allow for more detailed characterisation of and comparison between the reference countries and, ultimately, with EU countries. They have been selected to be broadly consistent with key factors provided by the World Economic Forum in its Global Competitiveness Report, and to be equally relevant to explaining economic development in general and the raw materials sector in particular in all countries included in this project. Unlike the 5 axis chart, the plotted points on the 12 axis chart are all the same size.

Five axis radar chart for Canada

Canada’s resources and manufacturing industries have continuously been the backbone of the country’s economic growth based on exports and a relatively medium-large domestic market. The services sector, which currently dominates the economic structure, is inextricably linked to the natural and mineral resources sector as the latter relies on a range of goods and services such as financial, business, transportation, and wholesaling services.

Canada’s trade, first with Britain and then with the U.S as the largest trading partner, is another factor highly explanatory of how the “trading nation” favoured by increasing terms of trade, managed to achieve high living standards based on continuous exports. Likewise, such exports, particularly those based on natural and mineral-based commodities combined with a small population, are based on a generous endowment of resources over a big territory and a good transport network allowing the mobility of goods and services towards ports.

Figure 27: Five axes radar chart for Canada.

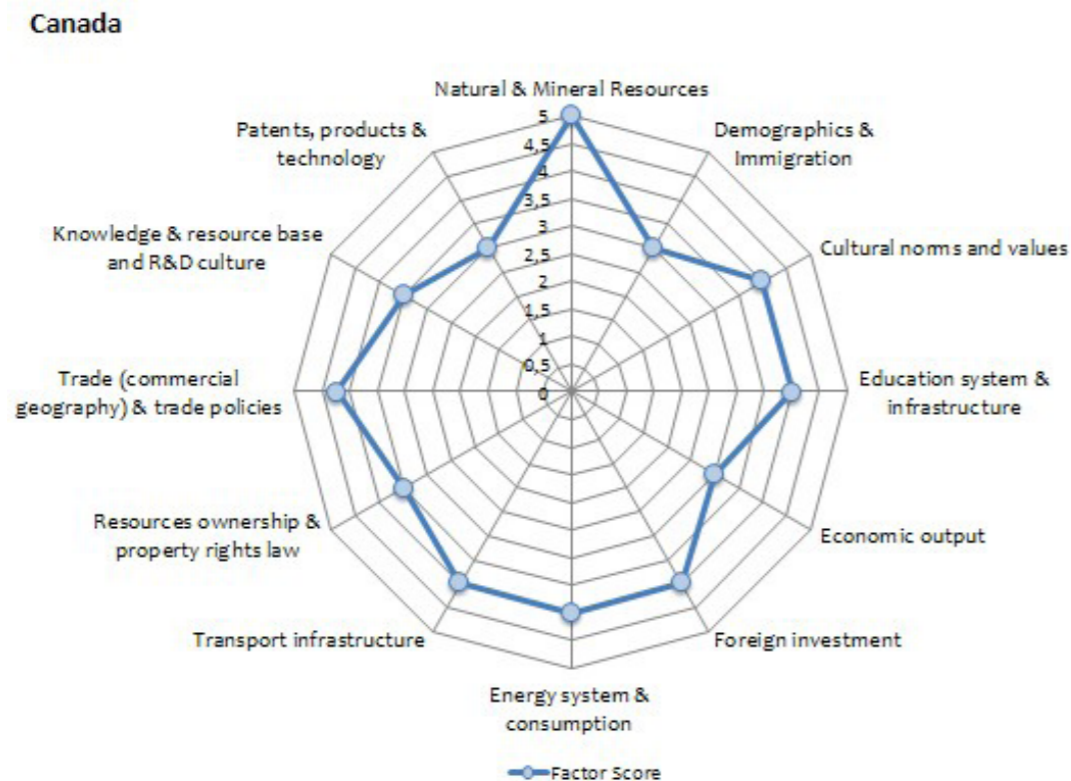


12 axis radar chart for Canada

A more detailed analysis (**Figure 28**) reveals the importance of the institutional context (rule of law, political stability, and the mineral ownership scheme of separable surface and mineral rights) which has favoured the flourishing of the forestry (and pulp and paper), and energy and non-energy minerals extractive industries, e.g. by promoting the role of pioneer prospectors companies (Canada has the world's largest cluster of junior exploration firms).

Also of importance are socio-cultural factors, such as a high educational level, a universal access to health, and of cultural norms and values based on an immigrant culture such as individualism, competition, a sense of motivation to achieve and accomplish objectives. Investments, particular inward investments from the USA have also been a key enabler. By contrast, the population growth creating a small but affluent domestic market and investments (private and public) in R&D have been factors with a low influence on determining the country's economic development.

Figure 28: Twelve axes radar chart for Canada



Appendix CA2: Canada multi-factor matrix

Category	Code	Subcategory	Weight	Justification of judgement	Source
GEO & ENVIRONMENTAL FACTORS	4.1	Geographical Situation	5	Canada's geo-political situation has favoured the country's economic development during different periods. During the 19th century, Canada benefited from trade with Britain, during WWII Canada benefited from its position by becoming an important supplier of military provisions for the English economy, while being distanced from the actual war zone. More recently, its strategic location next to the USA has enabled long-standing free-trade commercial agreements such as the Auto Pact or the NAFTA which have tied both North American economies and explain much of Canada's long-standing economic success	STATCAN, 2015a
	4.2	Natural & Mineral resources	5	The natural & mineral resources wealth has been very important in Canada's economic development history. Even though other industries such as the automobile has been of importance, resource-based exports (commodities such as wheat, pulp and paper, wood, energy and non-energy minerals) have continuously been the backbone of the Canadian economy.	Green, 2000; Pomfret, 2013;202
	4.3	Water resources	4	Water availability (well-watered regions) has also been very important particularly for the energy sector (thermal power plants and hydroelectricity generation - Canada is the second largest hydroelectricity producer in the world after China -), forestry-based industries, the mining industry and the agricultural sector	Canada West Foundation, 2010; Government of Canada, 2013b
	4.4	Climate	1	Despite risks imposed by sudden changes in the climate, the country has managed to lead forward its economic development process	-
	4.5	Geological Factors	1	Each year, more than 3,500 mostly small earthquakes are recorded in or near Canada, 50 of which can be felt. Canada has a history of very few destructive earthquakes (largest in 1949 in the Queen Charlotte Islands). Volcanic eruptions have not had an important role in the economic development.	Etkin and Dotto, 2010
	4.6	Ecologically Sensitive Areas	2	Canada's ecologically sensitive areas have moderately impeded the development of mining and other activities.	-
Subtotal		All geo & environmental factors (6)	18		
SOCIO-CULTURAL FACTORS	5.1	Historical Background	4	Canada's inflection points (Great Depression of the 1930s; World War II and the 1970s) were important as they indicate periods of structural change in the economy, shifting from protectionist periods towards an economy more open and closely related and integrated with the USA during the second half of the 20th century	Green, 2000; Marshall, 2014
	5.2.1	Demographics	3	Canada's population has grown to 35 million and is almost 10 times smaller than the USA. The affluent population does constitute a moderately important national market which has contributed to the long-run economic growth	OECD, 2014a; United Nations, 2015a

5.2.2	Ethnic composition	2	Canada is a multicultural society, with strong roots by the immigrants shaping the country. The ethnic heterogeneity has played a modest role for the economy.	Chui, 2013; Sze, 2012	
5.2.3	Languages	3	The ability to speak English and French has certainly increased the opportunities of the workforce and of Canada in the international market.	STATCAN, 2014a	
5.2.4	Religion	1	Most Canadians are affiliated with a Christian religion. This has not played a key role in Canada's economic development.	Chui, 2013	
5.2.5	Cultural Norms, Values & Conflicts	4	Canada's cultural tradition (immigrants) has reinforced achievement motivation, individualism, a competition-driven society which has been important drivers of innovation, for instance promoting a pioneer prospecting and exploration activities in search of a big project which may return millions in profits for shareholders.	The Hofstede Centre, 2015; Granato et al., 1996	
5.2.6	Civil society & environmental awareness	3	Canada's civil society is quite active and the environmental awareness is widespread in the society. Conflicts with First Nation communities have occurred and still occur with the mining industry, but this is not a major impediment.	Tanner, 1997; Christmas, 2014; Halley, 2013	
5.3.1	Education System	4	Canada has a highly educated population (and workforce) with high attainment levels. Education is seen in Canada as a route to increase earnings and improving living standards. It is also key for productivity growth and for the industry's success (currently the shortage of skilled labour is a challenge for the mining industry).	Conference Board of Canada, 2015a; Brochu et al., 2013; OECD, 2014b	
5.3.2	Education infrastructure	4	Canada has a good educational infrastructure which has enabled the country to attain very high education levels for its workforce, an important factor explaining economic growth.	STATCAN, 2013b	
5.4.1	Health system	3	Canada's population (and workforce) is generally healthy and the universal health care system has contributed to the strong economic performance. First Nations people and Inuit face some serious health-related challenges, such as high rates of chronic and contagious diseases (heart disease, type 2 diabetes, tuberculosis) and shorter life expectancy. The universal health care system has contributed to the strong economic performance.	STATCAN, 2013; OECD, 2014d; STATCAN, 2014b	
5.4.2	Health infrastructure	3	Canada's health infrastructure ranks below OECD average but relatively high in the world. Thus, its contribution to economic development is evaluated as moderate.	OECD, 2014c	
Subtotal		All socio-cultural factors (10)	34		

ECONOMIC FACTORS	6.1.1	Economic structure	4	Canada is now a services-based and oriented open economy. The change in the economic structure over time explains much of the economic development closely linked to the export of natural and mineral commodities. Canada's well-funded and strong capital markets have been key for the flourishing of the energy and non-energy mineral sectors, e.g. for the exploration cluster of junior mining firms.	Green, 2000; Government of Canada, 2013c; KPMG, 2014
	6.1.2	Industrial Geography	4.5	The manufacturing industry (food, automobiles, automobile parts) have been very important for Canada. If the forestry, mining, and oil and gas extractive industries are included, then they have been a backbone of Canada's economic development (much of the services which dominate GDP growth are closely related to these industries)	Baldwin and Macdonald, 2009; Green, 2000; The Canadian Chamber of Commerce, 2013
	6.1.3	Commercial Geography	4.5	Canada is considered a trading nation and its commercial relations with the USA (Canada's largest partner since early in the 20th century) have been a key factor enabling the growth of the economy and of living standards.	Cameron and Vesselovsky, 2014; Government of Canada 2009; Baldwin and Macdonald, 2012a
	6.1.4	Agricultural Geography	3	The agricultural sector was quite important in the early development of the country but its role has reduced its importance during the transition of the economy.	Green, 2000
	6.2.1	Economic diversity	3	Canada is unusual among developed countries in the importance of the primary sector, with the logging and oil industries being two of Canada's most important, thus, its economy tends now to be less diversified. During history, its economy was also less diversified than the USA for instance.	Mendleson, 2012
	6.2.2	Economic output	3	Canada's annual economic growth (measured by GDP growth) averaged 3.3% (1961-2014) with some recessions which explains moderately how the economy has grown and remained strong.	United Nations, 2015b
	6.2.3	Labour costs, mobility & employment	3	Labour costs have remained relatively stable in the last 3 decades and productivity has not increased. Unemployment has remained relatively low, and employment in the resources sector (including mining industry) has been an important contributor, particularly due to high salaries, and for First Nation people.	Marshall, 2014; NR-CAN, 2015b
	6.2.4	Interest rates	3	Bank of Canada's use of interest rates has been moderately important. The Bank raised interest rates considerably during the 1980s but then they have been maintained low aiming at boosting the economy and keeping inflation low.	Masson 2013
	6.2.5	Inflation rates	3	Inflation has been under control of the Bank of Canada since the 1970s via monetary policy. It has not been a key concern for the economic development since then.	Inflation.eu 2015
	6.2.6	Customer liquidation and spending power	3.5	The majority of Canadian households have lately increased their level of debt, which explains the deficit-financed spending power of the society and living standard. High spending power of a small population is explained due to rising terms of trade.	Uppal and LaRoche-Côté, 2015

6.2.7	Foreign investment	4	Foreign direct investments (inward and outward, particularly of the mining industry, and especially by the USA) explain much of Canada's economic development as a settler economy.	CIA, 2015d; CIA, 2015e; Baldwin and Macdonald, 2012a; Green, 2000; Marshall, 2014; Trading Economics 2015	
6.2.8	Public finance situation	3.5	Canada's federal (accumulated) gross public debt increased considerably since the 1960s and this has played an important role in Canada's development as borrowing financed much of the deficit spending in the domestic market (e.g. housing). Public debt to GDP ratio was reduced after mid-1990s but increased considerably in the last years at around a 90% which is considered still healthy level (after a debt turning point of around 90%-94% negative effect on growth prevails)	Menginger et al., 2015; Trading Economics, (2015c)	
6.3.1	Energy system, consumption & access	4	Canada figures as the 10th world's largest oil consumer country which indicates the importance of oil and natural gas for the energy matrix. On the supply side, Canada is the world's 5th largest producer of crude oil.	EIA, 2014; NEB, 2015a; STATCAN, 2015b	
6.3.2	Transport infrastructure	4	Canada is a vast country with large distances which have been overcome by an efficient transport infrastructure based on railways, roads, ports and hubs. Canada's transportation network forms the backbone of the country's economy.	COMT, 2014; MPWGS, 2014	
Subtotal	All economic factors (17)	50			
POLITICAL AND LEGAL FACTORS	7.1.1	Administrative structure	1	Canada is divided into 10 provinces and 3 territories each with its own regulations for the industry. The variability in regulations has not acted as an important factor in the economic development.	SNL Metals & Mining, 2015
	7.1.2	Governmental stability & transparency	4	Canada is considered a politically stable parliamentary democracy with very low risk of political instability. It also ranks as a non-corrupt country (position 10th in the world in the Transparency International Corruptions Perceptions Index 2014). Such traditional political stability has been very important in attracting investments, e.g. in the mining industry.	Transparency International, 2015; The Economist, 2009
	7.1.3	Fiscal policies	3.5	Canada's changing fiscal policy (government revenue and expenditures passing from Keynesianism to a mix emphasizing healthy government finances) have been of importance during different economic periods. Canada is considered in general to have an uncompetitive tax scheme; however, it is considered very favourable for the mining industry, e.g. seen in the cluster of junior exploration firms and the world's prevalence of Toronto as a mining finance centre.	KPMG, 2014; Makarenko, 2009; The Canadian Chamber of Commerce, 2013
	7.1.4	Government spending priorities & allocation	3.5	Government spending slightly declined expenditure in education, health, national defence, housing, and income security during 1992-2001, but the allocation of the budget still defines a large part to the Health System and to education and social programmes, which indicates the important role of the Canadian state in maintaining a healthy and well-educated workforce.	Department of Finance Canada, 2014

7.1.5	National Security	2	Defence spending was an important economic development factor during WWII as Canada became a main supplier of military equipment to Britain, but during peacetime it has had a relatively low importance in Canada's economy	Stone and Solomon, 2005
7.1.6	Safety & crime	1	Canada is a safe country, and its main cities are considered amongst the safest in the world. Safety has had a low role in the economic development.	Di Matteo, 2014; The Economist, 2015
7.1.7	Trade policies	4	Trade policies (shifting from protectionism via high tariffs to a more open economy) have been important instruments guiding economic development	Baldwin and Macdonald, 2012a; Hart, 2002
7.1.8	Bilateral, Multilateral & International agreements	4	Canada's bilateral agreements (mainly with the USA, formerly with Britain) and international agreements (a large part of Canada's trade policy) have been essential in enabling the country to become a "trading nation".	Hart, 2002; Government of Canada, 2015a
7.1.9	Sustainable development policies	3	Sustainable development is a commitment by the government and the industry for long now, with the forestry and mining industries leading sustainability practices. However, for the mining sector, much controversy and criticism exists toward companies' behaviour and impacts abroad.	NRCAN, 2015c; Butler, 2015; Deneault et al., 2008; Deneault and Sacher, 2012; Hill, 2014; KPMG, 2014
7.2.1	Legal Framework	3.5	The legal framework and the rule of law has had a moderate importance in attracting investments, and a high importance particularly for mining investments (Canada ranks in the top of investor friendly countries for mining investments)	KPMG, 2014; Jackson and Green, 2015; Wyatt and McCurdy, 2014
7.2.2	Resources Ownership & Property Rights Law	3.5	In Canada land (surface) and mineral rights are separable which indicates that individual (prospectors) or mining companies only need to obtain a lease (not buy) from the Crown to exploit the sub-surface minerals or the surface forests. This mineral ownership scheme has been instrumental in promoting exploration among individuals (pioneer prospectors) and junior companies incurring in high up front costs with the hope of making a significant discovery.	PDAC, 2015; KPMG, 2014
7.2.3	Business legislation	3	Business legislation and a favourable environment for investments have been moderately important attracting investments to Canada (Canada ranks 16th in the world in the Ease of doing Business indicator of the World Bank 2014)	World Bank, 2014
7.2.4	Employment, Labour laws & Unions	3	Labour laws are quite stringent and well-regulated in Canada. The union coverage rate in Canada has been declining since 1997 from a 34% to a 31% nowadays (2013). Unions and labour laws have had a moderate importance.	KPMG, 2014
7.2.5	Environmental regulations & their enforcement	3	Like other developed nations, Canada has strong environmental regulations and high enforcement capacity. With regards to CO2 and GHG emissions, the country has developed enabled by becoming responsible for 2% of the world's (historical) cumulative GHG and CO2 emissions in the periods 1990-2011 and 1850-2011 respectively.	Blakes Lawyers, 2012; Ge et al., 2014; Government of Canada, 2015b
Subtotal	All political and legal factors (13)	42		

8.1.1	Knowledge and resource base	4	Canada's science, technology and industry system is well established. Canada is well supplied with good universities, engineering schools, teaching hospitals, and technical institutes. Canada ranks relatively high in the world in terms of R&D personnel, expenditure on R&D and attractiveness to researchers & scientists. However, it ranks middle in the OECD on public and private spending on R&D. In general business expenditure on R&D is lower in comparison to other peer countries. Canada's public geoscience data has been very important for the development of the mining industry.	World Economic Forum, 2014; Institute for Management Development, 2014; Conference Board of Canada 2015b
8.1.2	R&D culture	3	In general, Canada does not have a strong R&D culture, and ranks poorly internationally in innovation. Canadian companies are thus rarely at the leading edge of new technology and too often find themselves a generation or more behind the productivity growth achieved by global industry leaders. University-industry collaborations are not well-developed. However, unlike the general trend, the Canadian mining industry is a global leader in capital investment, financing and innovation. The forestry industry is also investing much in succeeding its restructuring.	Conference Board of Canada, 2015c; Board of Trade of Metropolitan Montreal, 2011; Global Economics Limited, 2001; Marshall, 2014; CSLS, 2012; Minallance, 2012
8.2	Patents, products, technologies generated	3	Canada ranks 7th in the world (2011) in terms of scientific articles published by origin of author, in terms of patent applications (2012) Canada ranks 13th in the world behind the USA and Japan, regarding patent grants, Canada ranks 14th in the world and 17th if patents in force are examined. This evidences that Canada ranks relatively high in the world (top 20) but its R&D has not in general been a major explaining factor of Canada's economic advanced status.	Institute for Management Development, 2014; Council of Canadian Academies, 2013
8.3	Telecommunications & E-commerce	2	Telecommunications have played a moderate role in the last decades of economic development. Canada has a high internet penetration, ranks 5th in the world in terms of computers in use per capita, and it is the 11th largest e-commerce market in the world.	ITU, 2014; ATKearney, 2015
Subtotal	All tech factors (4)	12		

RADAR CHART	Sum of weights	Number of factors	Average	Multiplied by ten (to create the size of the point in the radar chart)
GEO & ENVIRONMENTAL FACTORS	18	6	3.00	30
SOCIO-CULTURAL FACTORS	34	11	3.09	30.9
ECONOMIC FACTORS	50	14	3.57	35.7
POLITICAL AND LEGAL FACTORS	42	14	3.00	30
TECHNOLOGICAL FACTORS	12	4	3	30

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