

1 AGRICULTURE AND MANUFACTURING SECTOR GROWTH IN NAMIBIA 2 DURING THE PERIOD 1981 to 2012: A Granger Causality test

6 Abstract

8 Namibia became independent in 1990. Since then, the democratic government has pursued
9 various development policy tools to empower Namibians economically. The 4th National
10 Development Plan identified four strategic economic growth enhancing activities, namely
11 agriculture, manufacturing, logistics and tourism. Agriculture remains the largest employer while
12 manufacturing is growing, but slowly. Logistics is increasingly becoming central to the supply
13 chain and to the transport related activities while tourism is growing fast. This paper is premised
14 on investigating whether or not there is a causal and long term relationship between agriculture
15 and manufacturing sector growth over the period 1981-2012. Ascertaining the direction of the
16 relationship is part of the objectives. Analytical methods that were used include unit root and
17 cointegration tests, and a Granger Causality model. With the use of time series data, the results
18 confirmed stationarity and cointegration. With 31 observations, no causal relationships were
19 established between agriculture and manufacturing in Namibia. When the time series data was
20 reduced to 21 observations (1991 – 2012), causal long-run relationships which are bi-directional
21 were confirmed between agriculture and manufacturing variables. Appropriate policy
22 interventions are required to influence how the two sectors should benefit from each other. Such
23 holds potential for both sustained employment creation opportunities and economic growth in
24 Namibia.

26 Keywords: *Stationarity, causality, and cointegration*

29 INTRODUCTION

30 Namibia is an uppermiddle income country. The main quest for Namibia is to reduce poverty by
31 means of creating employment opportunities for its citizens. For historical reasons, Namibia
32 became independent in March 1990, making it one among the latest countries to
33 achieve independence in Africa. The country is sparsely populated and it has a human population
34 size of 2.1 million. The economy is modestly growing but it has not created many jobs over the
35 years. The slow worker absorption by the economy has led to a high unemployment rate which
36 currently stands at 27 percent.

38 Over the years, Namibia's primary sectors have largely exported commodities in raw form.
39 Value-addition is only being emphasized in recent times. Thus the economy is heavily dependent
40 on exports from mining, fisheries and agriculture. This dependency holds very little prospects in
41 a long run which suggests the need to diversify the economy from being mainly an exporter of
42 primary products to one that produces finished goods. The biggest employer among the primary
43 sectors is agriculture while other sectors trail behind it. Mining is the biggest foreign currency
44 earner while tourism is the fastest growing sector. All the sectors are interrelated by the network
45 of logistics. As outlined in the 4th National Development Plan, logistics is one of the crucial
46 sectors that need special attention [1].

It is common knowledge to think that sectors of the economy work together. This means that there should be some interrelationships across various economic sectors. Since agriculture provides raw material to manufacturing, intuition suggests that testing for an existence of a relationship between the two sectors may shed more light on policy interventions needed in the medium and long term.

The objectives for this paper are: to study whether or not there is a causal relationship between growth of agriculture and of manufacturing, and also to determine the direction of the relationship if it exists. The hypothesis that was to be tested is that ‘there is no relationship between agriculture and manufacturing’.

LITERATURE REVIEW

There are various studies that have tested the relationships between economic variables. Some of the studies applied the methodological approaches that come closer to what was used for this paper. In a study by [2] about financial intermediation and economic growth in Sudan, unit root and cointegration tests were applied. Although his paper did not focus on agriculture and manufacturing, the manner in which the two tests that were mentioned earlier were applied provided some insight for the current paper.

While studying how the agricultural sector is linked to other sectors in Romania, [3] found that industrial growth had a harmful effect on the future course of agriculture, while the service sector stimulated the development of agriculture.

In attempting to establish the causal relationship between tourism and economic growth in Sri Lanka, [4] ran a unit root test and applied Johansen Cointegration test. The two tests were helpful in establishing stationarity and cointegration. A decomposition test was conducted. The findings are that general economic growth is caused by its own and by tourism, while tourism is only caused by economic growth at home and abroad.

In another study of the relationship between total exports, manufacturing and agricultural output in which the Granger causality model was applied, [5] found that industrial growth caused both growths of exports and of agriculture. Further, growth of agricultural output did not lead to higher growth rates of exports or industry.

When studying to establish the causal relationship between GDP, agriculture, industrial and services sectors, [6] revealed that equilibrium relationships existed between the sectors. It was found that growth of GDP granger-caused growth of agriculture and vice versa. Industrial sector growth granger-caused GDP growth and vice versa. The same was observed for industrial and services sectors. An unidirectional Granger causality was found to occur from industrial sector to agriculture and also from GDP to the service sector.

Closely similar to [6], [7] studied the causal relationship between GDP, agriculture, industrial and service sector growth in North Cyprus and achieved interesting results that point to the fact that

agriculture is a back bone of that economy. It is agriculture that feeds the industrial sector with raw materials. However, agriculture in that economy does not stimulate growth of GDP.

Agriculture was found to be an engine for economic growth in various studies in certain countries and those includes studies done by, among others,[7] and [8]. In developing countries, agriculture was found to be declining in terms of its contribution to economic growth. A more robust role for agriculture in terms of economic growth was observed across Asian states. The conclusion is that by increasing value addition in the agricultural sector, general economic growth may benefit [8].

A study by [9] to determine whether or not there was a long-run relationship between agriculture and economic growth in Thailand used among others, a Granger Causality model. The findings are that economic development stimulated agriculture. It also enlightens that long-term stable agricultural growth is necessary to allow economic development to occur.

In India, it was found that agricultural output growth causes imports and exports to grow, while import growth also caused agricultural output to rise. With regards to manufacturing, it came out that growth of manufacturing output and of imports jointly caused exports to increase. Exports and imports jointly caused manufacturing output to rise [10]. This study, however, did not check the relationship between agriculture and manufacturing directly but only via their relations to imports and exports.

An interrogation of Mellor's Law comes to mind here. Mellor's Law provides that as the agricultural sector grows faster, its relative size declines. This notion comes about due to the fact that technological know-how is seen as being more imperative to addressing the challenges of a growing population [11]. It is a contestable argument to have to believe that agriculture will decline after it has grown faster. While this Law is useful, its applicability will vary depending on the country's strategic sector growth priorities.

The literature presented ushers in a schematic view of the various economic components that links well with agriculture and manufacturing in the Namibian economy. Focus is not on all of the arrows but the following: 1, 3, and 5 while other arrows 4, 6 – 12 only show a wide relationship in the mainstream economy.

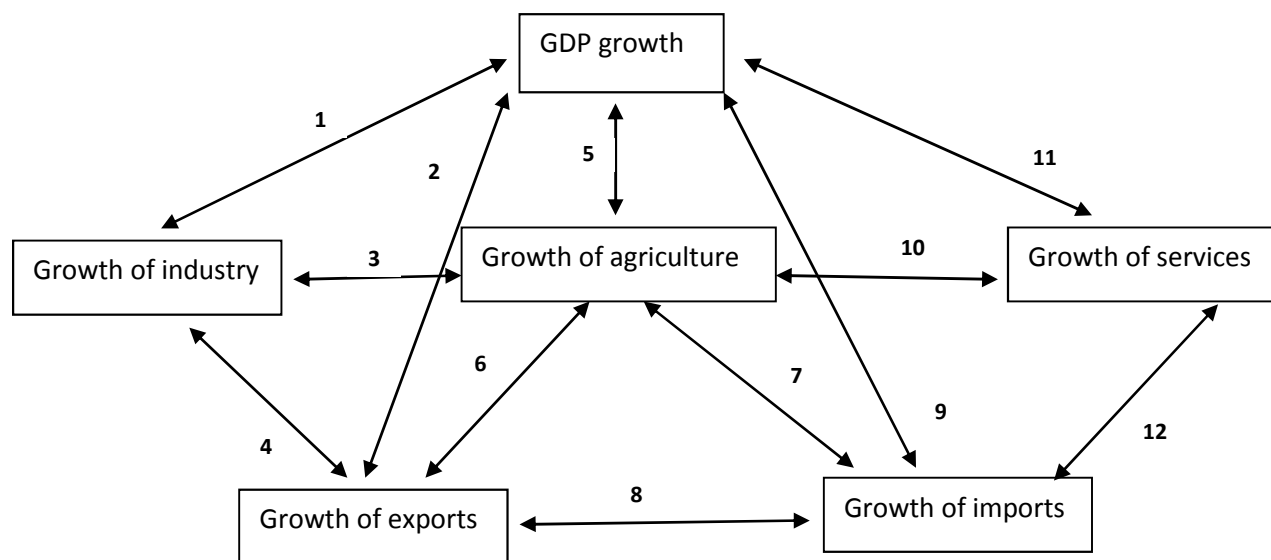


Figure 1: An overview on the possible causal relations between GDP and its sectors

MATERIALS AND METHODS

Data and analytical procedures

The study used annual GDP time series data for the period 1981 to 2012 at 2004 constant prices for both agriculture and manufacturing. The data was obtained from Namibia Statistics Agency. In order to determine whether or not the data is stationary, unit root test was undertaken by means of applying the Augmented Dickey-Fuller (ADF) test. (The ADF test was founded by Dickey and Fuller in 1979). After stationarity was confirmed the next step included testing for cointegration. The approach used in this case is to apply the Johansen cointegration test to check for the long-run relationship between variables. As it is the case in this study, cointegration was confirmed.

Model

Due to lack of empirical evidence which could conclusively indicate sequencing from either direction between agriculture and manufacturing output growth rates the Granger causality test on the Namibian data was performed. The following equations were constructed to establish the growth linkages between the agricultural and manufacturing variables:

$$AgGR_t = \alpha + \sum_{i=1}^n b_i AgGR_{t-i} + \sum_{i=1}^n y_i ManGR_{t-i} + e_t$$

$$ManGR_t = \alpha + \sum_{i=1}^n b_i ManGR_{t-i} + \sum_{i=1}^n y_i AgGR_{t-i} + e_t$$

Where: $AgGR$ is agriculture's growth rate variable,
 $ManGR$ represents manufacturing sector's growth rate variable, and
 ε_t is the error term.

RESULTS AND DISCUSSION

Using the correlation test (Table 1) to show the association of GDP growth in the agriculture and manufacturing sectors, the results reveal a positive correlation between the two sector GDP growth rates with $\text{anr} = 0.7921$.

Table 1: Correlation matrix table

	<i>AgGR</i>	<i>ManGR</i>
<i>AgGR</i>	1	0.7921
<i>ManGR</i>	0.7921	1

Unit root test

The Augmented Dickey-Fuller (ADF) test was applied to test for stationarity, but it should be noted that this test provides a test of the null hypothesis of non-stationarity. Table 2 below shows the ADF test results for both Agriculture and Manufacturing output growth rates series. The ADF test results show that the test statistics are smaller (in absolute value) than the 5% critical value. In this case the null hypothesis is rejected with an understanding that the variables are stationary. This implies that both variables Agriculture and Manufacturing output growth rates are stationary in their levels as well as in their first and second difference. This carries that the data is integrated in order.

Table 2: The Augmented Dickey-Fuller test results

Variable	Augmented Dickey-Fuller (ADF) Test Statistic		
		ADF(L)	CV
<i>AgGR</i>	Level	-5.354670 (0)	-2.960411
	First Difference	-6.704914 (1)	-2.967767
	Second Difference	-5.693543 (4)	-2.986225
<i>ManGR</i>	Level	-5.928171 (0)	-2.960411
	First Difference	-6.491467 (0)	-2.967767
	Second Difference	-5.489849 (7)	-3.004861

Note: L denotes the lag length selected using SIC, and CV denotes critical values at 5% significance level.

Co-integration test

Johansen Co-Integration test (Table 3) indicates that the null hypothesis that there is no cointegration is rejected for all the rank at 5% level of significance. This means that a long-run relationship between the variables exists.

Table 3: Co-integration test results

Null Hypothesis	Max-Eigen statistic	0.05 Critical Value	Trace Statistic	0.05 Critical Value
None	21.52500	14.26460	35.08700	15.49471
At most 1	13.56200	3.841466	13.56200	3.841466

Ho: has no co-integration; H₁: has co-integration

Granger Causality test

Table 4: Granger causality results of data for 1980-2012

Null Hypothesis:	Lag	Obs.	F-Statistic	Prob.	Decision
MANUFACTURING does not Granger Cause AGRICULTURE	1	31	0.10133	0.7526	Accept
	2	30	0.09740	0.9075	Accept
	3	29	0.29970	0.8252	Accept
	4	28	0.39859	0.8072	Accept
AGRICULTURE does not Granger Cause MANUFACTURING	1	31	0.25854	0.6151	Accept
	2	30	0.14695	0.8641	Accept
	3	29	0.25381	0.8578	Accept
	4	28	0.16801	0.9520	Accept

Granger Causality test results (Table 4) for the data of 1981 to 2012 indicate that growth of manufacturing output does not Granger-cause agricultural output to grow at all. In the same way, growth of agriculture output does not Granger-cause manufacturing output to rise. That means there is no causal relationship between the two variables.

Table 5: Granger causality results of data for 1991-2012

Null Hypothesis:	Lag	Obs.	F-Statistic	Prob.	Decision
MANUFACTURING does not Granger Cause AGRICULTURE	1	21	0.36627	0.5526	Accept
	2	20	2.70681	0.0991	Reject
	3	19	1.68547	0.2228	Reject
	4	18	0.69002	0.6170	Reject
AGRICULTURE does not Granger Cause MANUFACTURING	1	21	0.15152	0.7017	Accept
	2	20	4.76586	0.0250	Reject
	3	19	4.54547	0.0238	Reject
	4	18	3.66367	0.0490	Reject

Considering that Namibia became independent in 1990, economic policies also changed to be aligned to the democratic dispensation. In line with this occurrence, a deliberate choice was made in Table 5 to test the time series data recorded for the 21 years of post-colonial era. That means time series data was reduced to the post 1990 period. The results give a different picture in relation to causation among these variables. It comes out that there is no causation between the growth rates of these two sectors at lag 1. However, causation exists as from lag 2 till 4 and both sectoral growth rates tend to granger-cause each other at the lag of 2 to 4.

Conclusion

Empirical analysis on the causation between the two variables, namely manufacturing growth and agricultural growth using the data from 1981 to 2012 did not reveal any causation. With a shorter time series of 20 years, a causal relationship between agricultural and manufacturing growth variables during the period of 1991 to 2012 was confirmed. The causation experienced during this period runs from agriculture to manufacturing and vice versa. Such causation occurs at the lags of 2 and above. However, there was no causation registered at lag 1 which means that the impact of the growth in one sector has an impact on the other sector only after a period of more than one year. It shows that post-independence time is characterized by alignment of sectoral policies to improve economic growth.

For policy purposes, Namibia has to work on ensuring that sectoral economic policies are coordinated in a manner that national economic growth is stimulated. The historically given relationship between agriculture and manufacturing should be transformed to enable stronger linkages between the two sectors to occur. Our literature review has shown that several countries have managed to create positive sectoral feedback loops, and that agriculture can be a dynamizing sector. As years pass by, the principles of Mellor's Law may apply but robust policy measures to strengthen the role which the agricultural sector may play in supporting manufacturing and vice versa will highly be needed. Manufacturing should also be supported with policies that draw more on the needed production resources from agriculture. Going it this way could offer better scope for proper economic planning and attainment of reasonable sector growth, holding all other things constant.

References

1. National Planning Commission. Namibia's Fourth National Development Plan: 2012/13 to 2016/17. Windhoek: National Planning Commission.
2. Ali, S.A.L. Financial intermediation and economic growth in Sudan: An empirical investigation, 1970-2011. *British Journal of Economics, Management and Trade*. 2013; 3(4):332-358.
3. Subramaniam, V. and Reed, M. Agricultural inter-sectoral linkages and its contribution to economic growth in the transition countries. Contributed Paper Prepared for presentation at the International Association of Agricultural Economists Conference in Beijing, China. 2009. Available at: <http://ageconsearch.umn.edu/bitstream/51586/2/438a.pdf>
4. Weckermasinghe, G.B and Ihalanayake, R. The causal relationship between tourism and economic growth in Sri-Lanka: Some empirical evidence. 2006. Available at www.docstoc.com.
5. Vaezi, L. and Moghaddasi, R. Relationships between total exports with agricultural and manufacturing GDP in Iran. A Paper prepared for the International Conference on Applied Economics. 2009.
6. Rahman, M.M., Rahman, M.S., and Hai-Bing, W. Time series analysis of causal relationship among GDP, Agriculture, Industrial and Service sector growth in Bangladesh. *China-USA Business Review*. 2011; 10(1):9-15.
7. Katircioglu, S. Cointegration and causality between GDP, agriculture, industrial and service sector growth in North Cyprus: Evidence from time series data, 1977-2002.

- 253 Review of Social, Economic and Business Studies. (undated); 5(6):173-187.
- 254 8. Awokuse, T.O. Does agriculture really matter for economic growth in Developing
- 255 Countries? A selected Paper for presentation at the American Agricultural Economics
- 256 Association Annual Meeting, Milwaukee, WI. 2009.
- 257 9. Jatuporn, C., Chien, L, Sukprasert, P. and Thaipakdee, S. Does a long-run relationship
- 258 exist between agriculture and economic growth in Thailand? International Journal of
- 259 Economics and Finance. 2011; 3(3):227-233.
- 260 10. Kónya, L and Singh, J.P. Causality between Indian exports, imports, and agricultural,
- 261 manufacturing GDP. Discussion Paper No. A07.02. 2007.
- 262 11. Olmstead, A.L. and Rhode, P.W. Conceptual issues for the comparative study of
- 263 agriculture development. In: Lains, P and Pinilla, V (eds.), Agriculture and economic
- 264 development in Europe since 1879, London: Routledge, pp. 27-49. 2009.
- 265