The Impact of Industrialization on Economic Growth in Tonga

Tryson Yangailo
ytryson@yahoo.com
University of Zambia, Lusaka, Zambia

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.

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

(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 (Leibensein, 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 & Chambani, 2023; Lugina et al.,2022; Bokosi, 2022; Ibitoye et al.,2022; Wang & Su, 2019; Su & Yao,2017), while others have not (Iheoma & Jelilov, 2017; Ibbih & 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;
- l = 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

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 (CO_2) 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.

$$GDP = F(X1, X2, X3…Xn)+Ut$$

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: 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: 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: 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: 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

Model	R	R^2	Adjusted R^2	Overall Model Test			
				F	df1	df2	p
1	0.981	0.963	0.954	111	4	17	< .001

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

Predictor	Estimate	SE	t	p	Stand. Estimate
Intercept	-261.15	82.49	-3.166	0.006	
Industrial Output	20.04	2.59	7.752	< .001	0.8052
Exchange rate	77.08	27.93	2.760	0.013	0.1299
Interest Rate	3.90	2.45	1.591	0.130	0.1485
Inflation Rate	-1.33	1.93	-0.689	0.500	-0.0456

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

#	Hypothesis	β	p	Results
1	Industrialization has a positive and significant impact on economic growth	0.8052	< .001	Supported
2	Exchange rate has a positive and significant impact on economic growth	0.1299	0.013	Supported
3	Interest rate has a significant impact on economic growth	0.1485	0.130	Not Supported
4	Inflation rate has a positive and significant impact on economic growth	-0.0456	0.500	Not Supported

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; γ = 20.04) and exchange rate (p<0.05; γ = 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

Abbasnasab Sardareh, S., Brown, G. T., & Denny, P. (2021). Comparing four contemporary statistical software tools for introductory data science and statistics in the social sciences. *Teaching Statistics, 43*, S157-S172. https://doi.org/10.1111/test.12274

Ahmed, A. A., & Muhammad, R. A.(2021). A Beginners Review of Jamovi

Statistical Software for Economic Research. *Dutse International Journal of Social and Economic Research,6*(1),109-118.

Aman, Q., Ullah, I., Khan, M. I., & Khan, S. U. D. (2017). Linkages between exchange rate and economic growth in Pakistan (an econometric approach). *European Journal of Law and Economics*, *44*, 157-164.

Bokosi, F. K. (2022). The Effects of Industrialisation on Economic Growth: Panel data evidence for SADC countries. *African Journal of Economic Review*, *10*(3), 89-109.

Clunies-Ross, A., Foresyth, O., & Huq, M. (2010). *Development Economics.* London: McGraw Hill.

Fairbairn, T. I. (2019). *The Tongan economy: recent performance and future challenges.* Crawford School of Public Policy, The Australian National University. Asia Pacific Press.

Fa'otusia, P., 2019. *Statement by the Hon. Pilimilose Balwyn Fa'otusia, Governor for Tonga at the 2019 Annual Meetings : Governor's Statement No. 18*, World Bank Group. United States of America. Retrieved from https://policycommons.net/artifacts/1287662/statement-by-the-hon-pilimilose-balwyn-faotusia-governor-for-tonga-at-the-2019-annual-meetings/1887166/ on 07 Sep 2023. CID: 20.500.12592/tbhb6g.

Han, Y. (2020). The Impact of Exchange Rate Fluctuation on Economic Growth–Empirical Studies Based on Different Countries. In *4th International Symposium on Business Corporation and Development in South-East and South Asia under B&R Initiative (ISBCD 2019)* (pp. 29-33). Atlantis Press.

Hassen, A., & Ramakrishna, G. (2020). International Financial Reporting Standards adoption in Ethiopia: testing a mediation model. *African Journal of Accounting, Auditing and Finance*, *7*(2), 172-186.

Hirschman, A. (1958). *Strategy of Economic Development.* New Haven, Conn.: Yale University.

Ibbih, J. M., & Gaiya, B. A. (2013). A cross-sectional analysis of industrialisation and growth in Africa. *International Research Journal of Arts and Social Sciences*, *2*(6), 150-167.

Ibitoye, O. J., Ogunoye, A. A., & Kleynhans, E. P. (2022). Impact of

industrialisation on economic growth in Nigeria. *Journal of Economic and Financial Sciences*, *15*(1), 796.

Iheoma, E. H., & Jelilov, G. (2017). Is Industrialisation Has Impact the on Economic—Growth, ECOWAS Members' States Experience. *The Journal of Middle East and North Africa Sciences*, *3*, 8-19.

Jelilov, G., Enwerem, H. I., & Isik, A. (2016). The impact of industrialization on economic growth: the Nigeria experience (2000-2013). *British Journal of Advance Academic Research*, *5*(1), 11-20.

Jones, L.E., & Manuelli, R. (1990). A convex model of equilibrium growth: Theory and policy implications. *Journal of Political Economy*, *98*(5, Part 1), 1008-1038.

Juswanto, W.,& Ali, Z. (2016). *Economic growth and sustainable development in the Pacific Island countries.* ADB institute.

Karahan, Ö. (2020). Influence of exchange rate on the economic growth in the Turkish economy. *Financial Assets and Investing*, *11*(1), 21-34.

Kaunda, M., & Yangailo, T. (2023). Motivation on Employee Performance through Top Leadership Commitment. *International Journal of Management, Knowledge and Learning*, *12*,143-165. DOI: 10.53615/2232-5697.12.143-162

Khan, M. F. H. (2021). Impact of exchange rate on economic growth of Bangladesh. *European Journal of Business and Management Research*, *6*(3), 173-175.

Kogid, M., Asid, R., Lily, J., Mulok, D., & Loganathan, N. (2012). The Effect of Exchange Rates on Economic Growth: Empirical Testing on Nominal Versus Real. *IUP Journal of Financial Economics*, *10*(1).

Leibensein, H. (1957). *Economic Backwardness and Economic Growth.* New York: Wiley.

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

Lugina, E. J., Mwakalobo, A. B. S., & Lwesya, F. (2022). Effects of industrialisation on Tanzania's economic growth: a case of manufacturing sector. *Future Business Journal*, *8*(1), 1-11.

Mallik, G., & Chowdhury, A. (2001). Inflation and economic growth: evidence

from four south Asian countries. *Asia-Pacific development journal*, *8*(1), 123-135.

Mohsen, A. S. ., Hoang, F. A. ., & Tariq, A. F. . (2022). Effect of Interest Rates on Economic Growth in Bangladesh. *Journal of Economics*, *6*(1), 36–44. https://doi.org/10.53819/81018102t5086

Obansa, S. A. J., Okoroafor, O. K. D., Aluko, O. O., & Eze, M. (2013). Perceived relationship between exchange rate, interest rate and economic growth in Nigeria: 1970-2010. *American journal of humanities and social sciences*, *1*(3), 116-124.

O'Sullivan, A., & Sheffrin, S. (2003). *Economics: Principles in Action.* New Jersey : Prentice Hall.

Pramanik, S. (2021). *Exchange rate and Economic Growth-a comparative analysis of the possible relationship between them*. Indian Institute of Science Education and Research, Bhopal. Munich Personal RePEc Archive

Rogoff, K. (2017). Dealing with monetary paralysis at the zero bound. *Journal of Economic Perspectives*, *31*(3), 47-66.

Rosenstein–Rodan, P. (1943). Problems of Industrialisation in Eastern and Southern Term Europe. *Economic Journal*, *53*(210/211), 202-211.

Şahin, M. D., & Aybek, E. C. (2019). Jamovi: an easy to use statistical software for the social scientists. *International Journal of Assessment Tools in Education*, *6*(4), 670-692.

Su, D., & Yao, Y. (2017). Manufacturing as the key engine of economic growth for middle-income economies. *Journal of the Asia Pacific Economy*, *22*(1), 47-70.

Tarawalie, A. B. (2010). Real exchange rate behaviour and economic growth: evidence from Sierra Leone: economics. *South African Journal of Economic and Management Sciences*, *13*(1), 8-25.

The World Bank. (2023). *World Bank Open Data*. The World Bank. https://data.worldbank.org/country/

Tryson, Y. (2022). The Mediating Effect of Customer Focus on the Relationship Between Strategic Planning and Competitive Advantage in Railway Sector. *Journal of Operations and Strategic Planning*, *5*(1), 59-81.

Wang, Q., & Su, M. (2019). The effects of urbanization and industrialisation on decoupling economic growth from carbon emission–a case study of China. *Sustainable Cities and Society*, *51*, 101758. https://doi.org/10.1016/j.scs.2019.101758

Yangailo, T. (2022). Globalization on The Railway Transport Sector. *International Research Journal of Business Studies*, *15*(3).

Yangailo, T. (2023). The mediating effect of TQM practices on the relationship between strategic planning and productivity. *Management Science Letters*, *13*(2), 136-149.

Yangailo, T., & Chambani, T. (2023). The Impact of Industrialisation on Zambia's Economic Growth. *Journal of Developing Economies (JDE)*, *8*(1).

Yangailo, T., & Mkandawire, R. (2023). Assessing the influence of education and training on important innovations through quality results: the case of railway sector. *International Journal of Knowledge Management in Tourism and Hospitality*, *3*(1), 31-49.

Yangailo, T., Kabela, J., & Turyatunga, H. (2023). The Impact of Total Quality Management Practices on Productivity in the Railway Sector in African Context. *Proceedings on Engineering*, *5*(1), 177-188.

8   Appendices

8.1   Data

Table 4: Data

Year	Gross Domestic: GDP (Million USD$)	Industrial Output (Million USD$)	Exchange rate	Interest rate	Inflation rate
2000	204.85	18.17	1.76	-	6.33
2001	181.12	15.17	2.12	-	8.29
2002	182.76	14.39	2.20	-	10.36
2003	202.25	15.93	2.15	-	11.64
2004	230.66	17.69	1.97	-	10.97
2005	261.80	19.19	1.94	-	8.67
2006	292.23	20.33	2.03	-	6.15
2007	298.52	21.07	1.97	-	5.84
2008	344.44	23.09	1.94	-	10.45
2009	312.38	20.42	2.03	-	1.43
2010	366.83	22.04	1.91	-	3.53
2011	414.53	24.17	1.73	9.93	6.27
2012	470.71	27.55	1.72	9.35	1.15
2013	450.65	27.86	1.77	8.64	0.78
2014	439.88	27.43	1.85	8.24	2.51
2015	437.00	26.34	2.11	7.93	-1.05
2016	420.55	25.39	2.22	7.87	2.58
2017	460.37	27.43	2.21	8.04	7.52
2018	488.91	28.35	2.24	8.07	5.03
2019	512.05	26.46	2.29	7.83	1.18
2020	484.80	27.18	2.30	7.76	-0.35
2021	469.23	24.35	2.26	7.86	5.64

Source: World Bank

8.2   Q-Q Plot

Figure 1: Q-Q plot