Technical Appendix

Data, methodology and modelling behind the research

From resources to resilience: How Canada can capture more value through trade

September 2026

By Prerna Sharma, principal economist, EDC Economics
Malcolm Fisher, associate quantitative analyst, EDC Economics

Canada

Export Development Canada EDC

Table of contents

Economic Complexity Index

The Economic Complexity Index (ECI) is a measure of how sophisticated and diverse a country's productive capabilities are. Developed in Hausmann et al. (2014), the ECI combines country-to-country trade flows across thousands of products into a single measure that has been shown to be closely related to long-term gross domestic product (GDP) growth. The computation starts with the idea of revealed comparative advantage (RCA), which compares how strongly a country exports a product relative to the world average. From this, a binary matrix is built that records whether a country is specialized in a product (indicated where RCA > 1). This matrix captures two key concepts.

- **Diversity**: How many products a country exports with RCA > 1
- **Ubiquity**: How many countries export a product with RCA > 1

To combine these related concepts into a single index, ECI uses a network-based approach. The country-product matrix is multiplied by itself and then transformed using diversity and ubiquity weights. The final step is to extract the eigenvector associated with this transformed matrix, which identifies a stable ranking of countries based on their position in the network. After normalizing the eigenvector values, we have a country's ECI score, where higher values indicate countries with more complex, knowledge-intensive production structures. The eigenvector values are often transformed using z-score standardization to improve the interpretability of the measure.

Methodology: Growth model

To estimate the relationship between economic complexity and long-run economic growth, we employ a panel regression framework relating the ECI to long-term growth in real income per capita.

$$g_{i,t\to\Delta t} = \beta_0 + \beta_1 \ln \frac{\text{GDP}}{\text{Cap}}_{i,t} + \beta_2 \text{ECI}_{i,t} + \beta_3 \text{COI}_{i,t} + \beta_5 \text{HC}_{i,t} + \tau_t + \varepsilon_{i,t}$$

The dependent variable is real GDP per capita growth[1], measured as a 10-year compound annual growth rate (CAGR) using constant purchasing power parity (PPP)-adjusted GDP per capita from Oxford Economics. PPP-adjusted GDP growth was chosen to control for cross-country differences in price levels and exchange rate fluctuations, which improves the comparability of real purchasing power of income across countries. The analysis uses 10-year growth windows (1994-2004, 2004-2014, 2014-2024) to focus attention on medium- to long-run growth dynamics, reducing the influence of short-term cyclical fluctuations.

1 Real GDP per capita growth is commonly used as a proxy for productivity growth, as it reflects changes in economic output relative to population over time.

The core explanatory (independent) variables included in the analysis are shown below in **Table 1**.

Table 1: Description of independent variables used in the analysis

Variable	Rationale	Source
Initial income (log of GDP/capita)	Countries with lower income are expected to grow faster.	Oxford Economics
Economic Complexity Index	Measures the sophistication and diversity of a country's productive capabilities. Serves as the primary variable of interest, capturing the extent to which an economy produces complex, knowledge-intensive goods. Countries with higher complexity are expected to grow faster.	The Growth Lab at Harvard University
Complexity Outlook Index	Measures the productive position of a country. A country with a higher COI is closer to more complex products that it isn't currently producing. It therefore captures the likelihood of future diversification into more complex products. Countries with a higher complexity outlook are expected to grow faster.	The Growth Lab at Harvard University
Human capital	Included to control for broad educational attainment and workforce skill levels. Its inclusion allows us to interpret ECI as capturing capabilities beyond general education. Countries with more human capital are expected to grow faster.	Penn World Tables

Using these variables, we estimate the regression on a balanced panel of countries across three 10-year periods (1994-2004, 2004-2014, 2014-2024). Time fixed-effects are included to control for global shocks affecting all countries. Country fixed effects haven't been included, as they would absorb most of the cross-country variation in ECI that we would like to capture in the regression. Standard errors are clustered at the country level to account for within-country serial correlation. The results of the regression are presented in **Table 2**.

Table 2: Regression results

Variable	Estimate
$\ln \frac{\text{GDP}}{\text{Cap}}_{i,t}$	-0.0140*** (0.000)
$\text{ECI}_{i,t}$	0.0078*** (0.007)
$\text{COI}_{i,t}$	0.0021 (0.122)
$\text{HC}_{i,t}$	0.0099** (0.003)
Constant	0.1258*** (0.000)
N	366
R^2	0.2043
Sample	(1994-2004, 2004-2014, 2014-2024)
Errors	Clustered by country
VIF	3.53

Note: P-values shown in brackets under the estimates. Standard significance stars are used (*: significant at 10% level, **: significant at 5% level, ***: significant at 1% level).

All of the coefficients are as expected. The coefficient on ECI is positive and statistically significant, and implies that a one-standard-deviation increase in ECI is associated with approximately a 0.78 percentage point (pp) increase in annual GDP per capita growth over the subsequent decade. This magnitude is economically meaningful. Over a 10-year horizon, a one-standard-deviation difference between two countries' ECI scores is associated with an 8.07% difference in total economic growth. The model's R^2 of 0.2043 is in line with what is typically found in the literature. Complexity based growth models focus on long-term drivers rather than short-term fluctuations in a country's economy. Since economic complexity reflects underlying productive capabilities that evolve gradually, a large share of observed GDP growth is driven by temporary shocks and business cycles. As a result, a relatively modest R^2 is expected. In this context, the value of the model is less about fit and more about capturing a clear link between complexity and long run growth (Hausmann et al., 2014).

To ensure robustness, we re-estimated the regression under alternative definitions of the dependent variable (nominal GDP per capita, real GDP per capita and current PPP GDP per capita). **Table 3** shows the results of these robustness checks. Across all specifications, the ECI coefficient remains positive and statistically significant. The magnitude of the ECI coefficient also remains relatively stable across these specifications (ranging from 0.0066 to 0.0105). This consistency reinforces the conclusion that economic complexity is a robust predictor of long-run growth, independent of how income is measured.

Table 3: Regression results under various specifications of GDP per capita

Variable	Baseline (Constant PPP)	Nominal	Real	Current PPP
$\ln \frac{\text{GDP}}{\text{Cap}}_{i,t}$	-0.0140*** (0.000)	-0.0275*** (0.000)	-0.0110*** (0.000)	-0.0142*** (0.000)
$\text{ECI}_{i,t}$	0.0078*** (0.007)	0.0105** (0.025)	0.0075*** (0.007)	0.0066** (0.041)
$\text{COI}_{i,t}$	0.0021 (0.122)	0.0006 (0.8462)	0.0021* (0.096)	0.0021 (0.150)
$\text{HC}_{i,t}$	0.0099** (0.003)	0.0394*** (0.000)	0.0124*** (0.005)	0.0099*** (0.000)
Constant	0.1256*** (0.000)	0.1809*** (0.000)	0.0904*** (0.000)	0.1426*** (0.000)

Note: P-values shown in brackets under the estimates. Standard significance stars are used (*: significant at 10% level, **: significant at 5% level, ***: significant at 1% level).

Feasibility analysis: A thought experiment

To complement the empirical analysis of the relationship between economic complexity and long-run growth, we conducted a feasibility analysis that simulates how Canada's export structure could evolve under a path-dependent diversification process. This approach builds directly on the economic complexity framework, as the products that are added are "nearby" in the product space to Canada's export basket, meaning they require similar underlying capabilities. So, each product that is chosen to be added to the basket shares similar required skills, technologies and production know-how as the products that Canada produces today with comparative advantage. In practice, this means the model adds products to the basket that build on existing strengths.

Starting from Canada's observed export basket (products with revealed comparative advantage > 1) in 2024, we iterated through the following process:

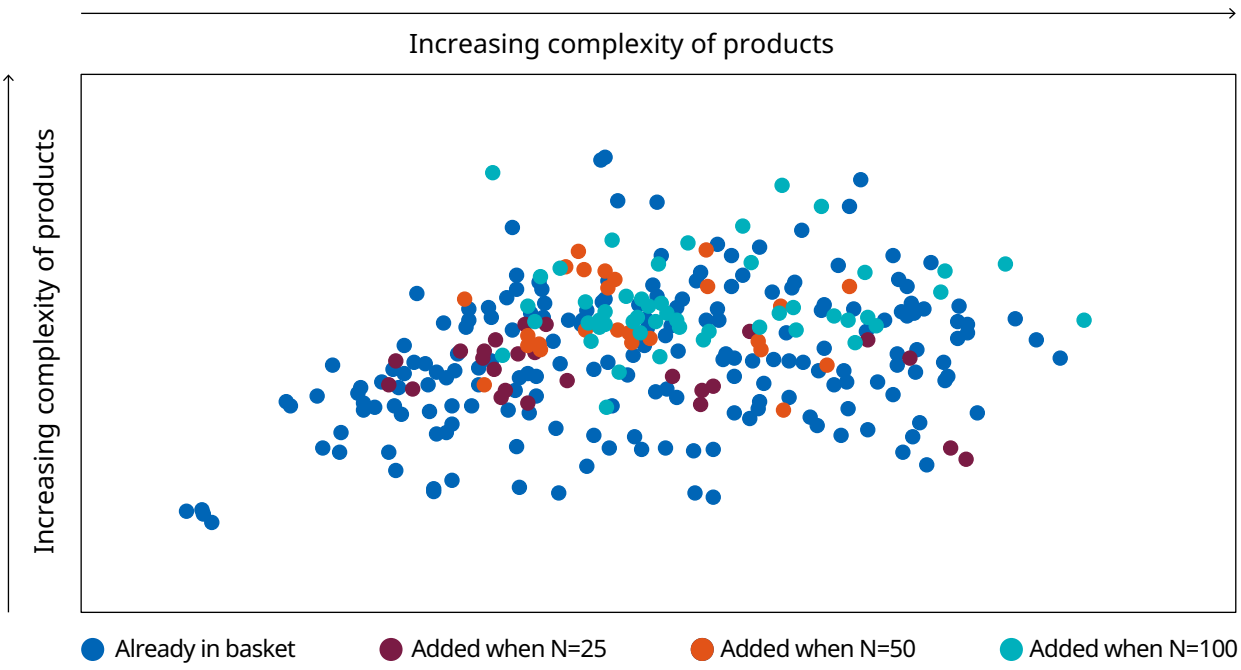
1. Add to Canada's export basket the product that meets the following conditions:
   - feasible (excludes mainly resource-driven products),
   - complexity-enhancing (products that would increase *Canada's Complexity Outlook Index*); and
   - closest in the product space (least distance to Canada's product space).
2. Recompute each country's *Economic Complexity Index*.
3. Recompute the distance of the remaining products that Canada doesn't export to Canada's product space.
4. Calculate the share of products in various categories that are in Canada's export basket.
5. Repeat from Step 1.

To maintain realism, the simulation is capped at 100 additional products. Beyond this point, the analysis becomes less meaningful and increasingly volatile, given that Canada begins with an already diversified export basket. It's also important to note that this analysis is conditioned on the current structure of global production and value chains. The model doesn't account for breakthrough innovations or general-purpose technologies that could fundamentally change the structure of global production patterns. As such, the results reflect path-dependent growth within the context of today's technological and industrial landscape.

Chart 1 visualizes Canada's position in the global product space in 2024, and how it evolves as new products are added through the simulation. Each point represents a product, and its position reflects its relationship to other goods in terms of shared capabilities. The added products tend to cluster around products Canada already exports with revealed comparative advantage, reflecting the nature of the process where only the closest products in Canada's product space are added to the basket. This suggests Canada would face higher costs in developing the capabilities required to produce data processing machines or photographic equipment (two of the Top 5 most complex products according to their PCI) and therefore these products aren't added to the basket in the analysis. Medical instruments and nuclear reactor components (also fairly complex products) on the other hand are added to the basket through the capability accumulation process, implying that Canada's product space is currently more aligned with these products.

Newly added products increasingly cluster in the upper-right region of the product space, which is generally associated with higher product complexity. This indicates that, as Canada diversifies, it is not only expanding the number of products it can competitively export, but also shifting toward more complex, capability-intensive activities.

Chart 1: Evolution of Canada's product space as products are added in the feasibility analysis



Source: The Growth Lab at Harvard University, EDC Economics calculations

Growth under different product upgrading scenarios

To project nominal GDP in 2025 Canadian dollar terms from a measure of future real GDP per capita in PPP terms, the process begins by computing the future value of real GDP per capita in PPP terms for the target year 2035. This value is then scaled using the ratio of nominal GDP per capita (in U.S. dollars) to real GDP per capita in PPP terms observed in the base year 2025, converting PPP-based real values into nominal equivalents in 2025 terms. To express the result in Canadian dollars, the adjusted per capita value is multiplied by the 2025 period-average exchange rate. Finally, multiplying by Canada's 2025 population yields the corresponding aggregate nominal GDP level.

References

Hausmann, R., Hidalgo, C., Bustos, S., Coscia, M., Chung, S., Jimenez, J., Simoes, A., Yildirim, M. (2014). The Atlas of Economic Complexity. Cambridge, MA: MIT Press.

Hidalgo, C., Klinger, B., Barabási A., Hausmann, R. (2007). The Product Space Conditions the Development of Nations. Science, 317(5847), 412-487. https://doi.org/10.1126/science.1144581

Lopes, C., Romero, J., Freitas, E. (2023). Smart diversification strategies differentiated by countries' complexity. CEPAL Review, Volume 2024, Issue 143, Aug 2024, p. 127 -147. https://doi.org/10.18356/16840348-2024-143-7

The Growth Lab at Harvard University (2026). "Growth Projections and Complexity Rankings" [Data set]. https://doi.org/10.7910/DVN/XTAQMC

The Growth Lab at Harvard University (2026). "Country Trade by Product" [Data set]. https://doi.org/10.7910/DVN/XTAQMC

Disclosure

Ce document est également disponible en français.

This document is intended as an overview only and doesn't provide specific advice. It shouldn't be relied upon as such. No action or decision should be taken without conducting detailed independent research and obtaining professional advice relevant to the specific subject matter.

Export Development Canada (EDC) has made reasonable commercial efforts to ensure the accuracy of the information contained in this document. However, EDC doesn't represent or warrant the accuracy, timeliness, or completeness of the information. This document, or any part of it, may become obsolete at any time. Users are responsible for verifying any information before relying on it. EDC isn't liable for any loss or damage resulting from inaccuracies, errors, or omissions in this document. This document doesn't constitute legal or tax advice. For such advice, please consult a qualified professional. EDC owns trademarks and official marks. Any use of an EDC trademark or official mark without permission is strictly prohibited. All other trademarks appearing in this document are the property of their respective owners. The information presented is subject to change without notice. EDC assumes no responsibility for inaccuracies contained herein.

Canada

EDC