Estimating Ontario's Potential Output Growth

Kimli Nguyen
Department of Economics, York University
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Dr. Tsvetanka Karagyozova
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Abstract

The main goal of this paper is to forecast Ontario's potential output growth from 2026 to 2035 using a Cobb-Douglas production function and a growth accounting framework. The projection is based on two (2) main assumptions: first, the state of AI and the overall growth of technology over recent years, and, second, the surge in labour markets due to increases of job opportunity in high-demand areas over the pandemic, and the recovery from the pandemic. Under these assumptions, Ontario's potential output growth increases from about 0.7 percent in 2026 to just under 3 percent by 2035.

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1. Introduction

A key component economists examine in any economy is its output growth potential. Following the end of COVID-19 pandemic disruptions and with technological advancements continuing to grow ever since, Ontario's economy has undergone significant structural adjustments as Canada's leading economy. In light of this, assessing how the province's potential output growth is affected becomes increasingly important.

Potential output growth, or POG, refers to the maximum sustainable rate of growth for an economy, assuming its productive resources, such as labor, capital, and technology are used at its full potential. Unlike real gross domestic product (GDP) growth, defined as the actual output of an economy over a specific period, POG is unobservable and must be estimated (Wolla, 2021).

Determining the potential growth is crucial for guiding policy decisions. For example, economists compare potential output with actual output to see whether an economy is underperforming or overperforming. When actual output is below potential output, the economy is underperforming, which leads to higher unemployment and lower inflation. Overperforming exists when actual output exceeds its potential, which can cause inflationary pressures as demand exceeds supply.

During the COVID-19 pandemic, Ontario's actual output fell sharply below its potential GDP due to unexpected lockdowns and reduced economic activity (Financial Accountability Ontario, 2021). In response to the negative output gap, the Bank of Canada implemented quantitative easing (QE), which is large-scale purchases of Government of Canada bonds from the Bank to inject cash into its financial system. With more excess reserves, the policy rate naturally decreases from 1.75% to 0.25% (Bank of Canada, 2025). This concept reflects the principle of money neutrality, which states that monetary policy influences real variables only in the short run. Therefore, QE helps stabilize actual output at a given period of time, preventing the chances affecting potential output growth in the long-run.

Potential output growth also affects decisions in fiscal policy. In this example, Ontario implemented expansional fiscal policy, which refers to boosting economic activity during a recession. They released an action plan that accounted for $17 billion to support healthcare, people and jobs (Blodgett & Skamski, 2020). Then, they also allowed for deferred tax payments

(Yelich et al., 2020) and provided additional assistance for small businesses, including grants, loans and rebates (Yelich et al., 2021). These initiatives together brought struggling individuals afloat and increased economic activity during a period of severe economic contraction and uncertainty.

The central reason economists, central banks, and policymakers pay attention to potential output growth is because it determines whether our current state of economy is where it should be ideally or not. A closed gap between potential growth and actual growth means that our economy is operating at its fullest: individuals are experiencing the best possible standard of living due to rising incomes, higher employment rates, increased consumer confidence and reduced reliance on social support programs. By understanding potential output growth and its most influential determinants, they can make informed decisions to bring the economy to its highest potential.

With all that noted, the goal of this paper is to form a projection for Ontario's potential output growth from 2026 to 2035. The first step is to identify values for capital, labour, and productivity consistent with an economy operating at full capacity, and plugging them into the Cobb-Douglas productivity formula to assess historical potential output. Then, a growth accounting framework is used to estimate potential output growth from labour input trends and labor productivity trends. In conducting this analysis, the main focus will be on technological advancements and population growth, and considering how they may affect labour input and labour productivity.

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2. Literature Review

The concept of potential output growth was founded in 1962 by Arthur Okun at the annual conference of the American Statistical Association (ZEW Economic Studies, 2009). He introduced the idea as a way to measure the level of output an economy could achieve under conditions of full employment and stable inflation.

Over time, this concept grew with theories such as Wicksell's (1898) idea of interest rate gaps and Keynes's (1930) Keynesian gap theories, which connected output, employment, and inflation. These ideas also linked to the well-known theory of the Phillips curve, which shows the trade-off between unemployment and price stability, and eventually evolved to today's definition of potential output growth (Tauber, 2020).

2.1 Methods of Calculating Potential Output Growth

As outlined in Mishkin's (2007) article, there are three distinct ways to calculate potential output growth: aggregate approaches, dynamic stochastic general equilibrium approaches, and production function approaches (also known as growth accounting). Aggregate approaches, or the top-down approach, is based on the idea of using already existing data of relevant variable(s) over a period of time and identifying potential output growth by observing long-term trends and drawing a "line of best fit" with the data. It is known to be simple and easy-to-produce, however, it also raises concerns about accuracy since it is backward looking and heavily dependent on the chosen parameters (Mishkin, 2007).

On the contrary, the dynamic stochastic general equilibrium (DSGE) approach is the most theoretically heavy. Potential output calculated under this method can fluctuate over time due to different kinds of shocks, for example, changes in fiscal policy or consumer preferences in saving and working. If the assumptions about what kind of shocks hit the economy are accurate, this method can create a very realistic timeline of what could happen to potential output growth, given that the model used is also relevant. Therefore, results can be drastically different based on the strategies used, making DGSE most powerful when economists want to visualize how an economy responds to shocks that are grounded in economic theory rather than data trends (Mishkin, 2007).

This paper will focus on utilizing the growth accounting approach to calculate output potential. This method relates to the concept of aggregate approaches as it also utilizes historical data. However, unlike the aggregate approach, growth accounting focuses on where the growth is originating from (what part of potential output comes from labour, productivity, etc.) rather than extracting potential growth as a whole from economic data patterns alone (UC Davis). It is efficient for determining what inputs are strongly influencing the economy and the lagging factors, which serves as an important benchmark when formulating effective policy responses.

2.2 The Cobb-Douglas Production Function

To better understand growth accounting, it is essential to examine the Cobb-Douglas production function. It begins with the mathematical representation that Charles Cobb and Paul Douglas (1927) introduced in their paper *A Theory of Production*, shown below:

$$P = b\,L^k\,C^{1-k} \tag{1}$$

This model highlights the relationship between *P*, representing total production, and its key inputs: labour *L* and capital *C*. The parameter *b* captures other influences on output, such as technology and efficiency, while *k* and $1-k$ represent the output elasticities of labour and capital. Two main assumptions were made: first, β is fixed, and second, the elasticities sum to one, implying constant returns to scale.

In Robert Solow's (1956) paper, *A Contribution to the Theory of Economic Growth*, the Cobb–Douglas equation evolves into the form shown in equation (2). In this updated model, technological progress is made explicit, as it is now replaced with *A* and represents Total Factor Productivity (TFP). In this paper, TFP will serve as a rough estimate for technological progress.

$$Y = A \bullet K^{\alpha} \bullet L^{\beta} \tag{2}$$

Compared to the previous model (1), the input elasticities α and β in (2) are allowed greater flexibility. For example, when the sum of these elasticities is less than one, it represents diminishing returns to scale, meaning output grows by less than 1% when labour and capital increase by 1% together. Contrastingly, increasing returns indicates the opposite for output, and occurs when the sum is greater than one. This adjustment in equation (2) improves upon the earlier version because it acknowledges that while constant returns to scale are theoretically ideal, real-world economies are rarely in perfect balance. For the purpose of this paper, constant returns to scale will be used for α and β.

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3. Model Creation

3.1 Growth Accounting

The concept of growth accounting was introduced by Solow (1956). It essentially breaks down the growth of something into the contributions of its main inputs. In this case, the

Cobb–Douglas production function can be rewritten in growth rates to show how much each input contributes to overall economic growth.

To start formulating the growth accounting formula, equation (2) in section 2.2 is extended by adding a time variable *(t)* to allow each component to change over time. This evolves the function to become its dynamic form, shown as (3), which can measure potential output at any given time:

$$Y(t) = A(t)K(t)^{\alpha}L(t)^{\beta} \quad (3)$$

Once it is in its dynamic form, the next step is to derive equation (3) above with respect to time, *(t)*, to get the instantaneous rate of change. This can be done by taking the log of the entire equation, interpreted as (4),

$$\ln Y(t) = \ln A(t) + \alpha \ln K(t) + \beta \ln L(t) \quad (4)$$

And then differentiating with respect to *(t)* to obtain (5),

$$\frac{d(\ln Y)}{dt} = \frac{d(\ln A)}{dt} + \alpha \frac{d(\ln K)}{dt} + \beta \frac{d(\ln L)}{dt} \quad (5)$$

However, in growth accounting, these rates are often rewritten with dot notation to simplify the equation while distinguishing derivatives with respect to time. When this is applied to (5), a simplified equation (6) is obtained:

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + \alpha \frac{\dot{K}}{K} + \beta \frac{\dot{L}}{L} \quad (6)$$

Note that the equation above is the basic growth accounting framework where the instantaneous growth of output, $\frac{\dot{Y}}{Y}$, is decomposed into a sum of its determinants. Specifically, the instantaneous growth of total factor productivity, $\frac{\dot{A}}{A}$, instantaneous growth of capital, $\frac{\dot{K}}{K}$, instantaneous growth of labour, $\frac{\dot{L}}{L}$, and the input elasticities α and β.

The final step here is to use the Solow residual to isolate total factor productivity from the other components in (8), as it is the only component that cannot be measured using existing economics data. The result is equation (7) as shown below:

$$\frac{\dot{A}}{A} = \frac{\dot{Y}}{Y} - \alpha\frac{\dot{K}}{K} - \beta\frac{\dot{L}}{L} \tag{7}$$

Note that TFP represents technological progress and all remaining sources of growth not explained by capital and labour. However, for potential output growth, annual data must be used, so the growth accounting identity must be written in discrete time. Rearranging equation (7) accordingly results to the discrete-time Solow residual:

$$\frac{\Delta A_t}{A_{t-1}} = \frac{\Delta Y_t}{Y_{t-1}} - \alpha\frac{\Delta K_t}{K_{t-1}} - \beta\frac{\Delta L_t}{L_{t-1}} \tag{8}$$

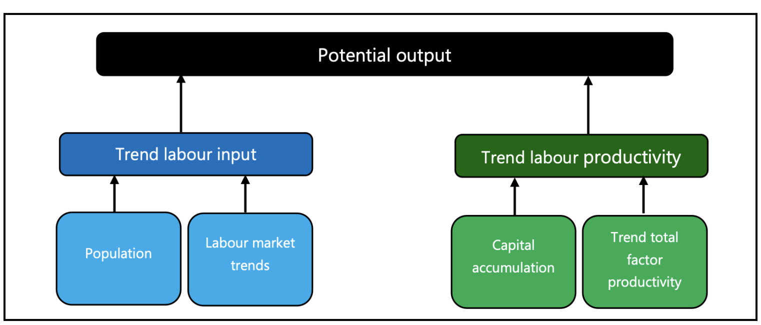
This expression isolates TFP growth directly from the observed changes in output, capital, and labour. The resulting measure of TFP, combined with the trend components of capital and labour input, provides the foundation for constructing Ontario's potential output growth in the next section.

3.2 Modelling Potential Output Growth

The breakdown of potential output growth includes two main components: trend labour input and trend labour productivity. Trend labour input reflects the long run pattern of the labour force and captures population growth and labour market participation.

Trend labour productivity measures how effectively these labour services are used, and is driven by capital accumulation[1] and TFP[2]. Total factor productivity captures improvements in efficiency, technology, organisational practices, and other structural changes that raise output independently of capital and labour growth.

Figure 1: Components of Potential Output Growth



Source: Brouillette et. al

[1] Another term can be capital deepening, which is used later on when deriving trend labour productivity.
[2] Defined earlier in Section 2.2.

To derive the equation for potential output growth, an extension of the previously stated growth accounting equation is required. Equation (6) is therefore rewritten as[3]:

$$\%\Delta Y_t = \%\Delta A_t + \alpha\%\Delta\left(\frac{K_t}{L_t}\right) + \beta\%\Delta L_t. \tag{9}$$

In this identity, the term $\%\Delta L_t$ represents growth in total labour input, which is measured using the growth in total hours worked. This captures changes in population, employment rates, and average hours worked. The expression $\alpha\%\Delta(K_t/L_t)$ reflects capital deepening, meaning increases in the amount of capital available per worker. The remaining component, $\%\Delta A_t$, corresponds to growth in total factor productivity (TFP), capturing improvements in efficiency or technology.

The focus is on long-term trends rather than short-term fluctuations when constructing potential output growth. Therefore, when the components in (9) are replaced with their trend values: trend labour input, trend capital deepening, and trend TFP growth, the following identity is formed:

$$POG_t = \underbrace{\left[\%\Delta \bar{A}_t + \alpha\%\Delta\left(\frac{\bar{K}_t}{\bar{L}_t}\right)\right]}_{\text{Trend labour productivity}} + \underbrace{\beta\%\Delta \bar{L}_t}_{\text{Trend labour input}} \tag{10}$$

This equation serves as the baseline for estimating Ontario's potential output growth in the subsequent sections.

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4. Determinants of Potential Output Growth

The next step in determining potential output growth is to obtain the necessary data for the variables in the production function. This paper extracts annual data for labour input (L), capital stock (K), and real GDP (Y) from Statistics Canada. To ensure consistency, all real variables are measured in 2017 chained dollars, which means it holds prices constant at 2017 levels. A relatively long sample period, 1997-2023, is selected to capture a more accurate historical trend and any long-term structural trends that have impacted potential growth.

[3] This method follows a similar framework as the Bank of Canada for their POG assessment in 2020 (Brouillette, 2020).

Once the datasets are obtained, they are formatted into a linear time-series table ready for plotting (see Figure 2). The cleaned dataset is then plotted and analyzed using R, however, using software such as Stata or Python would provide equivalent results.

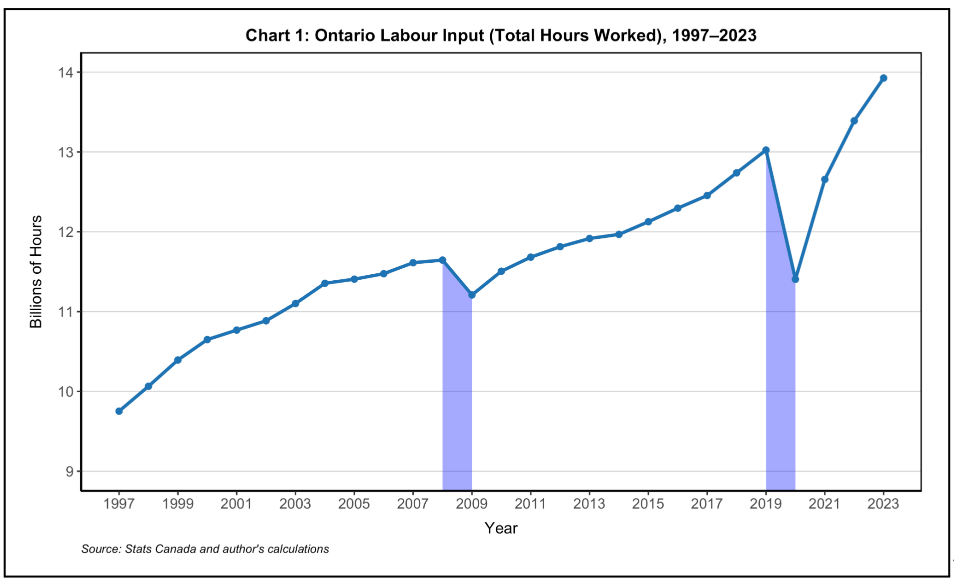
Figure 2: Labour Statistics to Plot Time-Series Model

Labour statistics	North American Industry Classification System (NAICS)	1997	1998	1999	2000	2001	2002
Hours worked for all jobs 3	All industries [T001] 4	9752202.2	10064380.5	10393381.5	10649364.5	10768055	10885120.8

Source: Stats Canada

4.1 Labour

The data obtained for labour is total hours worked for all sectors, including full time and part time for all participants. Another way to obtain the same data is to calculate participation rates, the number of employed workers, and the average hours they work. However, participation rates may be more useful for a cross check or as a substitute when total hours worked is not available.



[4]

From the graph above, input shows a clear long run upward trend from 1997 to 2023, rising from 9.7 to almost 14 billion hours, reflecting steady growth in the size of Ontario's workforce. This increase is largely driven by population growth, which became especially important during the implementation of flexible immigration policies in the 2010s (Government of Canada, 2009) and after the pandemic, when restrictions were lifted for the workforce.

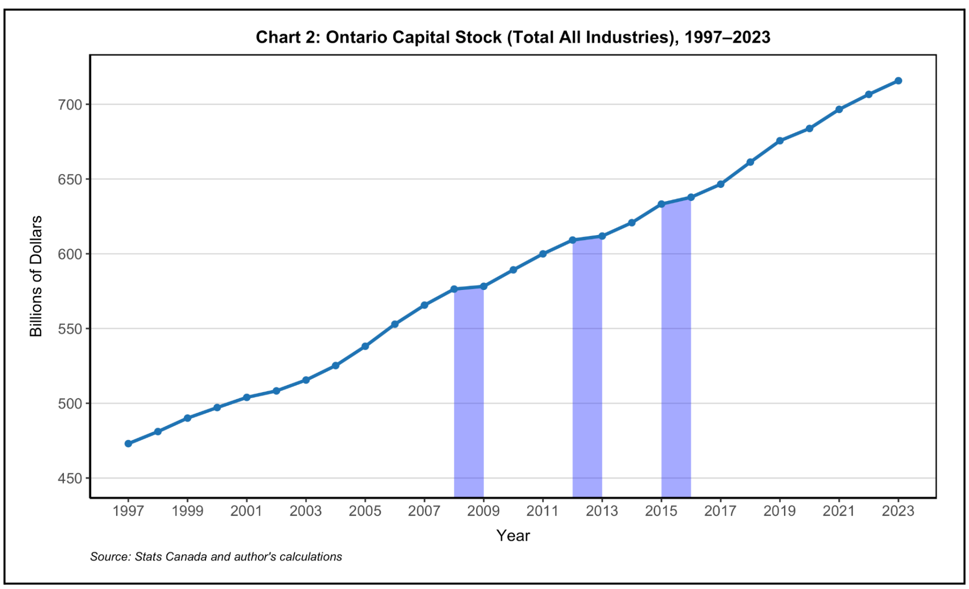
[4] The highlighted sections show the notable turnpoints in the relevant factor for this sample period.

However, there are two noticeable declines. The drop in 2009 followed the global financial crisis, when many manufacturing industries in Ontario cut hours or laid off workers (Statistics Canada, 2009). COVID-19 also had a large impact in 2020, when shutdowns and public health rules sharply reduced hours worked across the province.

This lines up with extremely fast population growth, including a large number of newcomers and international students working in high demand jobs, as well as the reopening of service industries that had been restricted during the pandemic. During this time, Ontario's labour market was operating at or near full capacity, and employers expanded hiring and hours worked to match the larger workforce (Statistics Canada, 2009).

4.2 Capital

Capital input (in this case is net stock investment) shows a steady and continuous rise from 1997 to 2023 as it grows from 470 billion dollars to more than 700 billion dollars. It is important to note, however, that it is normal for constant growth to happen because capital is a stock variable. Depreciation may lower the value of capital, therefore, as long as investment is greater than depreciation, the capital stock grows.



With that said, there are a few moments where the growth rate slows. These slow periods occur around the financial crisis from 2007 to 2009, as well as 2012 to 2013 and 2015 to 2016.

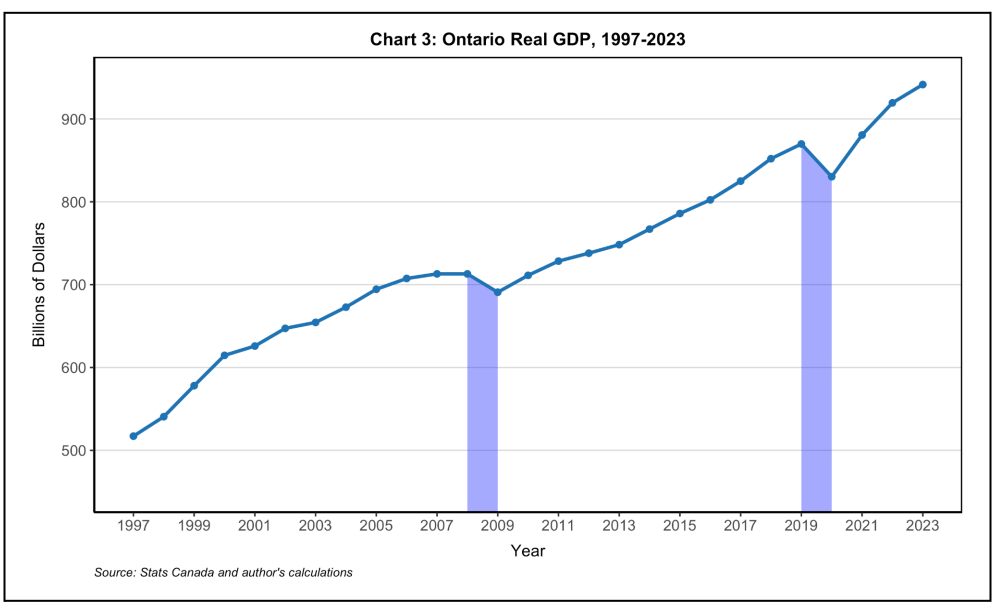
Although, there is no major event that clearly explains the later slowdowns, capital growth can slow when businesses face more uncertainty or weaker demand towards innovation. In those situations, companies tend to hold back on new investment, which may be what happened in those years.

It is also worth noting that the financial crisis created a visible slowdown in the capital series, while the pandemic did not. During the financial crisis firms faced credit problems, lower demand and more uncertainty (Gordon, 2017). However, in the pandemic, capital grew at a steady pace, partly because governments provided large financial support and interest rates stayed low. Companies also needed to invest in technology and remote work tools to adjust to this new era.

4.3 Actual GDP

Real output, or actual output in Ontario shows a strong upward trend from 1997 to 2023. Real GDP rises from approximately 520 billion dollars to nearly 950 billion dollars. Although the overall trend is positive, several noticeable slowdowns occur. A clear drop appeared in 2009 during the financial crisis. At that time output fell because demand collapsed in key industries, especially autos and exports, and many businesses reduced production.

A second major decline occurs in 2020 with the arrival of COVID-19. The fall is much sharper here than in 2009 because many industries were forced to shut down entirely, for at least a part of the year. Sectors that require in-person visits, such as hospitality, retail and personal services saw sudden and severe drops in economic activity.



Despite these downturns, real GDP recovers quickly. In 2021 and 2022, output increases as restrictions ease, demand rises and employment increases. The rapid population growth in Ontario after the pandemic also supports GDP growth. By 2023, real output reaches its highest point in the sample.

4.4 Estimating TFP and Output Elasticies Using Regression

The next step in this process is to use the obtained data from earlier to produce a production function, using (4) earlier now labelled as (11).

$$\ln Y(t) = \ln A(t) + \alpha \ln K(t) + \beta \ln L(t) \qquad (11)$$

The below regression provides values for the two output elasticities (α and β), and the intercept represents the average level of total factor productivity (TFP). Because all three variables grow over time, the regression naturally produces a very high R^2. This is common in time-series data and does not, on its own, confirm that the model is accurate. To solve this issue, it is crucial to test for stationary and robustness.[5]

Figure 3: Estimating Parameters for Cobb–Douglas Production Function (1997–2023)

	Results
TFP	0.317
	(0.298)
α	0.646***
	(0.091)
β	0.877***
	(0.139)
Num. Obs.	27
R²	0.979
Adjusted R²	0.977

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001 [6]

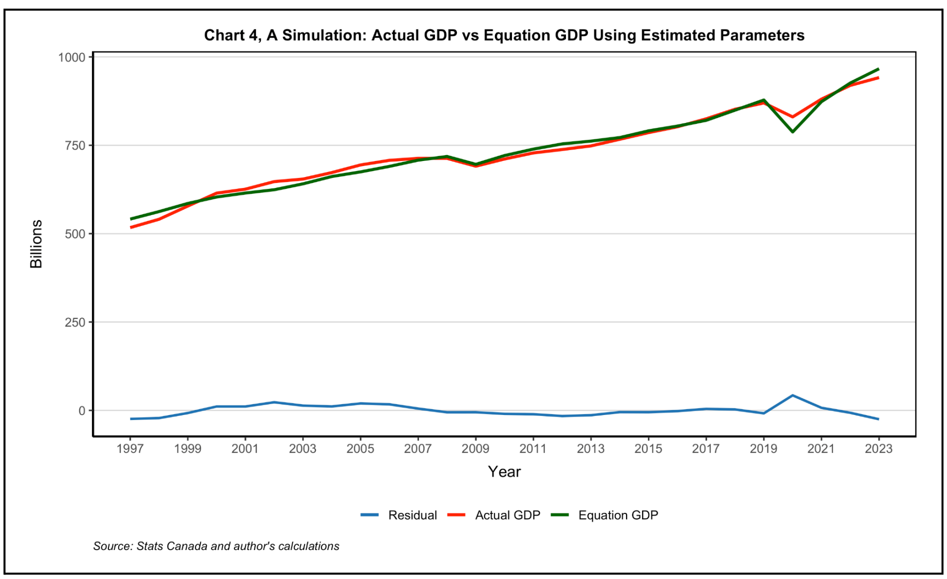
[5] The unit root tests reject the null hypothesis of a root in the residuals, meaning the residuals are stable over time and the model is reasonably reliable (see Appendix A for more details).
[6] This regression is calculated based on Labour, Capital and Real GDP obtained from the previous sections.

According to these results, the estimated coefficient for capital, α = 0.646, means that a 1% increase in the capital stock raises real GDP by about 0.65%, holding everything else constant. The labour coefficient, β = 0.877, means that a 1% rise in total hours worked increases real GDP by almost 0.88%. These values add up to roughly 1.52, showing increasing returns to scale. This could be seen as beneficial because it can boost overall production and the standard of living.

$$Y = A \bullet K^{\alpha} \bullet L^{\beta} \tag{12}$$

It is also worth noting that while our regression equation in theory is (11) stated earlier, the actual production function used to determine potential output growth is (2), or (12) above. Therefore, the regression yields ln(TFP) and not TFP by itself, and it must be converted back by taking the exponential in order to obtain the actual TFP level. This results in approximately 1.37.

4.5 Simulation Results



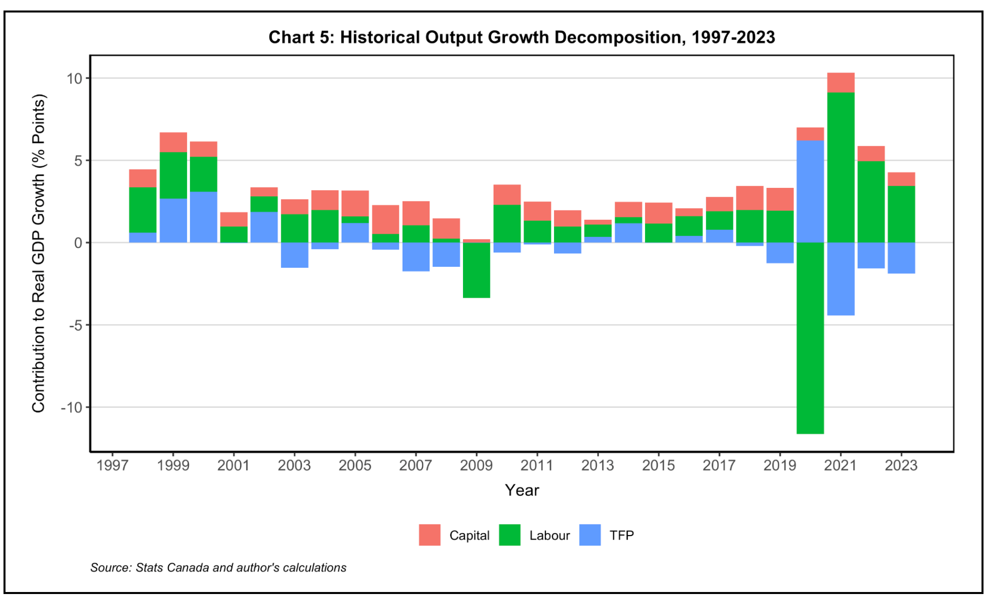
The simulation graph compares actual GDP with the GDP implied by the estimated production function. Since the two lines move closely together over time, it is a good sign that Ontario is not far away from its potential. In fact, there was a period of positive output growth: actual GDP higher than potential GDP, in the early 2000s. This may be because of the spike in investments and purchases before the financial crisis, as it underperformed afterwards.

The residual line shows the part of GDP that the model cannot explain. In this case, the residuals fluctuate around zero and remain relatively modest in most years, except during major economic shocks such as 2008-09 and 2020. To verify its accuracy, autocorrelation, heteroskedasticity, and normality tests were also performed[7]. Taken together with the previous conclusions, these results show that the residuals behave reasonably well and that the model is suitable for estimating TFP and potential output.

4.6 Historical Output Growth

Before calculating historical output growth, it is important to use trend contributions to smooth out values and ensure accuracy (see eq. (8)). Using the Ontario data, the trend contribution of capital to growth is 1.03 percentage points (pp), and labour's trend contribution is 1.20 pp. The main contributor here is labour, which matches findings from Stats Canada showing that labour input has been the largest driver of GDP growth (Table: 36-10-0208-01).

In this case, it is positive and averages 0.07 pp per year. This small value suggests that Ontario's long run growth has depended far more on capital and labour than on improvements in efficiency. However, it is important to note that TFP may also be negative; for example, in 2020 shown below. This does mean technology is worsening or disappearing. Instead, it may be because the existing resources for TFP that year were not used efficiently.

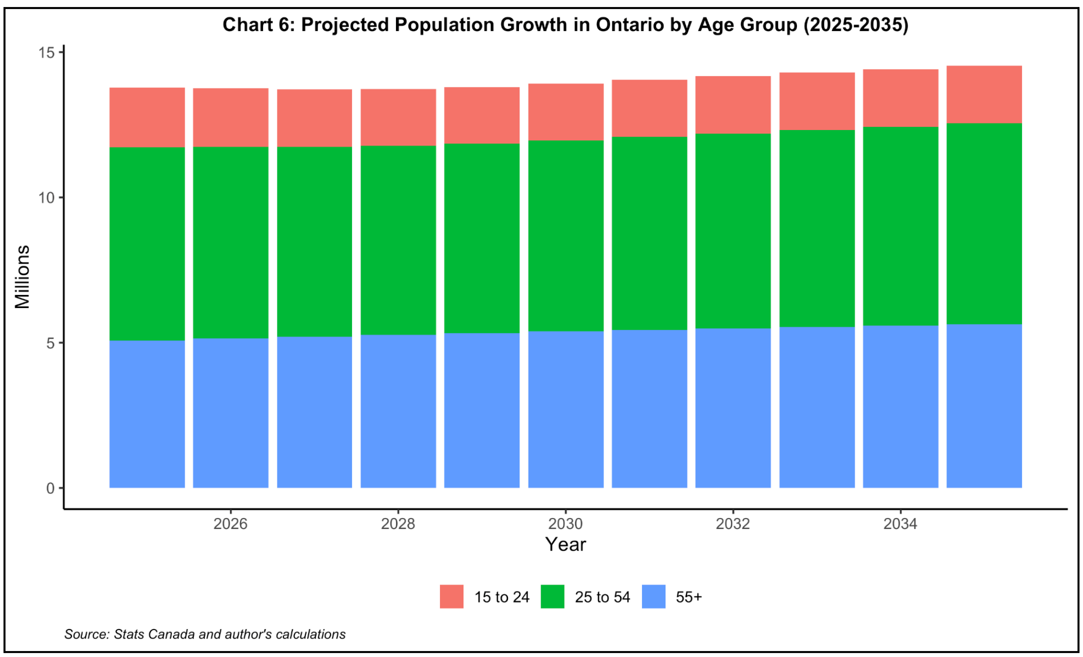


[7] See Appendix A for more details.

5. Labour Input Trends

Once historical potential output growth and trends are obtained, the final step is to utilize that data as a baseline to forecast the potential output growth for the next 10 years. However, note that while potential output growth rates may correlate with historical potential output, it should not rely on historical trends alone. Therefore, before forecasting, some assumptions about the future should be made, which will then be used to project the trend paths of labour, capital, and productivity.

5.1 Population Growth



The population projection graph shows that Ontario's working age population is expected to grow steadily from 2025 to 2035. Most of this increase comes from people in the 25-54 group and those aged 55 and older. This pattern is happening because Ontario's population growth is driven mainly by immigration, and most newcomers arrive as adults or graduating students who fall into the core working age category. At the same time, many people who are already living in the province are aging into the older group.

In general, there are three (3) projection cases: low-growth, reference, and high-growth, which are based on different assumptions about future population. Low-growth can assume a more pessimistic angle and high-growth is more optimistic. Any case may be used, but the reference case is used here because it represents the most baseline scenario if recent trends continue (Ontario Ministry of Finance, 2021).

5.2 Labour Market Growth

The labour market growth, or, participation rate table shows how different groups of people are to be working or looking for work[8]. Young people aged 15-24 participate less often because many of them are still in school or only working part time. Likewise, participation drops sharply for people aged 55+ as more of them begin to retire. There are also differences between men and women that reflect ongoing differences in work patterns and caregiving responsibilities.

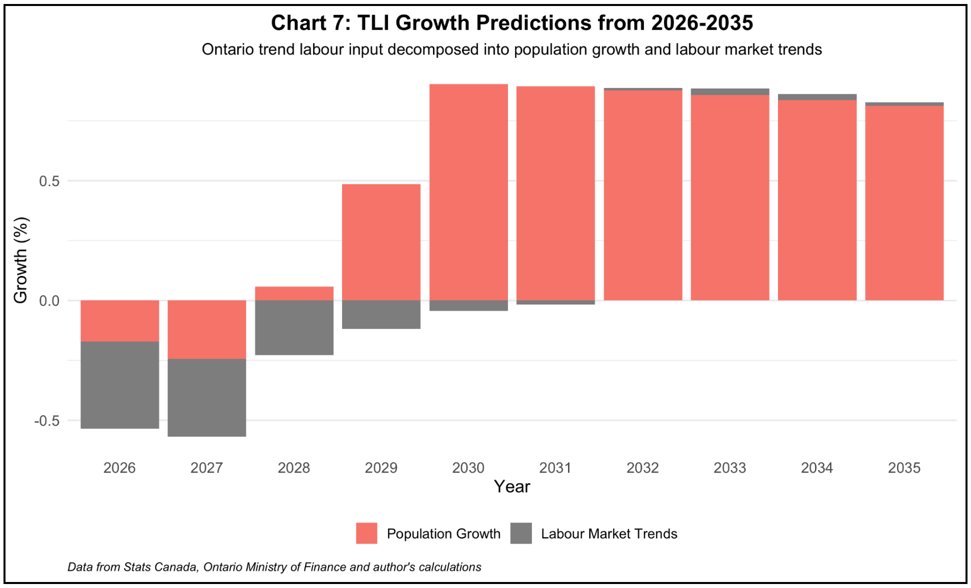
Table 1: Average Participant Rates, by Gender and Age Group, from January 2017 to December 2019

Group	Participant Rate
Men 15-24	62.7%
Men 25-54	90.4%
Men 55+	44.3%
Women 15-24	61.9%
Women 25-54	81.5%
Women 55+	32.9%

[9]

The trend labour input graph in the next page shows how much of future labour supply growth comes from population increases and how much comes from underlying labour market factors.

[8] While the table above only specifies men and women, other identities such as non-binary may be included. In this case, however, the data provided did not specify this.
[9] Data calculated from the Ministry of Finance population projections.



Almost all of the growth in labour input over the next decade comes from the growing population. Since participation rates are held constant in this trend measure, the shift toward an older population reduces the amount of labour input that can be generated from each person, especially since the chart in Section 5.1 states that the amount of younger individuals is drastically lower.

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6. Labour Productivity Trends

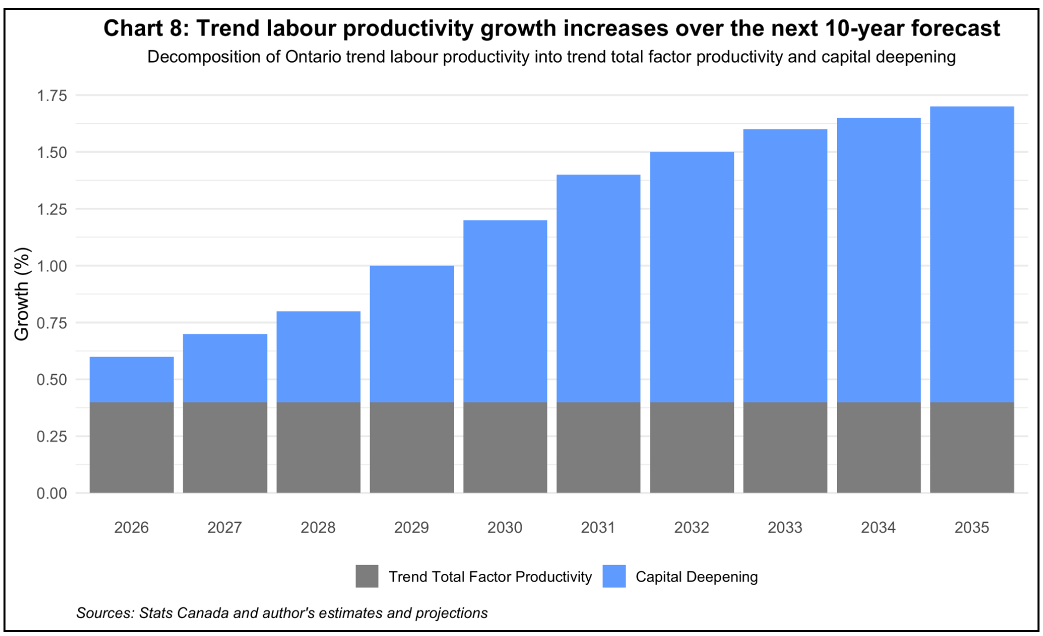
6.1 Capital Accumulation

In the years immediately after COVID-19, Ontario's labour force recovered quickly as public-health restrictions eased and participation increased. Strong population growth, including high immigration, increased the supply of workers faster than the capital stock could adjust, which temporarily reduced capital per worker and weighed on labour productivity. This result is similar to the Bank of Canada findings that trend labour productivity was dragged down by the drastic increase for trend labour input in 2023 and 2024 (Devakos et al., 2024).

Looking ahead, this paper assumes that firms respond to the larger labour force by raising investment in equipment and software, including digital technologies and AI tools. According to McKinsey, the usage of AI is becoming increasingly common in 2025, with most companies stating that they use it for at least one function (McKinsey & Company, 2025). Therefore, this paper assumes that capital deepening contributes only modestly to productivity growth in the early years, but rises around 2030 as firms adopt new technologies and adjust their capital stock to the larger post-pandemic labour force. In the later years, capital growth is assumed to return to a more normal pace, and the contribution of capital deepening stabilizes.

6.2 Trend Labour Productivity

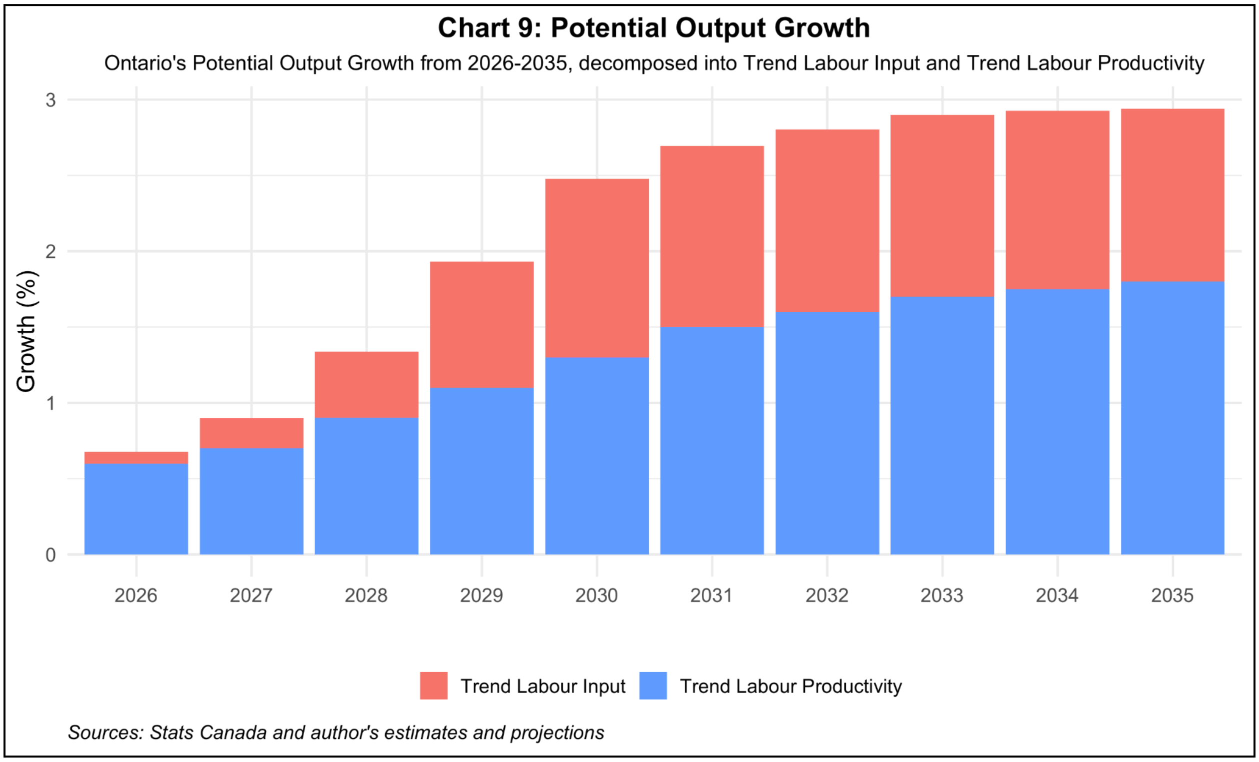
Historical TFP growth in Ontario was very weak, averaging only 0.07 percentage points per year in the regression in Section 4.4. However, historical TFP is not an appropriate basis for forecasting future productivity in the current environment. This is because there has been a rapid acceleration in the adoption of digital technologies, online business platforms, cloud software, automation, and AI-enabled tools post-pandemic (Singla et al., 2025). Firms have also reorganized production around hybrid, remote work, and the use of AI tools, which has increased flexibility and reduced operating costs.



With that said, this paper adopts a trend TFP growth rate of 0.4% per year, which is around the average TFP range of 0.5% that the Bank of Canada has assessed in the 2020s (Brouillette et al., 2024). The reason TFP in this case is lower is simply due to the uncertainty of AI being in its "pilot stage" (McKinsey & Company, 2025).

7. Potential Output Growth: 2026 to 2035

Now with both trend labour input (TLI) and trend labour productivity (TLP) factors obtained, potential output growth can be calculated[10]. The following chart yields the results for Ontario from 2026-2035:



Ontario's potential output growth rises from about 0.7 pp in 2026 to just under 3 pp by 2035. This increase reflects both population trends and steady improvements in productivity, including technology advancements. At the start of the period, TLI makes only a small contribution to growth, around 0.1 to 0.2 pp[11] in 2026 and 2027. By the early 2030s, labour input added roughly 1.2 to 1.3 pp to potential growth because of the growing population.

TLP also rises over time, but the increase is more modest. Productivity adds about 0.6 pp to growth in 2026 and reaches around 1.8 pp by 2035. This pattern reflects steady investment in capital and the ongoing use of digital tools and artificial intelligence in workplaces, as much of the rapid shift toward new technologies happened during or right after the pandemic period.

[10] Recall that potential output growth is calculated with eq. 10 and fig. 1, in Section 3.2.
[11] pp means percentage points, as stated in Section 4.6.

Because many of these changes have already been absorbed, current productivity growth follows a smoother path.

7.1 Limitations

After careful comparisons with the Bank of Canada in their 2024 POG[12] assessment, the projected potential output growth calculated here may be higher than what is normally expected (Devakos et al., 2024). This could be because the model follows an optimistic approach where population growth remains strong and productivity (including technology) improves at a steady pace.

Another reason could be because of the amount of assumptions. As stated in Section 1.2, using the dynamic stochastic general equilibrium (DSGE) is the most theoretically heavy and relies on many assumptions, but it could be the most accurate model if the assumptions are correct. For example, recently announced tariffs by the United States also create uncertainty for Ontario businesses, which may lower capital outlook (FAO, 2025). This paper did not consider that.

A possible slowdown or recession in North America would have similar effects (OCC, 2025). In addition to this, unemployment rates may increase due to the job market being more pessimistic (FAO, 2025a). These risks mean that actual productivity growth could fall below the trend estimates in the short term, even though the long run outlook for technology use remains positive.

[12] POG is potential output growth. See introduction for more information.

8. References

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8.2 Stats Canada Data Sets

Table 36-10-0489-01 Labour statistics consistent with the System of National Accounts (SNA), by job category and industry

Table 36-10-0096-01 Flows and stocks of fixed non-residential capital, by industry and type of asset, Canada, provinces and territories (x 1,000,000)

Table 36-10-0222-01 Gross domestic product, expenditure-based, provincial and territorial, annual (x 1,000,000)

Table 36-10-0208-01 Multifactor productivity, value-added, capital input and labour input in the aggregate business sector and major sub-sectors, by industry

Appendix A: Stationary & Diagnostics Test

The appendix table below shows two (2) main tests performed on the regression analysis. First, an Augmented Dickey-Fuller (ADF) test was applied for variables Y, K, and L, which was based on data from Stats Canada. This was to ensure that these variables shows persistent trends over time rather than remaining stable around a fixed level.

After running the simulation, diagnostic tests were applied to the residuals to check whether the model meets key statistical assumptions. Specifically, these tests examine whether the residuals are correlated over time (autocorrelation), whether their variance remains the same (heteroskedasticity), and whether they are normally distributed around zero (normality). These checks help determine whether the regression results can be interpreted reliably and whether further adjustments are required.

Appendix Table 1: Diagnostic Tests for Cobb–Douglas Regression

Test	Variable	Statistic	p-value	Conclusion
ADF Unit Root Test	Real GDP (Y)	-1.89	0.61	Non-stationary (unit root)
ADF Unit Root Test	Capital Stock (K)	-2.33	0.44	Non-stationary (unit root)
ADF Unit Root Test	Labour Input (L)	-3.51	0.06	Non-stationary (unit root)
Autocorrelation	Regression Residuals	0.76	0.00	Reject H_0 (issue detected)
Heteroskedasticity	Regression Residuals	11.39	0.00	Reject H_0 (issue detected)
Normality	Regression Residuals	0.19	0.91	No issue detected

The ADF test results indicate that real GDP, capital, and labour are non-stationary, meaning these variables follow long-run trends rather than fluctuating around a constant level. This does not imply a limitation for the analysis. The normality test also shows no issue, which means it support the overall fit of the model.

However, the autocorrelation and heteroskedasticity tests reject the null hypothesis. These issues are likely from the previous stated Simulation Results: global financial crisis and the COVID-19 pandemic. In particular, the pandemic had a large impact on labour input compared to other variables, which helps explain autocorrelation in the residuals. To fix this, robust standard errors can be applied to ensure reliability when interpreting.

Appendix B: AI Use Disclosure

I used AI in the preparation of this report in the following ways:

[Understanding economic concepts, providing synonyms, generating prompts for preliminary research, and brainstorming project outline.]

<u>Below are examples of some prompts I used in the preparation of this report.</u>

Explaining Economic Concepts (for better understanding)
"How is potential output growth and real output growth related?"
"Explain the process of quantitative easing and how it lowers interest rates."

Preliminary Research
"I am writing an empirical report that estimates potential output growth for the next 10 years (2025-2035). I want to focus my paper on technology advancements and post-pandemic effects. Please provide some examples of research prompts I can use for my preliminary research."

Brainstorming Project Outline
"Consider the outline of an empirical report and my topic. Create a step-by-step realistic guideline I can follow to complete this project within 8 weeks. Please also include a rough draft of the table of contents."
"Break down the guideline into simpler terms. What are some example topics to include for each part of the guideline?"