

Energy, Exchange, and Migration: An Econometric Assessment of Factors Shaping Canada's GDP

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ABSTRACT

Over the past decade, Canada's economic performance has been characterized by slowing growth and increasing policy debate regarding immigration and resource dependence. This study empirically examines the macroeconomic determinants of Canada's Gross Domestic Product (GDP) over the period 2000–2023 using multiple linear regression analysis. Two models are estimated: a long-run model covering 2000–2023 and a short-run model covering 2012–2023 that incorporates global oil prices. Explanatory variables include the unemployment rate, net migration, the CAD–USD exchange rate, and Brent crude oil prices. The short-run model exhibits strong explanatory power (Adjusted $R^2 = 0.84$), with exchange rate depreciation ($p \approx 0.001$) and oil price increases ($p < 0.001$) exerting statistically significant positive effects on GDP. In contrast, the long-run model shows that net migration is a significant and positive driver of GDP ($p < 0.001$), while exchange rate depreciation is negatively associated with output over longer horizons (Adjusted $R^2 = 0.68$). The unemployment rate is statistically insignificant in both specifications. These findings suggest that Canada's GDP dynamics are shaped by a combination of short-run external trade and commodity price shocks and long-run demographic expansion. Policy implications emphasize the importance of balancing immigration-led growth with productivity-enhancing reforms while reducing vulnerability to volatile commodity cycles.

Keywords: Canada GDP; Macroeconomic factors; Net migration; Exchange rate; Oil prices; Unemployment; Economic growth; Time series analysis

INTRODUCTION

The Canadian economy has experienced considerable volatility over the past two decades, shaped by shifts in global energy markets, immigration policies, and exchange rate dynamics. While Canada's abundant natural resources and open trade system have historically supported growth, the past decade has seen a pronounced slowdown in real GDP expansion. Public

discourse increasingly attributes this to contrasting policy directions: critics of the Liberal Party argue that excessive immigration has strained infrastructure and reduced per-capita gains, whereas opponents of the Conservative Party contend that overreliance on crude oil exports has left the economy vulnerable to global commodity cycles.

Understanding which macroeconomic factors most directly influence Canada's GDP is therefore of both academic and policy significance. Prior research has identified several key channels. Trade policy liberalization and tariff reform have had measurable effects on output and welfare (1, 2). Global oil price shocks have been shown to drive as much as 40% of domestic production fluctuations through monetary and

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trade channels (3). Exchange rate volatility, particularly against the U.S. dollar, affects productivity in the tradable sector (4), while immigration contributes to aggregate labor supply and long-run potential output (5). However, there remains limited empirical work comparing the relative strength of these factors over both short- and long-term horizons.

This paper aims to address that gap by applying a multiple regression model to assess the effects of unemployment rate, net migration, exchange rate, and oil price on Canadian GDP. The inclusion of both long- and short-run models allows for a comparative understanding of cyclical versus structural determinants of growth. The findings provide insight into how Canada's resource dependence and demographic expansion interact with external shocks, offering guidance for policies aimed at fostering more stable and sustainable economic performance.

From a theoretical perspective, neoclassical growth models emphasize labor supply expansion and capital accumulation as drivers of long-run output, providing a framework for understanding the role of immigration in GDP growth. Open-economy macroeconomic models highlight the importance of exchange rates in influencing net exports and aggregate demand, while resource-dependence theories explain how commodity price fluctuations, particularly oil, can amplify cyclical volatility in resource-rich economies such as Canada (6, 7). These theoretical insights motivate the empirical specification employed in this study.

LITERATURE REVIEW

Gross Domestic Product (GDP) is composed of four main components: consumption, investment, government spending, and net exports. The Canadian economy is influenced by a diverse range of structural and policy-driven factors, including trade policy, energy markets, exchange rate movements, and demographic shifts. Recent empirical literature has deepened the understanding of how these components influence GDP in both the short and long run, with varying transmission mechanisms.

Charbonneau, de Munnik, and Murphy (1) provide an in-depth evaluation of Canada's trade policy experience, focusing on how free trade agreements and tariff reductions affect economic output. Their findings suggest that open trade regimes foster productivity and GDP growth by enhancing market access and encouraging export diversification. However, the introduction of the

National Policy in 1879 raised average tariff rates from roughly 14% to over 21%, peaking near 32% by 1891, which Pomfret (2) estimated imposed welfare losses equivalent to 4–8% of GDP, largely through higher consumer prices and inefficiency. Notably, Charbonneau *et al.* (1) argue that the long-run gains from trade liberalization were driven not only by volume effects but also by structural improvements in resource allocation and innovation. This reinforces the idea that trade policy is a critical determinant of GDP growth in Canada.

In contrast, the volatility of global commodity markets introduces a different dimension to GDP fluctuations. Delpachitra, Hou, and Cottrell (3) examine the macroeconomic effects of international oil price shocks on the Canadian economy. It was noted that over 40% of fluctuations in Canadian domestic production (over a four-year horizon) are attributable to the monetary policy channel following an oil shock. Employing a structural vector autoregression model, the authors identify a strong and asymmetric relationship between oil prices and GDP, particularly through Canada's role as a net energy exporter. The study finds that positive oil price shocks generally boost Canadian GDP via increased investment and trade surpluses, while negative shocks contribute to contractions, especially in resource-dependent provinces. This underscores the vulnerability of Canada's growth trajectory to external commodity cycles.

Another key factor in Canada's macroeconomic landscape is the exchange rate. Harris *et al.* (4) investigate whether movements in the Canada–U.S. exchange rate can induce productivity changes, thereby affecting GDP. The study identifies a causal link between sustained real exchange rate appreciations and productivity slowdowns in the tradable goods sector. This result highlights the importance of exchange rate stability for maintaining international competitiveness and sustaining long-run growth. It also suggests that currency misalignments can have persistent effects on resource allocation and sectoral output, thus influencing aggregate GDP.

Demographic and labor market shifts also play a crucial role in shaping Canada's output dynamics. Champagne *et al.* (5) assess the macroeconomic implications of increased immigration. While higher immigration levels support aggregate GDP growth by expanding the labor force, the report notes that GDP per capita gains are less clear, particularly in the context of lagging productivity. Moreover, the study finds that the short-term inflationary effects of population growth are offset by expanded supply in the medium term, leading to a nuanced view of immigration's net macroeconomic

effect. These findings are particularly relevant in light of Canada's recent immigration policy expansions.

Together, these studies illustrate the multifaceted nature of Canadian GDP determinants. They emphasize that while policy levers such as trade liberalization and immigration can stimulate long-run output, external shocks—whether from oil markets or currency fluctuations—pose significant risks to macroeconomic stability. The literature also points to the importance of considering regional disparities and sectoral compositions when modeling GDP responses in Canada, highlighting the need for robust econometric frameworks capable of capturing these complex dynamics.

Overall, the literature reveals both consensus and divergence regarding the drivers of Canadian GDP. There is broad agreement that trade openness and immigration support long-run output growth, though their effects on productivity and per-capita income remain debated. In contrast, studies on oil prices and exchange rates emphasize short-run volatility rather than sustained growth, highlighting Canada's exposure to external shocks. This study contributes to the literature by integrating these strands within a unified econometric framework, explicitly comparing short-run and long-run effects across demographic, trade, and commodity-related variables.

METHODS AND MATERIALS

Model Specification

This study employs multiple linear regression analysis to examine the relationship between Canadian GDP and selected macroeconomic determinants. The dependent variable is Canada's annual Gross Domestic Product (GDP), measured in billions of current U.S. dollars. Independent variables are chosen based on economic theory and prior empirical literature and include the unemployment rate, net migration, the CAD–USD exchange rate, and global oil prices.

The unemployment rate is defined as the percentage of the labor force that is unemployed. Net migration is measured as the annual net inflow of migrants to Canada, expressed in thousands of persons. The exchange rate is measured as the annual average number of Canadian dollars per U.S. dollar (CAD/USD). Oil prices are measured using the Brent crude oil benchmark in U.S. dollars per barrel and are included only in the short-run specification to capture recent commodity market dynamics.

Two regression specifications are estimated. The

short-run model (Model A) covers the period from 2012 to 2023 and includes all four explanatory variables, allowing for an assessment of recent resource and exchange-rate effects. The long-run model (Model B) spans 2000 to 2023 and excludes oil prices to preserve a longer time series and focus on structural determinants of growth, particularly demographic and exchange-rate dynamics. Both models are estimated using ordinary least squares (OLS), with statistical inference based on standard errors, p-values, and goodness-of-fit measures.

Although the unemployment rate is statistically insignificant in both models, it is retained due to its theoretical importance as a core macroeconomic indicator and to reduce the risk of omitted variable bias (6). Multicollinearity among regressors is assessed using variance inflation factors (VIFs), which are reported and discussed in the following section.

The general form of the model is:

$$GDP_t = \beta_0 + \beta_1 Unemployment_t + \beta_2 Migration_t + \beta_3 ExchangeRate_t + \beta_4 OilPrice_t + \varepsilon_t \quad (\text{Eq. 1})$$

Model A:

$$GDP_t = \beta_0 + \beta_1 Unemployment_t + \beta_2 Migration_t + \beta_3 ExchangeRate_t + \beta_4 OilPrice_t + \varepsilon_t \quad (\text{Eq. 2})$$

Model B:

$$GDP_t = \beta_0 + \beta_1 Unemployment_t + \beta_2 Migration_t + \beta_3 ExchangeRate_t + \varepsilon_t \quad (\text{Eq. 3})$$

Where:

- β_0 is the intercept,
- $\beta_1, \beta_2, \beta_3, \beta_4$ are coefficients for the explanatory variables,
- ε_t is the error term.

Both models were estimated using ordinary least squares (OLS). Calculations were implemented in Excel. Model performance was evaluated using R-squared, Adjusted R-squared, p-values, and F-statistics to assess statistical significance and goodness-of-fit.

Data and sample construction

All data used in this study are obtained from publicly available and authoritative sources to ensure accuracy and consistency. The dataset consists of annual observations spanning 2000–2023, yielding 24 observations for the long-run model and a reduced sample of 12 observations

for the short-run model covering 2012–2023.

Canada's Gross Domestic Product (GDP), measured in current U.S. dollars, is sourced from the World Bank and International Monetary Fund databases (8). The unemployment rate is obtained from Statistics Canada and the OECD, reflecting standardized annual labor market conditions (9). Net migration data, measured in thousands of persons, are compiled from Statistics Canada and the World Bank (10).

The nominal exchange rate is measured as Canadian dollars per U.S. dollar (CAD/USD) and is sourced from the Bank of Canada and IMF International Financial Statistics (11). Oil price data are measured using the Brent crude oil benchmark (USD per barrel), obtained from the U.S. Energy Information Administration (EIA) (12). Brent crude is used due to its relevance as a global pricing benchmark for internationally traded oil and its suitability for capturing external commodity price shocks affecting Canada's export revenues (Table 1).

RESULTS

Multicollinearity Diagnostics

Table 2 reports VIF values for the long-run model (Model B, 2000–2023). All variables exhibit VIF values between 1.03 and 1.58, which are well below commonly used thresholds (5–10), indicating negligible multicollinearity among regressors.

Table 3 presents VIF values for the short-run model (Model A, 2012–2023). VIF values are moderately higher, reflecting stronger co-movement among macroeconomic variables in the post-2012 period. The exchange rate displays the highest VIF (7.71), followed by oil prices (5.76) and net migration (4.31), while unemployment remains low (2.91). Although moderate multicollinearity is present, these values remain within acceptable limits for macroeconomic time-series analysis. Importantly,

multicollinearity primarily affects the precision of coefficient estimates rather than coefficient bias; therefore, all variables are retained.

Regression Results

Two regression models were estimated. Model A examines short-run determinants of GDP over 2012–2023 and includes oil prices, while Model B examines long-run determinants over 2000–2023 and excludes oil prices.

Model A: Short-Run Model (2012–2023)

Table 4 shows that the short-run model explains a large proportion of GDP variation (Adjusted R² = 0.84). Exchange rate depreciation and oil price increases are

Table 2. Variance Inflation Factors (VIFs) for the Long-Run Model (Model B, 2000–2023). VIF values for explanatory variables in the long-run model, assessing multicollinearity.

Variable	VIF
Unemployment	1.54
Net migration	1.58
Exchange rate	1.03

Table 3. Variance Inflation Factors (VIFs) for the Short-Run Model (Model A, 2012–2023). VIF values for explanatory variables in the short-run model, assessing multicollinearity.

Variable	VIF
Unemployment	2.91
Net migration	4.31
Exchange rate	7.71
Oil price (Brent)	5.76

Table 1. Descriptive Statistics for Variables Included in Regression Analysis (2000–2023). Summary statistics (mean, standard deviation, minimum, and maximum) for GDP, exchange rate, unemployment rate, net migration, and oil prices.

Variable	Mean	Median	Standard Deviation	Min	Max	Observation
GDP (Billion USD)	1508.330833	1590	428.6921	738.98	2190	24
Unemployment rate (%)	7.008333333	7.05	1.0056	5.3	9.7	24
Net migration (thousands of people)	263.6561667	226.222	85.58874	185.643	459.988	24
Exchange rate (CAD per USD, period average)	1.244166667	1.29	0.168856	0.99	1.57	24
Oil price (optional)	75.0941667	71.1	25.1197237	41.96	111.63	12

both statistically significant and positively associated with GDP. Specifically, a one-unit increase in the CAD/USD exchange rate is associated with an estimated increase of approximately 2,971 billion USD in GDP, while a one-dollar increase in Brent crude prices is associated with an increase of about 17 billion USD in GDP.

In contrast, unemployment and net migration do not exhibit statistically significant effects in the short-run specification. These findings suggest that short-term fluctuations in Canadian GDP are primarily driven by

external price and trade-related factors rather than labor market or demographic changes.

Model B: Long-Run Model (2000–2023)

Table 5 presents results for the long-run model, which explains a substantial share of GDP variation (Adjusted $R^2 = 0.68$). Net migration emerges as a statistically significant and positive determinant of GDP. The coefficient implies that an increase of 1,000 net migrants is associated with an increase of approximately 3.77 billion USD in GDP.

Table 4. Short-Run Regression Results for Determinants of GDP (Model A, 2012–2023). Coefficient estimates and model statistics for the short-run regression examining exchange rate, oil prices, unemployment, and net migration effects on GDP.

	Coefficients	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-3128.9292 (925.6169)	-3.3804	0.0118	-5317.6655	-940.1930
Unemployment rate (%)	37.4927 (37.2495)	1.0065	0.3477	-50.5885	125.5738
Net migration (thousands of people)	-0.8951 (0.5611)	-1.5952	0.1547	-2.2220	0.4317
Exchange rate (CAD per US\$, period average)	2970.9089 (588.3881)	5.0492	0.0015	1579.5921	4362.2257
Oil price (optional)	16.9798 (2.5318)	6.7066	0.0003	10.9931	22.9666

ANOVA

	df	SS	MS	F	Significance F
Regression	4	466316.325	116579.081	15.0980279	0.00149396
Residual	7	54050.3419	7721.47741		
Total	11	520366.667			

Table 5. Long-Run Regression Results for Determinants of GDP (Model B, 2000–2023). Coefficient estimates and model statistics for the long-run regression examining exchange rate, unemployment, and net migration effects on GDP.

	Coefficients	t Stat	P-value	Lower 95%	Upper 95%
Intercept	2149.794 (663.4316)	3.240415	0.0041	765.8997	3533.688
Unemployment rate (%)	55.00182 (62.57124)	0.879027	0.389826	-75.5195	185.5231
Net migration (thousands of people)	3.766078 (0.7446240)	5.05769	6.02E-05	2.212819	5.319336
Exchange rate (CAD per US\$, period average)	-1623.48 (304.6558)	-5.32891	3.24E-05	-2258.98	-987.982

ANOVA

	df	SS	MS	F	Significance F
Regression	3	2997078	999025.9	17.51674	8.12E-06
Residual	20	1140653	57032.65		
Total	23	4137731			

The exchange rate is also statistically significant in this specification but exhibits a negative coefficient, indicating that sustained currency depreciation is associated with lower long-run GDP. The unemployment rate remains statistically insignificant.

Overall, these results indicate that while exchange rates and commodity prices influence short-run GDP movements, long-run GDP growth in Canada is more closely associated with demographic expansion through net migration.

DISCUSSION

Comparative Analysis

A comparison of the two regression models reveals clear differences in the determinants of Canadian GDP across time horizons (Table 6). As summarized in the regression result, the short-run model (2012–2023) exhibits a stronger overall fit (Adjusted $R^2 = 0.84$) than the long-run model (2000–2023), largely due to the inclusion of oil prices, which capture recent commodity-driven fluctuations in output. In the short run, exchange rate depreciation and oil price increases are both positively and statistically significantly associated with GDP (Table 6). These results are consistent with open-economy macroeconomic theory, in which a weaker domestic currency improves export competitiveness and raises net exports, thereby increasing aggregate demand (6, 7). For a resource-exporting economy such as Canada, higher oil prices further amplify this effect by increasing export revenues, investment in the energy sector, and related spillovers to the broader economy.

By contrast, the long-run model highlights the structural importance of net migration, which emerges as a statistically significant and positive determinant of GDP over the full 2000–2023 sample (Table 6). This suggests that demographic expansion contributes to long-term output growth through gradual increases in labor supply and aggregate demand. Notably, the exchange rate

coefficient reverses sign in the long-run specification, indicating that sustained currency depreciation is negatively associated with GDP over longer horizons.

This divergence underscores the importance of distinguishing between cyclical and structural drivers of economic growth. Variables that stimulate output in the short run, such as commodity prices or exchange rate movements, do not necessarily support sustained growth over longer periods.

Exchange Rate Dynamics Across Time Horizon

The contrasting exchange rate effects observed across the two models warrant particular attention (Table 6). In the short-run specification, exchange rate depreciation is positively associated with GDP, consistent with the standard trade competitiveness channel emphasized in open-economy models. A weaker Canadian dollar lowers the foreign-currency price of exports, supporting export volumes and revenues, particularly in manufacturing and energy-intensive sectors (6, 7).

However, the long-run results indicate a statistically significant negative relationship between exchange rate depreciation and GDP (Table 6). This finding suggests that sustained depreciation may reflect underlying macroeconomic weaknesses rather than acting as an independent engine of growth. Over extended periods, persistent currency weakness can be associated with lagging productivity growth, reduced capital inflows, and higher import costs, all of which may constrain long-term output.

Thus, while currency depreciation may provide short-term stimulus, the results imply that it does not substitute for productivity-enhancing structural reforms. In the Canadian context, exchange rate movements appear to function as a cyclical adjustment mechanism rather than a reliable driver of long-run economic expansion.

Economic Interpretations of Migration Effects

The strong and positive long-run association between net migration and GDP aligns with neoclassical growth theory, which identifies labor force expansion as a key determinant of potential output (6, 7) (Table 6). Sustained immigration increases the supply of labor, supports aggregate demand, and enlarges the productive capacity of the economy over time. The absence of a statistically significant migration effect in the short-run model does not contradict this long-run relationship. Rather, it reflects the presence of temporal lags and short-term adjustment costs. New migrants require time to integrate into the labor market, while increased population growth

Table 6. Comparative analysis of short-run and long-run regression results.

Factor	Model A (Short-Run)	Model B (Long-Run)
Adjusted R^2	0.84 (strong fit)	0.68 (moderate fit)
Net Migration	Negative & NS	Positive & significant
Exchange Rate	Positive & significant	Negative & significant
Oil Price	Strong impact	Not included

can initially place pressure on housing, infrastructure, and public services. These transitional effects may offset immediate output gains, rendering the short-run impact statistically insignificant.

Importantly, the results support a cautious interpretation: while net migration contributes positively to long-run GDP levels, the magnitude and timing of these gains depend on complementary policies that facilitate labor market integration and productivity growth.

Unemployment and Output Dynamics

Across both model specifications, the unemployment rate is not statistically significant (Table 6). This result suggests that unemployment functions primarily as a lagging indicator of economic activity rather than as an independent driver of GDP growth. In macroeconomic terms, unemployment responds to fluctuations in output rather than causing them, particularly in economies with active fiscal and monetary stabilization policies.

In the Canadian case, policy interventions during major downturns, such as the 2008 financial crisis and the COVID-19 pandemic, may have further weakened the contemporaneous relationship between unemployment and GDP. As a result, variations in output appear to be more strongly influenced by structural demographic factors and external shocks, such as commodity price movements, than by short-term labor market fluctuations.

Policy Implications

The findings carry several policy-relevant implications. First, Canada's sensitivity to oil price fluctuations highlights the continued importance, and risk, of resource dependence. While high commodity prices can boost output in the short run, they also expose the economy to external volatility. Diversification toward higher value-added and less resource-dependent industries may enhance long-term stability.

Second, exchange rate depreciation can stimulate output temporarily, but the long-run results caution against relying on currency weakness as a growth strategy. Without concurrent improvements in productivity and investment, sustained depreciation may be associated with weaker long-term performance.

Third, net migration contributes positively to long-run GDP growth, but these benefits are neither immediate nor automatic. Complementary investments in housing, infrastructure, and labor market integration are essential to translate population growth into sustained economic gains.

Limitations

Despite its contributions, this study is subject to several limitations. First, the short-run model relies on a small sample size ($n = 12$), which may reduce statistical power. Second, omitted variable bias may be present, as factors such as interest rates, fiscal policy, and productivity are not explicitly modeled. Third, measurement error and data quality limitations, particularly in migration and oil price series, may affect coefficient estimates. Using GDP measured in current USD may introduce exchange rate related valuation effects. However, this choice ensures consistency across international data sources. Future research could employ real GDP in constant prices or domestic currency terms to isolate volume effects. Finally, the use of static linear regression restricts the analysis from capturing dynamic or lagged effects, suggesting that future research could benefit from vector autoregression or error-correction frameworks.

CONCLUSION

This study examined the macroeconomic determinants of Canada's Gross Domestic Product (GDP) over the period 2000–2023 using multiple linear regression models to distinguish between short-run and long-run relationships. Two specifications were estimated: a long-run model covering the full sample period and a short-run model focusing on the post-2012 period, which incorporates global oil prices.

The empirical results indicate that the drivers of Canadian GDP differ substantially across time horizons. In the short run, exchange rate depreciation and increases in global oil prices are positively and statistically significantly associated with GDP. These findings are consistent with open-economy and resource-based frameworks, in which currency movements and commodity price fluctuations affect output through trade competitiveness and export revenues (6). However, these effects appear to be primarily cyclical rather than structural.

In contrast, the long-run model highlights the role of net migration as a statistically significant determinant of GDP over extended periods. Sustained population inflows are associated with higher aggregate output, reflecting gradual labor force expansion and demand growth. At the same time, exchange rate depreciation is negatively associated with GDP in the long run, suggesting that persistent currency weakness may reflect underlying macroeconomic constraints, such as lagging

productivity or reduced investment, rather than acting as a source of sustained economic expansion.

Importantly, the unemployment rate is not statistically significant in either specification. This result suggests that unemployment functions mainly as a lagging indicator of economic activity rather than as an independent driver of output, particularly in the presence of active macroeconomic stabilization policies.

Taken together, the findings emphasize the importance of distinguishing between short-term stabilization mechanisms and long-term growth fundamentals. While external factors such as oil prices and exchange rate movements can generate temporary fluctuations in output, long-run economic performance appears more closely linked to structural factors, including demographic trends and productivity-related conditions. Policies aimed at supporting sustainable growth should therefore complement immigration-driven labor force expansion with investments in productivity, infrastructure, and economic diversification, while avoiding reliance on persistent currency depreciation or commodity price cycles as growth strategies.

Several limitations should be acknowledged. The short-run analysis is based on a limited number of observations, and the regression framework does not capture dynamic or lagged adjustment processes. Future research could extend this analysis by incorporating additional macroeconomic variables, employing dynamic time-series models, or examining regional heterogeneity within Canada.

CONFLICT OF INTEREST

The author declares that there are no conflicts of interest regarding the publication of this article.

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