The Impact of Industrialization on Economic Growth in Tonga

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Abstract – This study examines the impact of industrialization on economic growth in Tonga. The Tongan government has worked tirelessly to ensure that the country achieves and sustains industrialization to drive economic growth. This study was undertaken because of conflicting findings from previous studies on the nature of the relationship that exists between economic growth and industrialization. Some studies have shown that industrialization has a positive and significant impact on economic growth, while others have not. The study used secondary data from World Bank data statistics and specified a model where GDP was the dependent variable while industrial output, inflation, interest rate and exchange rate were the independent variables. Jamovi software was used to analyze the data using multiple regression analysis. The results show that industrialization and exchange rate have a positive and significant impact on economic growth in Tonga. This implies that the existing industrialization policy should be maintained and implemented accordingly. The government of Tonga should continue to provide a good and attractive environment for industrial growth in the country. Replication of this study in other countries is recommended and future studies are also recommended to consider the inclusion of other macroeconomic indicators such as FDI and others as variables.

Keywords – Economic growth, Industrialization, Tonga

1 Introduction

Tonga faces numerous development constraints, including those related to a limited resource base, geographic isolation and fragmentation, and vulnerability to external shocks (Fairbairn, 2019). However, the government has worked tirelessly to improve the quality of life for all Tongans. Tonga has worked hard to meet most of its international obligations and commitments under the Barbados Plan of Action, the Mauritius Implementation Strategy, and the Millennium Development Goals. For example, the Tonga Strategic Development Framework (TSDF II) 2015-2025 aims to build resilient infrastructure, promote equitable and sustainable industrialization, and support innovation. The Tonga Strategic Development Framework II 2015-2025
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(TSDFII) continues to guide the country's overall economic development and is based on the national vision of "a more progressive Tonga that supports a higher quality of life for all" (Fa’otusia, 2019).

The tendency of the industrial sector to stimulate economic growth has led many economists to formulate various theories to promote industrialization. Among the early famous theories are: Nelson’s low equilibrium trap theory; Leibenstein’s critical minimum effort thesis (Leibenstein, 1957); the equilibrium growth doctrine; the disequilibrium growth doctrine of Hirschman (1958); the big push theory of Rosenstein-Rodan (1943), etc. However, the influence of these theories on policy decisions has varied considerably over time.

Due to the small populations of Pacific Island countries, economies of scale are not possible and industrialization is limited. High transportation and raw material costs make entrepreneurship difficult to sustain, and islanders rely on family, clan, and community relationships as a social safety net (Juswanto & Ali, 2016).

In line with Goal 9 of the 2030 Agenda for Sustainable Development (build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation), the government has been working tirelessly to ensure that the country achieves and sustains industrialization to drive economic growth. As a result, there was a need to determine whether industrialization in Tonga is having an impact on economic growth based on current policies. This is due to conflicting findings on the nature of the relationship that exists between economic growth and industrialization. Some studies have found that industrialization has a positive impact on economic growth (Yangailo & Cham-bani, 2023; Lugina et al., 2022; Bokosi, 2022; Ibitoye et al., 2022; Wang & Su, 2019; Su & Yao, 2017), while others have not (Iheoma & Jelilov, 2017; Ibibh & Gaiya, 2013; Jelilov et al., 2016). This study was the first to be conducted in the Tongan context.

2 Literature review

The theoretical underpinning of this research study was the endogenous growth model, which is an aggregate production function developed by Jones and Manuelli (1990). This model, which avoids diminishing returns to capital, is presented as follows:

\[ Y = f(k,l) \]

- \( Y \) = per capital output;
- \( I \) = labour industrial output ratio and;
- \( k \) = capital industrial output ratio.

In a broader sense, industrialization is defined as an increase in the value added to GDP by non-services and non-agricultural industries. It is an increase in the value added of the secondary sector and is more commonly associated with the industrial sector. Although the Tongan economy is based
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on agriculture, the manufacturing sector remains essential to the country’s development, growth and industrialization strategy.

Clunies-Ross et al. (2010) define economic growth as an increase in per capita income over time. O’Sullivan and Sheffrin (2003), on the other hand, define industrialization as a process of economic and social development that typically transforms a human being from an agrarian to an industrial one. According to O’Sullivan and Sheffrin (2003), industry affects economic growth in three ways: large-scale energy development, modernization, and metallurgical production. They also claim that industrialization is usually associated with a process of social rationalization.

Empirical Review

There have been mixed results on the nature of the relationship between economic growth and industrialization.

Yangailo and Chambani (2023) examined the impact of industrialization on economic growth in Zambia. The study found that Zambia’s industrialization has an impact on the country's economic growth.

Lugina et al. (2022) investigated the impact of industrialization on Tanzania’s economic growth by focusing on the drivers of structural change in Tanzania’s manufacturing sector between 1970 and 2017 using a vector error correction model based on a parsimonious model. The study found a significant and positive relationship between industrialization and economic growth.

Bokosi (2022) conducted a study on the impact of industrialization on economic growth, using balanced panel data from six Southern African countries over the period 1978-2019. The empirical results show that an increase in industrialization is positively associated with economic growth in both the short and long run.

Ibitoye et al. (2022) used Johansen cointegration and Granger causality tests to examine the impact of industrialization on economic growth in Nigeria. The results showed a positive and statistically significant relationship between industrialization and economic growth.

Wang and Su (2019) conducted a study in China to examine the impact of industrialization on the decoupling of economic growth from China's carbon emissions from 1990 to 2015. The study used Johansen cointegration and Granger causality techniques. The results showed a (very strong) decoupling between carbon (CO₂) emissions and economic growth, implying that industrialization has a stronger impact on economic growth.

Su and Yao (2017) investigated the role of the manufacturing sector in the middle-income development stage. The study included large datasets from different industries. The results showed that during the middle-income stage, the manufacturing sector dragged all other sectors with it. A decline in the growth of the manufacturing sector, on the other hand, has a negative impact on the growth of all sectors, both in the long run and in the short run. In summary, the study shows that the industrial sector is the main driver of growth in middle-income economies.

Iheoma and Jelilov (2017) conducted a study to examine the impact of industrialization on the economic growth of 10 members of the Economic Community of West African States (ECOWAS). Nigeria, Ghana, Benin, Cape
Verde, Gambia, Senegal, Ivory Coast, Guinea-Bissau, Niger, and Mali were among the countries included in the study. The study analyzed secondary data from the Central Bank of Nigeria and the National Bureau of Statistics using ordinary least squares (OLS) and F-test. The results showed that industrialization has a long-term negative impact on economic growth.

A study conducted by Ibbih and Gaiya (2013) on a cross-sectional analysis of fifty-four African countries on the relationship between industrialization and economic growth, revealed a weak relationship. The least squares regression method was used in the research.

3 Method and Data

This study used data from the World Bank Statistical data (refer to the appendices). The model was tested using regression analysis. Only statistics on GDP, manufacturing output, interest rate, and exchange rate were needed to approximate the parameters of the model.

\[ GDP = F(X_1, X_2, X_3\ldots X_n) + U_t \]

In this case:

- GDP (Y) is gross domestic product; X1 is industrial production (MO); X2 is foreign exchange rate (FER); X3 is bank interest rate (BIR); X4 is inflation (IR); while Ut is error.

Regression model was used for data analysis for this study using Jamovi software. This software has been widely used by different researchers in different studies (see Yangailo & Mkandawire, 2023; Tryson, 2022; Hassen & Ramakrishna, 2020; Yangailo, 2022; Abbasnasab Sardareh et al., 2021; Kaunda & Yangailo, 2023; Şahin & Aybek, 2019; Yangailo, 2023; Yangailo et al, 2023; Ahmed & Muhammad, 2021). This and other related models have been used in some previous studies analyzing data in similar settings (see Ibbih & Gaiya, 2013; Iheoma & Jelilov, 2017; Su & Yao, 2017).

Research Hypotheses

Based on the previous studies, this study developed the following hypotheses:

According to Yangailo and Chambani (2023), Lugina et al. (2022), Bokosi (2022), Ibitoye et al. (2022), Wang and Su (2019) and Su and Yao (2017), industrialization has a positive and significant impact on economic growth. Therefore, we propose the following:

\[ H1: \text{Industrialization has a positive and significant impact on economic growth.} \]
According to Tarawalie (2010), Aman et al. (2017) and Obansa et al. (2013), exchange rate has a positive and significant impact on economic growth, thus, we propose that:

\[ H2: \text{Exchange rate has a positive and significant effect on economic growth.} \]

According to Mohsen et al. (2022), Lilley and Rogoff (2019) and Rogoff (2017), interest rate has a significant impact on economic growth, therefore, we propose that:

\[ H3: \text{Interest rate has a significant effect on economic growth.} \]

According to Mallik and Chowdhury (2001), inflation rate has a positive and significant impact on economic growth, therefore, we propose that:

\[ H4: \text{Inflation rate has a positive and significant effect on economic growth.} \]

### 4 Data Analysis and Interpretation

The results of the regression analysis are shown in the Table 1 and Table 2. The results show that an increase in industrial output increases GDP by 20.04 magnitudes, an increase in the exchange rate increases GDP by 77.08 magnitudes, an increase in interest rates increases GDP by 3.90 magnitudes, and an increase in inflation decreases GDP by -1.33 magnitudes.

#### Table 1: Model fit measures

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R²</th>
<th>( \text{Adjusted R}^2 )</th>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.981</td>
<td>0.963</td>
<td>0.954</td>
<td>111</td>
<td>4</td>
<td>17</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

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Table 2: Model Coefficients - Gross Domestic (Million USD$)

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Estimate</th>
<th>SE</th>
<th>t</th>
<th>p</th>
<th>Stand. Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-261.15</td>
<td>82.49</td>
<td>-3.166</td>
<td>0.006</td>
<td></td>
</tr>
<tr>
<td>Industrial Output</td>
<td>20.04</td>
<td>2.59</td>
<td>7.752</td>
<td>&lt;.001</td>
<td>0.8052</td>
</tr>
<tr>
<td>Exchange rate</td>
<td>77.08</td>
<td>27.93</td>
<td>2.760</td>
<td>0.013</td>
<td>0.1299</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>3.90</td>
<td>2.45</td>
<td>1.591</td>
<td>0.130</td>
<td>0.1485</td>
</tr>
<tr>
<td>Inflation Rate</td>
<td>-1.33</td>
<td>1.93</td>
<td>-0.689</td>
<td>0.500</td>
<td>-0.0456</td>
</tr>
</tbody>
</table>

The data in Table 1 also show that $R^2$ is 0.963. This suggests that the four independent (predictor) factors together explain 96.3% of the variation in GDP growth. The industrial output coefficient is positive and significant at 5%, indicating that growth in manufacturing output has a positive and significant impact on economic growth in Tonga. The exchange rate coefficient is positive and significant at 5%, indicating that the exchange rate has a positive impact on economic growth in Tonga.

Table 3: Summary of hypotheses

<table>
<thead>
<tr>
<th>#</th>
<th>Hypothesis</th>
<th>β</th>
<th>p</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Industrialization has a positive and significant impact on economic growth</td>
<td>0.8052</td>
<td>&lt;.001</td>
<td>Supported</td>
</tr>
<tr>
<td>2</td>
<td>Exchange rate has a positive and significant impact on economic growth</td>
<td>0.1299</td>
<td>0.013</td>
<td>Supported</td>
</tr>
<tr>
<td>3</td>
<td>Interest rate has a significant impact on economic growth</td>
<td>0.1485</td>
<td>0.130</td>
<td>Not Supported</td>
</tr>
<tr>
<td>4</td>
<td>Inflation rate has a positive and significant impact on economic growth</td>
<td>-0.0456</td>
<td>0.500</td>
<td>Not Supported</td>
</tr>
</tbody>
</table>

5 Discussion

The coefficient of determination ($R^2$) indicates that the model was significant ($R^2=96.3\%$), which means that 96.3% of the variation in GDP, the dependent variable, was explained by all four different independent (predictor) variables, while 3.7% was not well explained due to extraneous factors not captured in the above model. The model found a statistically significant relationship between GDP and industrial production at the 0.05 level of significance.

The main objective of the study was to examine the impact of industrialization on economic growth in Tonga. The results showed that of all the independent variables used in this study (interest rate, industrial (manufacturing) output, inflation, and exchange rate), industrial output ($p<0.001; \gamma = 20.04$) and exchange rate ($p<0.05; \gamma = 77.08$) were statistically significant, thus...
Hypothesis 1 and Hypothesis 2 are supported. This means that industrial output and exchange rate have a strong and significant impact on Tonga's economic growth. This study supports the findings of Lugina et al. (2022), who found that industrialization helps European and East Asian economies grow. The findings of this study are also consistent with previous studies that show that industrialization has a positive and significant relationship with economic growth (see Ibitoye et al., 2022; Yangailo & Chambani, 2023; Lugina et al., 2022; Bokosi, 2022; Wang & Su, 2019; Su & Yao, 2017). This finding contradicts previous research studies that found a negative relationship between industrialization and economic growth (Iheoma & Jelilov, 2017; Ibbih & Gaiya, 2013).

On the other hand, the study shows that the exchange rate has a positive and significant impact on the country's economic growth. This is consistent with previous studies that found similar results (see Khan, 2021; Pramanik, 2021; Kogid et al., 2012), but contradicts Karahan (2020) who found a negative causal relationship between the exchange rate and economic growth.

Based on the results of this study, we can safely conclude that under existing policies, industrialization has a significant impact on economic growth in Tonga.

6 Conclusion

This study examines the impact of industrialization on economic growth in Tonga for the period 2000 to 2021. The following macroeconomic indicators were used in the study: GDP as dependent variable and manufacturing (industrial) output, inflation, interest rate and exchange rate as independent variables. According to the findings of the study, industrialization and exchange rate both have a positive and significant impact on Tonga's economic growth. This implies that the existing industrialization policy should be maintained and implemented accordingly. The government of Tonga should continue to provide a good and attractive environment for industrial growth in the country.

The study was conducted in Tonga, which limits the generalizability of the findings to other countries. Replication of this study in other countries is strongly recommended. Future studies are also recommended to consider the inclusion of other macroeconomic indicators such as FDI and others as variables.

7 References


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Lilley, A., & Rogoff, K. (2019). The case for implementing effective negative interest rate policy. *Available at SSRN 3427388*.


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8 Appendices

8.1 Data

Table 4: Data

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross Domestic: GDP (Million USD$)</th>
<th>Industrial Output (Million USD$)</th>
<th>Exchange rate</th>
<th>Interest rate</th>
<th>Inflation rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>204.85</td>
<td>18.17</td>
<td>1.76</td>
<td>-</td>
<td>6.33</td>
</tr>
<tr>
<td>2001</td>
<td>181.12</td>
<td>15.17</td>
<td>2.12</td>
<td>-</td>
<td>8.29</td>
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<tr>
<td>2002</td>
<td>182.76</td>
<td>14.39</td>
<td>2.20</td>
<td>-</td>
<td>10.36</td>
</tr>
<tr>
<td>2003</td>
<td>202.25</td>
<td>15.93</td>
<td>2.15</td>
<td>-</td>
<td>11.64</td>
</tr>
<tr>
<td>2004</td>
<td>230.66</td>
<td>17.69</td>
<td>1.97</td>
<td>-</td>
<td>10.97</td>
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<tr>
<td>2005</td>
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<td>19.19</td>
<td>1.94</td>
<td>-</td>
<td>8.67</td>
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<tr>
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<td>2.03</td>
<td>-</td>
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<tr>
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<td>21.07</td>
<td>1.97</td>
<td>-</td>
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<tr>
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<td>-</td>
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<tr>
<td>2010</td>
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<td>1.91</td>
<td>-</td>
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<tr>
<td>2011</td>
<td>414.53</td>
<td>24.17</td>
<td>1.73</td>
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<td>6.27</td>
</tr>
<tr>
<td>2012</td>
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<td>27.55</td>
<td>1.72</td>
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<td>2013</td>
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<td>8.24</td>
<td>2.51</td>
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<tr>
<td>2015</td>
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<td>26.34</td>
<td>2.11</td>
<td>7.93</td>
<td>-1.05</td>
</tr>
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<td>2016</td>
<td>420.55</td>
<td>25.39</td>
<td>2.22</td>
<td>7.87</td>
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<td>2017</td>
<td>460.37</td>
<td>27.43</td>
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<td>7.52</td>
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<tr>
<td>2018</td>
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<td>28.35</td>
<td>2.24</td>
<td>8.07</td>
<td>5.03</td>
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<tr>
<td>2019</td>
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<td>2020</td>
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<td>27.18</td>
<td>2.30</td>
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<tr>
<td>2021</td>
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<td>24.35</td>
<td>2.26</td>
<td>7.86</td>
<td>5.64</td>
</tr>
</tbody>
</table>

Source: World Bank

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8.2 Q-Q Plot

Figure 1: Q-Q plot

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