Research Paper

ECON8270-1-R-2024F

Title: ***College Graduates and Economic Development: A Comparative Analysis of China and Canada***

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Abstract

This study examines the impact of higher education on economic growth in Canada and China, utilizing data from 2000 to 2023 from the National Bureau of Statistics of China, Statistics Canada, and the World Bank. Despite growing interest, comprehensive comparative studies are limited. Our findings indicate that increased government spending on education fosters growth in Canada but has a negative impact in China. While capital expenditure benefits both nations, unemployment significantly hinders growth in Canada, whereas its effect in China is weaker. The COVID-19 pandemic showed no notable impact on either country's growth, emphasizing the complex relationship between education and economic development.

Keywords: Educational impact, Economic development, Comparative analysis, Government spending.

1. Introduction

Economic growth is closely linked to the availability and quality of education, making it essential to study the role college graduates play in driving economic development. China and Canada, despite their differences in size and political systems, have heavily invested in education, recognizing its importance for long-term prosperity. In China, the rapid economic progress over recent decades is largely attributed to the expansion of higher education, resulting in millions of graduates entering the workforce (Qi et al., 2022). Conversely, Canada maintains an established educational framework focused on developing human capital to ensure sustained growth and economic competitiveness.

This paper explores the relationship between college graduates and economic development in China and Canada through a comparative analysis. Using the Cobb-Douglas production function, the study examines how key inputs, such as the number of graduating students, labour force, and capital, influence economic output (GDP) in both nations. The analysis aims to quantify the impact of educational investments and socio-economic factors on economic growth, revealing how these variables interact in distinct economic environments. Data from sources like the National Bureau of Statistics of China and the World Bank Group was cleaned and merged for this research. The results offer insights into how government policies and educational attainment contribute to sustainable economic development.

The analysis utilizes data from 2000 to 2023 to quantify the impact of educational investments and socio-economic factors on economic growth, revealing how these variables interact in distinct economic environments. In performing the regression analysis, we anticipate identifying a strong positive relationship between these variables and economic output, indicating that increased investments in education significantly enhance economic performance.

2. Background

In the past decades, China's economy has rapidly grown and is now the second in the world. Its accession into the World Trade Organization (WTO) in 2001 had already accelerated significantly the transformation which had integrated the country more into the global economy. In 2010, China also outgrew Japan in nominal GDP and in that way cemented its place as the second most important economy in the world. The economic growth in China has been fully linked to strategic investments that the country has made in education, building its human capital and creating the required foundation for economic well-being. Further steps towards improvement in education, especially in less-developed regions, will provide the grounds for sustaining economic growth in the future (Hanushek & Woessmann, 2008).

Canada's economic development is closely linked with its historical and industrial evolution. By the 1960s, the country was at a very high standard of living and significantly urbanized, incorporating most of the characteristics that defined more developed nations. By the 1980s and 1990s, Canada had been recognized as officially an industrialized and high-income nation, playing an important role in the world economy and part of international institutions like the G7 (Barro, 1991). The economic progress of Canada is critically entwined with its education system. Its multicultural nature and high standard have made Canada a hotbed in the global economy. International students annually spent approximately CAD 37.3 billion in 2022, comprising about 1.2% of Canada's GDP and supporting more than 360,000 jobs. In brief, Canada is a typical developed country, while China, although the second largest economy in the world, still faces low per capita income and large inequality in wealth distribution, so it is still a typical developing country. In this section, we give some necessary background information relevant to our research.

According to the National Bureau of Statistics of China, there were about 949,800 college students in China in 2000, but in 2023 it rocketed to 11,740,000, increasing as high as 12 times. While the number of college students in Canada increased from 850,416 in 2000 to 1,842,291 by 2023, according to Statista, this is just a two-time increase. This huge contrast in growth rates between the two countries reflects the sharp contrast in their educational expansion. Economic development is interlinked with the growth of education, and the GDP growth rate is a very important indicator in such studies.

The improvement in the educational system has greatly supported economic development in China. In Figure 1, the fast growth in the number of college students has been accompanied by sustained GDP growth of more than 6% before the COVID-19 pandemic. This correlation underlines that education has been instrumental in the economic development of China.

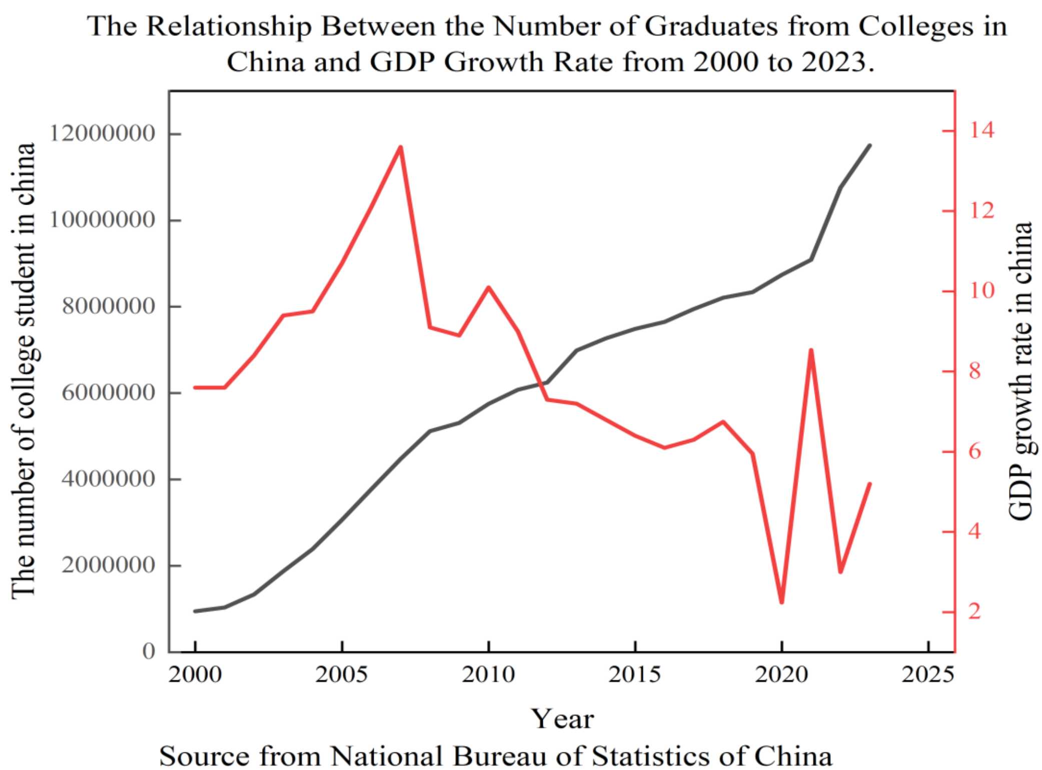

Figure 1

Figure 2 presents the number of college students in Canada. Though a general trend observed is upward, still there were two kinds of fluctuations. The first one was at the time of the global financial crisis that started in 2008, when initially the number increased and then showed a fall. In this time, the growth rate in GDP of Canada was observed as the lowest about -4.02%. The second fluctuation happened during the COVID-19 pandemic in 2020 and was marked by a steep increase in the number of college students followed by an abrupt decline. In this very period, Canada's GDP growth rate also suffered a strong drop, reflecting that economic difficulties are closely connected with ups and downs in higher education enrolment.

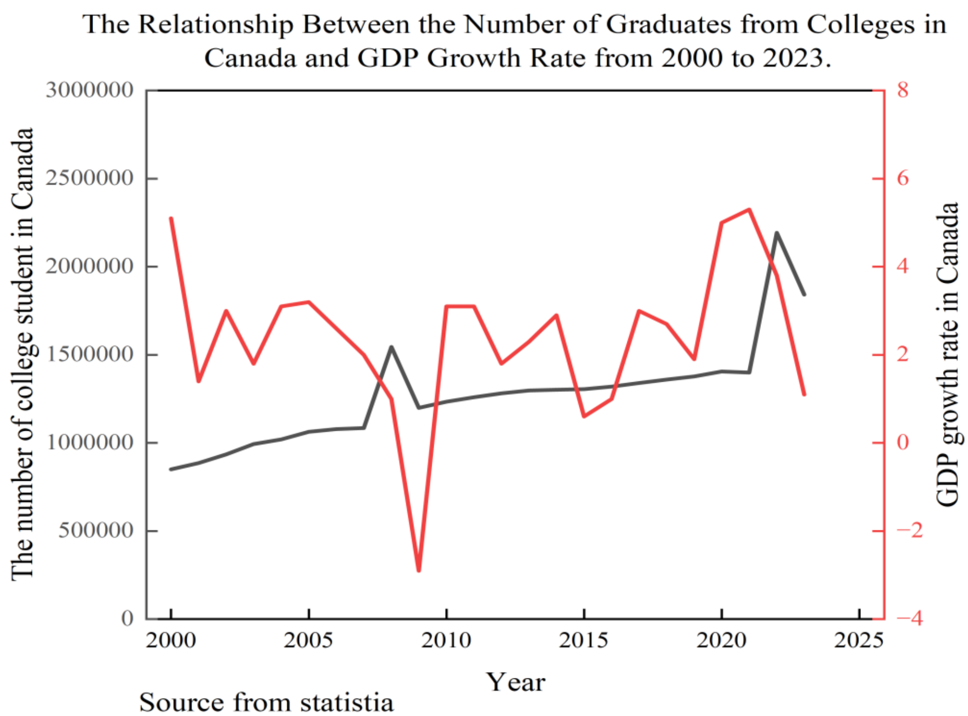

Figure 2

Another critical indicator is the education expenditure growth rate. As shown in Figure 3, Canada's growth rate has consistently surpassed that of China. While China's growth rate has remained relatively stable, Canada's growth rate experienced significant increases between 2004 and 2010, notably outpacing China's during this period. This highlights Canada's substantial investment in education compared to China's more steady progression.

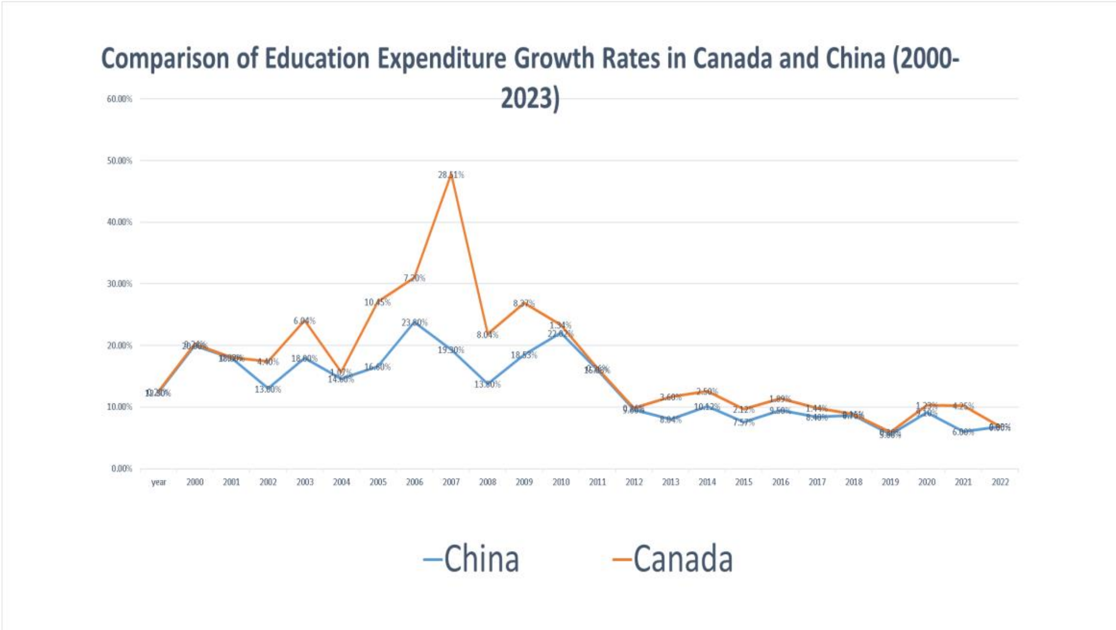

Figure3

The unemployment rate is another important economic measure that is closely related with education. Generally speaking, the higher the educational attainment, the lower the unemployment rate will be due to the adaptability and skills developed through education. Figure 4 below shows that although the unemployment rate in China has generally been lower compared to that of Canada, the two rates began converging in 2020 and converged by 2023. This might be evidence of a global event associated with the COVID-19 pandemic.

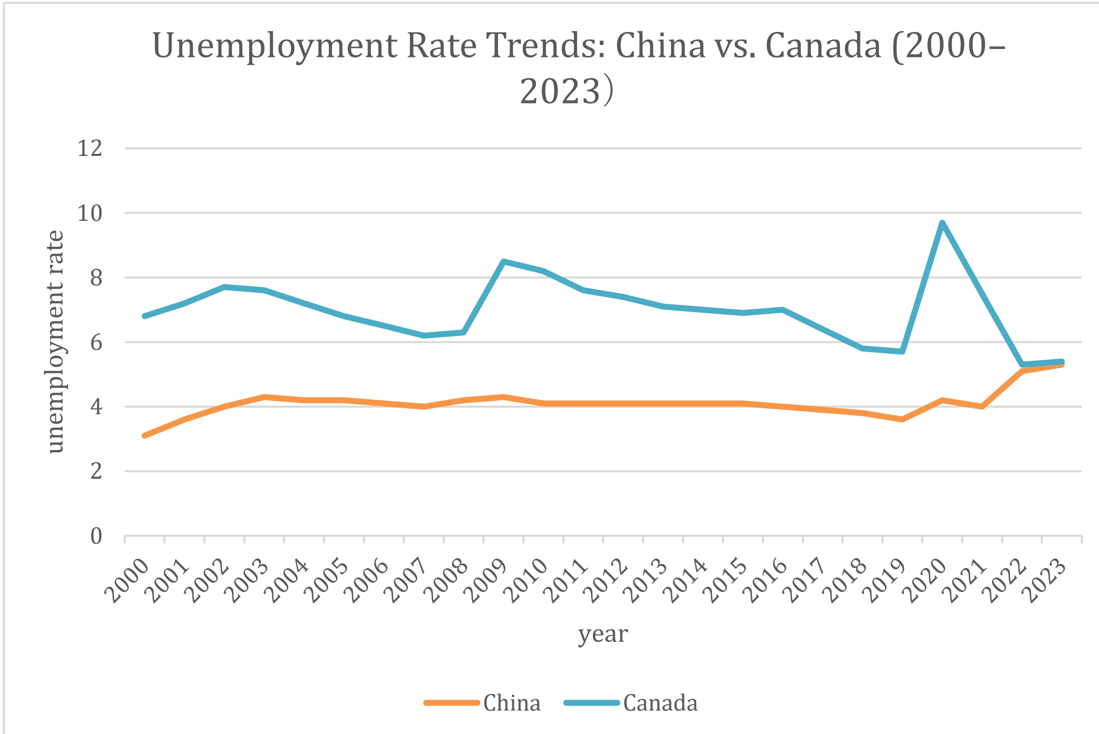

Figure 4

In conclusion, this section has emphasized how responsive and efficient higher education systems contribute towards economic growth, as observed from the comparative analysis between China and Canada.

3. Literature Review

The literature highlights the significant impact of higher education on economic growth in both China and Canada, emphasizing its role in enhancing human capital and productivity. Chen (2016) shows that increased enrolment and government spending in higher education positively correlate with GDP growth, necessitating prioritization of educational investments for economic development.

Chen and Zhou (2017) further explore how a skilled labour force contributes to GDP growth and innovation, stressing the importance of sustained government spending on education. Li and Zhang (2015) argue that investments in higher education are crucial for transitioning China to a knowledge-based economy, linking educational reforms to improved economic outcomes. Bing (2023) discusses how higher education fosters high-quality economic development in China by promoting digital literacy and innovation, crucial for productivity in the digital era.

In Canada, Ruhs and Anderson (2010) highlight the contributions of international graduates in addressing skill shortages, thereby driving economic growth. Chatterjee and Pritchett (2018) emphasize the role of universities in developing human capital, asserting that public investment in education yields significant economic returns. Frenette (2004) supports this by showing a correlation between educational investment and GDP growth.

Zhang and Sethi (2019) compare the two countries' higher education systems, noting China's focus on rapid expansion versus Canada's emphasis on quality. Yang and Burch (2020) analyse strategies for attracting international talent, revealing Canada's focus on inclusivity, while China prioritizes educational infrastructure.

Lastly, Liu et al. (2018) compare sustainable development practices in industrial parks, noting China's rapid industrialization contrasts with Canada's focus on innovation and sustainability.

In conclusion, higher education is crucial for economic growth in both China and Canada, with each country adopting different approaches. Continued investment in education is vital for enhancing human capital and ensuring long-term economic competitiveness.

4. Economic Model

To illustrate the relationship between education and GDP per capita growth, we can utilize a growth model that incorporates human capital, drawing on the foundational work of Bils and Klenow (2000). Our starting point is a production function that does not impose specific assumptions regarding preferences or capital markets:

$$Y(t) = K(t)^{\alpha}[A(t)H(t)]^{1-\alpha}$$

where *Y* is the flow of output, *K* is the stock of physical capital, *A* is a technology index, and *H* is the stock of human capital. We expect all three factors will affect the flow of output positively. Specifically we assume:

$$\frac{\partial Y}{\partial K} > 0, \qquad \frac{\partial Y}{\partial A} > 0, \qquad \frac{\partial Y}{\partial H} > 0$$

In other words, Y(t) is an increasing function of K(t), A(t), and H(t).

Next, we will specify our function for the stock of human capital. The stock of human capital depends on the number of workers in the economy and their level of human capital. For explanation, suppose that all cohorts go to school from age 0 to s (years of schooling attained), and work from s to T. So that, we have:

$$H(t) = \int_{s}^{T} h(a,t)L(a,t)da \ ,$$

where L(a,t) is the number of workers in cohort *a* at time *t* and h(a,t) is their level of human capital. The individual human capital stocks increase with the worker's years of schooling and their experience, and teacher human capital.

5. Data

The main reason for choosing data from Canada and China for comparison is the significant difference in their stages of economic development. By comparing these two countries, we aim to highlight the varying impacts of education on economic development in different economic contexts. Both Canada and China have relatively comprehensive educational and economic statistical data, which provide a reliable basis for the study. It is undeniable that the more data available, the more accurate the conclusions. However, due to the limited availability of certain historical data, we have chosen to focus on data from the period between 2000 and 2023.

The primary sources of information are the National Bureau of Statistics of China and Statistics Canada. For example, data on GDP growth rates and unemployment rates for both countries are sourced from these institutions. In contrast, the original data for Canada's "The total number of post-secondary education graduates in the country" is provided by the website Countryeconomy. On the other hand, data on "Research and development expenditure (% of GDP)" and "Gross capital formation (% of GDP)" can be found in the detailed historical records available from the World Bank Group.

Detailed information is shown in the Table 1 below:

	Variable name on StataMP	Measurement in raw data	Source
Gross Domestic Product	gdp	Annual percentage growth rate	China:the National Bureau of Statistics of China Canada: Statistics Canada
The total number of post-secondary education graduates in the country	Edu	Annual percentage growth rate	China:the National Bureau of Statistics of China Canada:countryeconomy
Government expenditure on education, total	GovE	(% of GDP）	China:the National Bureau of Statistics of China Canada: Statistics Canada
Unemployment Rate	Ur	Annual rate	China:the National Bureau of Statistics of China Canada: Statistics Canada

Research and development expenditure	RD	(% of GDP)	World bank group
Gross capital formation	Cap	(% of GDP）	World bank group

Table 1: Explanation of the variables

Source: Authors' compilation

In order to make proper empirical analysis, we decided to change measurement of some variables, namely:

1.The total number of post-secondary education graduates in the country （EdQn）

To see the real change in the total number of post-secondary education graduates in the country per year, we have to take into account of the change in total population as well. For example, in year 2000:

$$\frac{\text{The total number of post} - \text{secondary education graduates in the country}_{2000}}{Total\ population_{2000}}$$

$$= Ratio_{2000}$$

In the same way the Ratio_{2001} can be found. Then Growth in the ratio of the total number of post-secondary education graduates to the total population in the country

is computed as follows:

$$\frac{Ratio_{2001} - Ratio_{2000}}{Ratio_{2000}} * 100\%$$

The same measurement procedures were applied to the other variables as were used for the raw data.

6. Empirical Analysis: Canada vs. China

In order to investigate the potential causal relationship between education and economic growth, we consider an econometric model that represents both the quantitative and qualitative measures of education. This model estimates how different measures of education, combined with other economic variables, affect GDP per capita growth over time. The general form of the econometric model is as follows:

$$GDPpercapitagrowth = \beta_1 + \beta_2 EdQuality + \beta_3 EdQuantity + \beta_i X_i + \varepsilon_i \tag{1}$$

In this equation, **EdQuality** refers to the qualitative measure of education (such as government spending on education), while **EdQuantity** represents the quantitative measure (e.g., the ratio of individuals holding a bachelor's degree to the total population). The term Xi encompasses other relevant factors such as capital, technology, and Unemployment rate, all of which may also impact GDP growth.

To estimate the econometric model, we selected several key variables based on data availability and their potential impact on economic growth:

- **Education Quality (EdQuality)**: We use the growth rate of government expenditure on education per capita as a measure of education quality, based on the assumption that higher government spending improves educational outcomes.

- **Education Quantity (EdQuantity)**: The ratio of individuals who have obtained a bachelor's degree to the total population is used to represent the quantitative aspect of education. Following the methodology of Paul D. Gottlieb et al. (2003), we focus on the bachelor's degree as it distinguishes skilled workers from those with less formal education.
- **Physical Capital**: The growth rate of gross capital formation serves as a proxy for physical capital, which is expected to have a positive effect on economic growth.
- **Technology**: The growth rate of domestic spending on research and development (R&D) is chosen to represent technological advancement, which is generally seen as a key driver of economic progress.
- **Labor Force Participation**: We use the unemployment rate as a proxy for labour force participation. A higher unemployment rate is generally associated with underutilized labour, which may negatively affect economic growth.

The main model specification is:

$$GDP = \beta_1 + \beta_2 GovE + \beta_3 Edu + \beta_3 Cap + \ \beta_4 RD + \beta_5 Ur + \varepsilon_i$$

Here are the independent variables, each on a separate line:

GovE : Growth of per capita government expenditure on education

$\boldsymbol{Edu}$: Growth in the ratio of the number of people conferred bachelor's degrees to total population

$\boldsymbol{Cap}$: Growth rate of gross capital formation

$\boldsymbol{RD}$ **:** Growth rate of gross domestic spending on R&D

$\boldsymbol{UR}$: Unemployment rate

This updated specification includes all the key education variables (education quality and quantity), as well as physical capital, technology, labor force participation, and their lagged values. The addition of the COVID dummy variable allows us to directly evaluate its impact on GDP growth, controlling for the other economic factors.

$$GDP = \beta_1 + \beta_2 GovE + \beta_3 Edu + \beta_3 Cap + \ \beta_4 RD + \beta_5 Ur + \beta_6 \text{COVIDDummy} + \varepsilon_i$$

COVIDDummy is a binary variable indicating whether the data point corresponds to the period of the COVID-19 pandemic (for example, 1 for the years 2019 to 2021, and 0 for pre-pandemic years). The COVID dummy allows us to isolate the specific effect of the pandemic on economic growth.

Additionally, to account for the potential time lag in economic relationships, we introduce lagged variables for GDP growth, R&D, Unemployment rate and education measures. This recognizes the possibility that current economic growth may be influenced not only by current variables but also by past outcomes, including past levels of variables.

The detailed econometric model, incorporating all lagged variables and the COVID dummy, is specified as follows:

$$\begin{aligned} GDP = \beta_1 + \beta_2 GovE + \beta_3 Edu + \beta_3 Cap + \ \beta_4 RD + \beta_5 Ur + \beta_2 LagGovE \\ + \beta_3 LagEdu + \beta_3 LagCap + \ \beta_4 LagRD + \beta_5 LagUr \\ + \beta_6 \text{COVIDDummy} + \varepsilon_i \end{aligned}$$

LagGovE, LagEdu, LagCap, LagRD, LagUr: These are the lagged versions of the respective variables, included to account for the delayed impact that these factors may have on current GDP growth. Economic variables often take time to show their full effect on an economy.

To estimate this model, we use **Ordinary Least Squares (OLS)** regression, ensuring that the time-series data are appropriately de-trended to account for long-term economic trends. This helps isolate the short-term fluctuations and the relationships between the variables of interest. By including both current and lagged variables, we can capture the dynamic interactions between education, capital, technology, unemployment, and government expenditure on growth.

We expect both education quality, measured by per capita government expenditure on education, and education quantity, captured by the ratio of people holding a bachelor's degree, to positively impact GDP growth. However, given the inclusion of lagged variables, these effects may be observed in future years rather than immediately. Similarly, the growth rate of physical capital formation is anticipated to boost GDP by enhancing productivity, though its full impact may take time. Higher spending on research and development is expected to foster technological progress, which drives long-term economic growth, but this effect may also be delayed. The unemployment rate is expected to have a negative relationship with GDP growth, as high unemployment reflects inefficiencies in the labor market. Lagged unemployment variables could reveal the cumulative effect of past high unemployment on growth. Lastly, the COVID dummy variable is expected to have a negative coefficient, reflecting the direct economic disruption caused by the pandemic, which may be compounded by delayed effects such as long-term slowdowns due to public health measures and shifts in global trade.

Using the OLS estimation technique in stata, we obtained the following estimation results:

Table 2: the OLS regression results
Source: Authors' compilation using Stata(Appendix)

The regression analysis for both Canada and China reveal important insights about the relationship between various economic variables and growth, with differences in the results based on the model specifications.

Canada's Regression Results:

1. Initial Data (Growth Rate):

- **GovE_var**: The coefficient for government expenditure is **4.6960** with a p-value of **0.037**, suggesting that a 1% increase in government expenditure is associated with a **4.7% increase in economic growth**, and this relationship is statistically significant at the 5% level.
- **Edu_var**: The coefficient for education expenditure is **0.0406**, but the p-value of **0.228** indicates that the relationship is **not statistically significant**, meaning there is insufficient evidence to conclude that education expenditure affects growth in Canada.
- **Cap_var**: Capital expenditure shows a positive coefficient of **0.3176**, but with a p-value of **0.413**, this result is not statistically significant, suggesting that capital expenditure does not have a clear impact on growth in Canada.

- **RD_var**: Research and development expenditure has a positive coefficient of **4.4450**, but the p-value of **0.317** indicates that it is **not statistically significant** either.
- **Unr_var**: The unemployment rate has a statistically significant negative coefficient of **-1.3230** with a p-value of **0.023**, meaning higher unemployment is associated with lower economic growth in Canada.

2. Data with Lag Variables:

- **GovE_var**: With lag variables included, the coefficient for government expenditure increases slightly to **4.7013**, and the p-value is **0.045**, which is statistically significant at the 5% level, confirming the positive relationship with economic growth.
- **Edu_var**: The coefficient for education expenditure remains the same (**0.0406**), but it is still **not statistically significant** (p-value = 0.242), suggesting that education expenditure continues to have no discernible effect on growth.
- **Cap_var**: Capital expenditure remains similar to the initial model with a coefficient of **0.3177**, but the p-value of **0.427** indicates no significant effect on growth.
- **RD_var**: The coefficient for research and development is slightly higher (**4.4560**) compared to the initial model, but it remains **statistically insignificant** (p-value = 0.336).
- **Unr_var**: The coefficient for unemployment is **-1.3260** with a p-value of **0.036**, which is slightly more robust than in the initial specification, but still not overwhelmingly strong.

3. With COVID Dummy:

- **COVID Dummy**: The COVID dummy variable has a coefficient of **0.0002** with a p-value of **0.988**, indicating no significant effect of the pandemic on growth in Canada, as the coefficient is almost zero and highly insignificant.

China's Regression Results:

1. Initial Data (Growth Rate):

- **GovE_var**: In contrast to Canada, government expenditure in China has a **negative coefficient of -3.5721**, which is statistically significant (p-value = **0.038**), suggesting that higher government expenditure is associated with slower economic growth in China.
- **Edu_var**: The coefficient for education expenditure is **-0.0251**, but it is **not statistically significant** (p-value = **0.725**), indicating that education expenditure does not significantly affect growth.
- **Cap_var**: Capital expenditure has a **positive coefficient of 0.6614** with a p-value of **0.004**, indicating that capital expenditure is statistically significant and positively related to economic growth in China.
- **RD_var**: The coefficient for research and development is **-1.5230**, but with a p-value of **0.423**, this result is not statistically significant, suggesting R&D does not significantly affect economic growth.
- **Unr_var**: The unemployment rate has a negative coefficient of **-1.1889** with a p-value of **0.400**, but it is **not statistically significant** in explaining growth in China.

2. Data with Lag Variables:

- **GovE_var**: With lag variables included, government expenditure in China continues to show a **negative relationship** with growth, with a coefficient of **-3.7991** and a p-value of **0.041**, confirming the negative effect of government spending on growth.
- **Edu_var**: Education expenditure remains negative (**-0.0700**) but continues to be **statistically insignificant** (p-value = **0.185**).
- **Cap_var**: Capital expenditure remains significant with a positive coefficient of **0.6639** (p-value = **0.005**), continuing to show that capital expenditure has a positive and significant impact on growth.
- **RD_var**: The coefficient for research and development is **-0.8723**, and with a p-value of **0.725**, it is still statistically insignificant.
- **Unr_var**: Unemployment has a slightly more negative effect in this specification, with a coefficient of **-1.5270**, but the relationship remains **statistically insignificant** (p-value = **0.359**).

3. With COVID Dummy:

- **COVID Dummy**: In China, the coefficient for the COVID dummy is **0.0247** with a p-value of **0.151**, suggesting a **slightly positive relationship** between the pandemic and economic growth, but it is **not statistically significant**, implying that the pandemic did not have a substantial or statistically meaningful impact on growth during the study period.

Comparative Analysis:

The results between Canada and China differ significantly in terms of the relationship between government expenditure and economic growth. In Canada, government expenditure has a positive and statistically significant effect on growth, while in China, the relationship is negative and significant, indicating that higher government spending may inhibit growth. Capital expenditure is positively related to growth in both countries and is statistically significant in both initial and lag models, highlighting the importance of investment in physical capital for economic growth.

Unemployment, however, shows contrasting effects in the two countries. In Canada, the unemployment rate has a significant negative impact on growth, suggesting that rising unemployment stifles economic growth. In China, while unemployment also has a negative effect, it is not statistically significant, indicating a weaker or less certain relationship between unemployment and growth.

The COVID-19 pandemic, represented by the dummy variable, does not appear to have a significant effect on economic growth in either country. Both Canada and China show insignificant coefficients for the COVID dummy, suggesting that, after controlling for other variables, the pandemic did not have a meaningful impact on economic growth during the study period.

7. Conclusion

This analysis, through the lenses of data from the period 2000 to 2023 derived from the National Bureau of Statistics of China, Statistics Canada, and the World Bank, brings forth ample signs of variation in the association that exists between levels of education, government expenditure, physical capital, and economic growth within Canada and China.

Both countries show a positive association of capital expenditure with growth in GDP. However, government expenditure has contrasting effects in that it positively influences growth in Canada, while in China, it is negatively associated, suggesting inefficiencies in spending.

The role of education shows limited statistical significance in both countries, indicating the need for further investigation of its long-term impacts. Unemployment adversely affects growth in Canada but is insignificant to growth in China, reflecting different labour market dynamics.

Surprisingly, the COVID-19 pandemic did not meaningfully impact economic growth in either economy when controlling for other factors, reflecting some level of resilience within the economies.

The overall findings imply that in evaluating the impact of educational and governmental policies on economic growth, context does matter, hence providing valuable material for the policymakers. Further studies could elaborate more on these linkages and their implications for economic development.

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Appendix:

Table 2: Regression Results for Canada and China (Coefffcient estimates, (Standard errors), and [P values])

Country	**Canada**				**China**			
Specifications	**Initial Data (growth rate)**		**Data with lag variables**		**Initial Data (growth rate)**		**Data with lag variables**	
Variable	**Without COVID Dummy**	**With COVID Dummy**	**Without COVID Dummy**	**With COVID Dummy**	**Without COVID Dummy**	**With COVID Dummy**	**Without COVID Dummy**	**With COVID Dummy**
GovE_var	4.6960 (2.080) [0.037]	4.7013 (2.17) [0.045]	0.9290 (1.097) [0.415]	1.1607 (1.4123) [0.430]	-3.5721 (1.5917) [0.038]	-3.7991 (1.7151) [0.041]	-3.1083 (1.5871) [0.076]	-3.3533 (1.5022) [0.050]
Edu_var	0.0406 (0.032) [0.228]	0.0406 (0.033) [0.242]	-0.0209 (0.0179) [0.267]	-0.0196 (0.0191) [0.329]	-0.0251 (0.0704) [0.725]	-0.0227 (0.0722) [0.757]	-0.0426 (0.0487) [0.400]	-0.0700 (0.0491) [0.185]
Cap_var	0.3176 (0.379) [0.413]	0.3177 (0.390) [0.427]	0.0444 (0.3213) [0.893]	0.0108 (0.3563) [0.977]	0.6614 (0.1986) [0.004]	0.6639 (0.2034) [0.005]	0.0588 (0.2772) [0.836]	-0.1058 (0.2816) [0.715]
RD_var	4.4450 (4.322) [0.317]	4.4560 (4.50) [0.336]	1.9508 (4.6587) [0.683]	2.1947 (4.9439) [0.667]	-1.5230 (1.8569) [0.423]	-0.8723 (2.4434) [0.725]	-4.4739 (6.0843) [0.478]	-13.6805 (8.2404) [0.128]

Country	Canada				China			
Specifications	Initial Data (growth rate)		Data with lag variables		Initial Data (growth rate)		Data with lag variables	
Variable	Without COVID Dummy	With COVID Dummy	Without COVID Dummy	With COVID Dummy	Without COVID Dummy	With COVID Dummy	Without COVID Dummy	With COVID Dummy
Unr_var	-1.3230 (0.533) [0.023]	-1.3260 (0.582) [0.036]	-1.6856 (0.2478) [0.000]	-1.7135 (0.2773) [0.000]	-1.1889 (1.3783) [0.400]	-1.5270 (1.6209) [0.359]	-3.3394 (1.3040) [0.026]	-1.0173 (1.9339) [0.610]
lagy_can			0.0537 (0.1195) [0.662]	0.0851 (0.1675) [0.623]			0.4040 (0.2005) [0.069]	0.5590 (0.2135) [0.026]
lagGovE_can			-0.5766 (1.0919) [0.608]	-0.7843 (1.3597) [0.577]			-0.3714 (1.8714) [0.846]	1.8220 (2.2573) [0.438]
lagEdu_can			-0.0286 (0.0209) [0.198]	-0.0283 (0.0218) [0.224]			-0.0862 (0.0527) [0.130]	-0.0840 (0.0497) [0.122]
lagCap_can			-0.1569 (0.3228) [0.637]	-0.1085 (0.3788) [0.780]			-0.0281 (0.2099) [0.896]	0.0010 (0.1984) [0.996]
lagRD_can			0.9973 (4.7972) [0.839]	1.0483 (5.0150) [0.839]			4.2327 (5.6462) [0.469]	9.7185 (6.3805) [0.159]

Country	Canada				China			
Specifications	**Initial Data (growth rate)**		**Data with lag variables**		**Initial Data (growth rate)**		**Data with lag variables**	
Variable	**Without COVID Dummy**	**With COVID Dummy**	**Without COVID Dummy**	**With COVID Dummy**	**Without COVID Dummy**	**With COVID Dummy**	**Without COVID Dummy**	**With COVID Dummy**
lagUnr_can			1.8500 (0.3703) [0.000]	1.9331 (0.4872) [0.003]			6.0519 (1.4983) [0.002]	6.4002 (1.4280) [0.001]
covid_dummy	- (N/A)	0.0002 (0.013) [0.988]	-	0.0021 (0.0074) [0.785]	- (N/A)	-0.0064 (0.0152) [0.677]	-	0.0247 (0.0159) [0.151]
_cons	-0.2812 (0.1846) [0.145]	-0.2815 (0.1910) [0.159]	-0.0486 (0.0949) [0.619]	-0.0629 (0.1115) [0.585]	-0.0005 (0.0562) [0.994]	0.0093 (0.0620) [0.883]	0.0711 (0.0487) [0.172]	0.0106 (0.0601) [0.863]
R-squared	0.3804	0.3804	0.9502	0.9506	0.6670	0.6705	0.9120	0.9291
SSE	0.0073	0.00738	0.0005370	0.0005328	0.00517	0.00512	0.0013670	0.0011012
F-statistic	2.21	1.74	19.07	16.03	7.21	5.77	10.37	10.93