Canada’s Standard of Living in 2042: Will Policy Keep Pace with Technology?

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Visions For Canada 2042
Imagining the Canada of the Future
March 2nd-4th, 2017
Carleton University
HOW WILL TECHNOLOGICAL ADVANCE IMPACT CANADA IN 25 YEARS FROM NOW?

- Economic
- Social
Labour Market

\[
\frac{\text{Employed}}{\text{Population}} = \left( \frac{\text{Employed}}{\text{Labour force}} \right) \times \left( \frac{\text{Labour force}}{\text{Population}} \right)
\]

\[E-Pop\ RATIO = \text{EMPLOYMENT RATE} \times \text{PARTICIPATION RATE}\]
REAL INCOME PER PERSON

- A measure of Canadian Standard of Living
- It simultaneously reveals and masks many things
- It reveals how an average person is doing relative to previous generations, and relative to other countries
- It masks the distribution of income in the society
ECONOMIC GROWTH = the growth in REAL INCOME PER PERSON
Figure 1: Real income per person in Canada, 1914-2014
Figure 2: Real income per person in Canada, 1981-2014

Average growth = 0.9% per year
A Useful Decomposition

Level

\[
\text{REAL INCOME} = \text{PRODUCTIVITY} \times \text{HOURS PER PERSON PER HOUR PER PERSON}
\]

Growth rate

\[
\text{ECONOMIC GROWTH} = \text{PRODUCTIVITY GROWTH} + \text{HOURS GROWTH}
\]
Figure 3: Annualized Growth Rates of Output per Capita, Output per Hour and Hours per Capita
List of considerations

- Physical capital and investment
- Human capital (educational attainment)
- R&D, Knowledge, Ideas
- Economic policies
- Demographic shifts (baby boomers, immigration)
- Climate change
- Health care
- Globalization
- Institutions

In today’s presentation we will mainly focus on the four items in bold
MODERN IDEAS-ORIENTED GROWTH THEORY

The stock of ideas drive growth (Romer 1990, Aghion and Howitt, 1992)

\[
\text{PRODUCTIVITY GROWTH} \propto \left\{ \frac{K}{Y}, H, \text{Ideas}, n \right\}
\]

- \( \frac{K}{Y} \): the capital-to-output ratio
- \( H \): OECD defines human capital as the ‘productive wealth embodied in labour, skills and knowledge’.
- R&D: The global intensity, ideas are non-rivalrous, so global idea creation matters (global researchers producing new ideas)
- \( n \): The higher the population rate, the higher the number of researchers producing ideas
Sources of Canadian Productivity Growth

This modern ideas-oriented theory implies (Jones, 2002)

\[
\text{PRODUCTIVITY GROWTH} = \text{TRANSITIONAL GROWTH} + \text{LONG-RUN GROWTH} \{K/Y, \mathcal{H}, \text{Ideas}\}
\]

Based on Hasanzadeh-Khan (2017)
Canada: 1981-2014

\[1.09\% = 1 \text{ percentage point} + 0.09 \text{ percentage points}\]
CAN WE COUNT ON TECHNOLOGICAL IDEAS TO DRIVE LONG-RUN GROWTH IN THE FUTURE?
Technological change

- Productivity growth varied considerably in past ⇒ Distinct “technological eras” of ideas (David 1999, Jovanovic 2005)

- “General purpose technologies” - Deep inventions that are pervasive, improving over time, give rise to spin-off inventions

  - IR1 - Steam engine, railroads (1750-1830)
  - IR2 - Electrification, internal combustion, indoor water/plumbing (1870-1900)
  - IR3 - Informations and communications technologies: computers, internet, digitization, robotics, AI (1960 - ?)
GPT’s, frontiers and productivity

- Where does a small country like Canada fit into these “technological eras”? ⇒ Spill-overs from global “technological frontier” of ideas (Gunn 2013)

- IR2 had substantial impact on global technological frontier and thus productivity in frontier country US from late 1800’s to 1970’s (David 1991, Gordon 2015)


- Huge debate in literature about future impact of IR3 on productivity
Will IR3 create high future growth?

The pessimists (Gordon 2015):

- Late 90’s surge from IR3 was it
- IR2 transformed work and cultural life, happen only once
- Recent innovations centered on entertainment

The optimists (Brynjolfsson & McAfee 2014):

- Late 90’s surge was just the beginning
- Digitization technologies not subject to as tight “physical constraints” as IR1, IR2 “muscle power” innovations
- “Inflection point” in innovation, very significant developments in very short time
Moore’s Law

**Figure 4:**

**FIGURE 1.** A plot of the increasing number of transistors per CPU confirms the accuracy of Moore’s prediction. Note that the vertical axis is log scale.
IR3 and inequality

• Much of debate has focused on predictions about average productivity in future

• But researchers tend to be in much more agreement about implications of IR3 for inequality

• Not a new worry. Past IR’s caused significant labour displacement: machine automation of “muscle power” performed by humans

• But “automation anxiety” was largely misplaced as new categories of jobs created (Akst 2013, Acemoglu 2016)
But is this time different?

- Machine automation of “mental power”

- Humans thought to retain comparative advantage at “extremes” of skill distribution (Autor 2015), complex cognitive and communicative tasks (Acemoglu 2016, Brynjolfsson & McAfee 2014)

- But ICT threaten moving into areas previously thought safe domain of humans

- Result: increased likelihood of rising inequality among labour
IR3 and capital-labour inequality

- Digital/digitized goods non-rival, can be reproduced at very low marginal cost

- As result, scale of production of new product can be enormous, and can replace entire industry of workers.
  - Ex. TurboTax software (Brynjolfsson & McAfee 2014)

- Income that previously flowed to the workers now flows to the creator of the idea/product

- Large amount of income of new products concentrated in relative few capital owners
Figure 5: Average and median income in Canada
Figure 1

Comparable estimates of the intergenerational elasticity between father and son earnings for the United States and twenty-one other countries.

Source: Published estimates collected by the author and using the methods in Corak (2006).
CONJECTURE

It is likely that the gap between average and median incomes will continue to diverge over the next 25 years.

Why?
Because machines are becoming better at substituting humans out of their jobs

- Wait....if machines are so good at replacing humans, why do we still have jobs? - The Polanyi’s Paradox (Autor, 2015)
- It must be because ‘We can know more than we can tell’ (Polanyi, 1966), and machines are not good at this
- But this view is challenged (i.e., machines are becoming better at replacing humans)
  - Machine Learning
  - Environmental Control
Economics:
Scarcity ⇒ Distribution

- Economic policies aimed at **REDISTRIBUTION OF INCOME** are likely to become extremely important for the Canada of the future.

- Will Policy keep pace with technology?