A MACROECONOMETRIC MODEL OF THE NAMIBIAN[1] ECONOMY

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Abstract

This paper presents a supply side macroeconometric model of the Namibian economy for the period 1971 to 2009. In this paper, the main characteristics of the Namibian economy are summarised. The model comprises of six behavioural equations (production, labour demand, investment, financial development, price level and wages) of the supply side of the economy. Identities and definitions are introduced in order to link endogenous variables. This ensures that there is a full dynamic system. The Engle-Granger two step econometric technique that take into account of time series properties of the data such as non-stationary are employed to construct a macroeconometric model for Namibia. The results indicate that labour demand, investment, wages, prices and financial development are determinants of economic growth in Namibia. Policies that enhance financial development, investment and labour demand should be implemented to accelerate economic growth. The estimated macroeconometric model can be used to for forecasting or policy simulation in the Namibian economy.

JEL Codes: C5; C51; C52

Keywords: macroeconometric; cointegration; unit roots; simulation; forecasting, growth, Namibia.

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1. INTRODUCTION

Namibia has achieved moderate growth rate of 4.9 percent during the period 1990 to 2009. It has also achieved macroeconomic stability during the same period. However, the average moderate growth rate of 4.9 percent is below the target of 7 percent which is required to alleviate poverty and ensure that the country achieve the standard living comparable to the developed countries by the year 2030. The moderate growth rate and macroeconomic stability were not sufficient to reduce unemployment and further accelerate poverty reduction. Unemployment has been on an increasing trend especially from the late 1990s to 2009. The real GDP declined in 2009 by 0.7 percent, while unemployment rate increased to 36 percent. The rise in unemployment is attributed to the fact that the growth rate is just moderate and not high enough to generate the much-needed job. The country has excess savings over investment. The excess savings has resulted in capital outflows mainly to South African financial markets. This situation is not typical of a developing country and indicates that Namibia has not been able to convert these excess savings into investment projects that can accelerate economic growth and provide employment to the increasing labour force. This raises an important question on what can be done to accelerate economic growth and reduce the high unemployment rate.

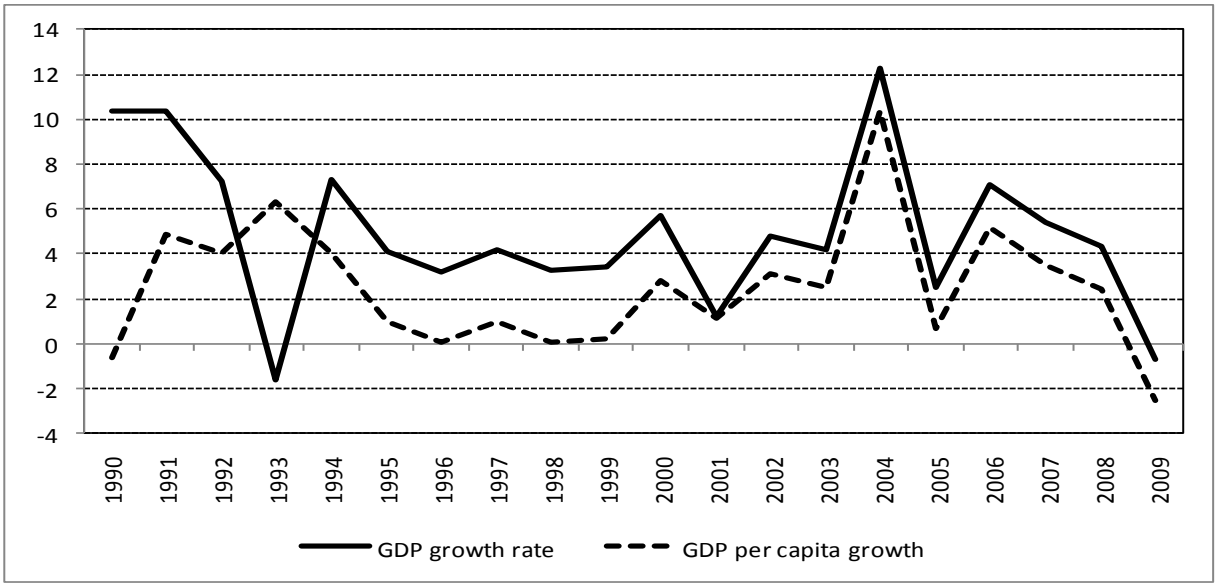
There is a need for an economic framework that captures the underlying characteristics of the Namibian economic environment. This will assist in analysing various policy interventions that will generate high economic growth and reduce unemployment. A macroeconometric model is a useful tool in analysing factors and policies that can generate high economic growth and reduce unemployment. In light of the above, the objective of this study is to develop and estimate a macroeconometric model for the Namibian economy. The model is on the supply side of the economy. This could assist in providing a long-term solution to accelerate economic growth and reduce the rising unemployment. The rest of the study is organised as follows. Section 2 provides brief overview of the Namibian economy. Section 3 discusses the theoretical framework (theoretical models to be estimated). Section 4 explains the empirical framework and outlines the econometric methodology as well as data to be used for estimation of the model. The empirical results are presented in Section 5, while Section 6 concludes.

2. BRIEF OVERVIEW OF THE NAMIBIAN ECONOMY

2.1 Growth Trends and GDP by Sector

Since Namibia gained independence in 1990, the government has placed great emphasis on boosting economic growth. The two most important parts of the government strategy to create employment opportunities and address the socio-economic imbalances inherited from the colonial times are diversification of the economy and development of the agricultural and manufacturing sectors. Real GDP growth for the period 1990 to 2009 is plotted in Figure 1, which shows that Namibia recorded moderate growth rates during the period 1990 to 2009. A negative real GDP growth rate of -0.7 was recorded in 2009 and this is attributed the global economic crisis of 2008-2009. The average real GDP growth rate for the period 1990 to 2009 was 4.9 percent. The real GDP per capita growth tracked that of real GDP during the same period. This average real GDP growth rate is below the 7 percent growth target under Vision 2030. According to the National Planning Commission (2004), Vision 2030 is a vision that will guide Namibia to make deliberate efforts to improve the quality of life of its people to the level of their counterparts in developed world by the year 2030. The 7 percent real GDP growth rate per year is required in order to achieve the target of Vision 2030.

Figure 1. Real GDP and Real GDP per capita growth rates



Source: Data from the Bank of Namibia

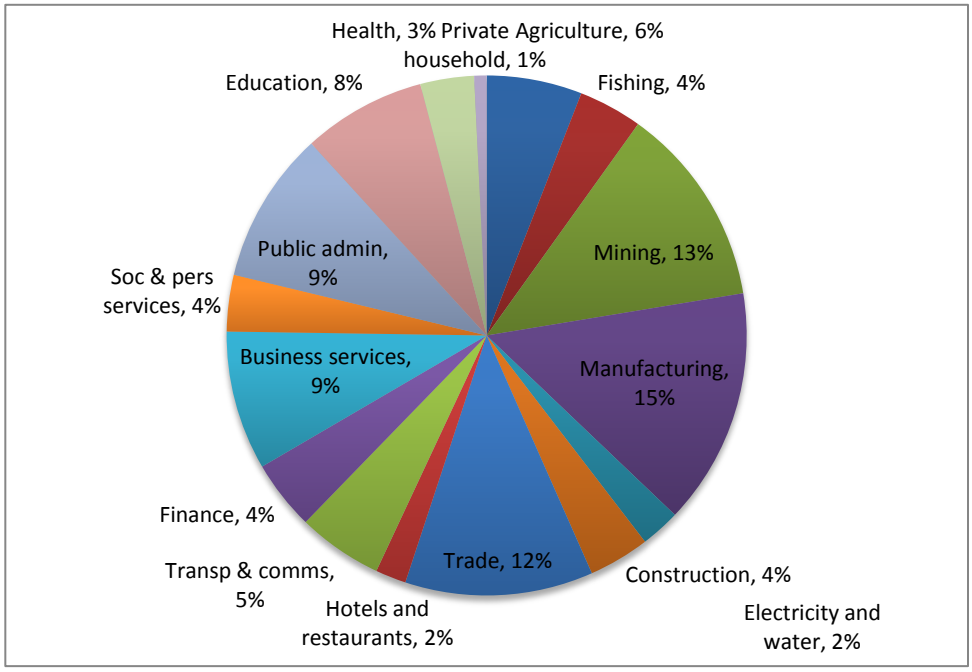
The composition of Namibia's GDP shows that the economy is dominated by tertiary industries (such as wholesale and retail trade, hotels and restaurants, transport and communications, financial and business services; education, health and government), which accounted for an average of 57 percent during 1990 to 2009. Trade, government and business services accounted for the largest shares of the tertiary (services) sector. The secondary sector comprises manufacturing, electricity & water and construction, and accounted for an average of 16 percent of the GDP during 1990 to 2009. Although the contribution of manufacturing to GDP increased from 10 percent in 1990 to 14 percent in 2009, Namibia still has a small

manufacturing base. The manufacturing sub-sector is dominated by meat processing, fish processing and beverages.

The primary sector, which consists of agriculture, forestry, fishing and mining accounted for an average of 20 percent of GDP during the same period, with the main contribution from mining and quarrying.

Although the Namibian economy is more diversified than many others in sub-Saharan Africa, further diversification remains a main component of government policy. More efforts are still needed to diversify the economy from the traditional sectors and develop other industries such as manufacturing. Diversification of the economy has the potential to contribute to economic growth and generate the much-needed employment as well as poverty alleviation.

Figure 2. Sectoral Contribution to GDP (average, 2005-2009)



Source: Data for the figure are obtained from Bank of Namibia

2.2 Savings and investment trends

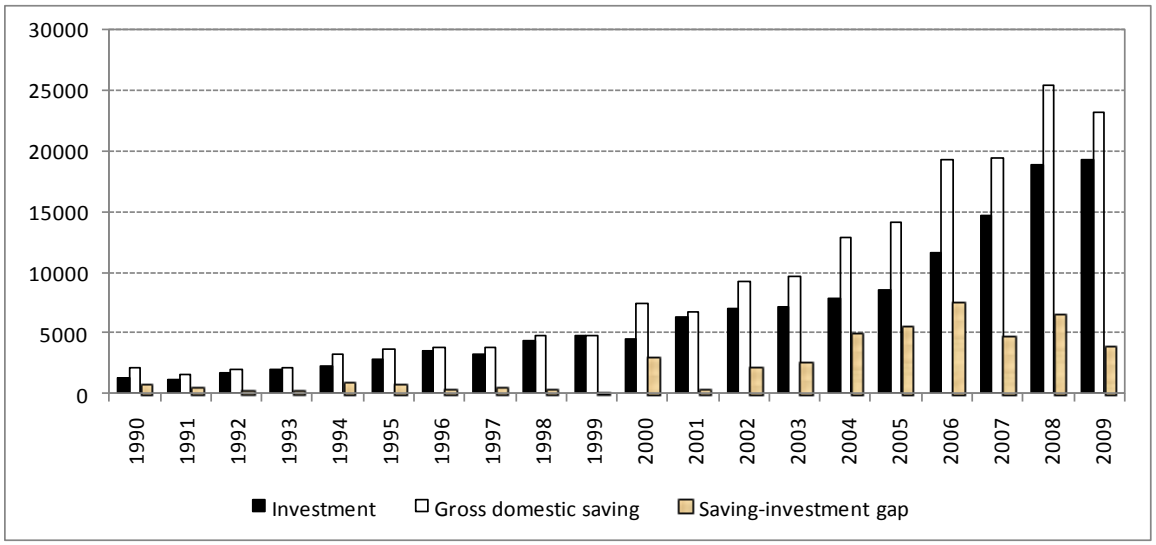
2.2.1 Aggregate Saving and Investment to GDP

Gross domestic savings is defined as the difference between gross national disposable income and final consumption expenditure; i.e., income that is not consumed, is saved. If a country spends its national income on consumption, there will be fewer resources available for savings, and for investment. However, while domestic savings are the main source of finance for investment, domestic savings and investment may not be equal. The difference between savings and investment reflects the foreign savings position of the country. If there is excess savings over investment, it will result in foreign lending and this

will be reflected in an outflow of capital. However, if national savings are deficient (less than investment) it will lead to import of capital through foreign borrowing.

The trends in savings and investment are plotted in Figure 3. Namibia experienced excess savings over investment for the period 1990 to 2009, reflected in surpluses on the current account of the balance of payments. The gap between savings and investment reached its highest level of N$7.5 billion in 2006. The global economic crisis caused excess savings to fall to a relatively low level of N$3.8 billion in 2009, as overall savings declined.

Figure 3: Saving, investment and saving-investment gap (Namibia dollar N$ million)



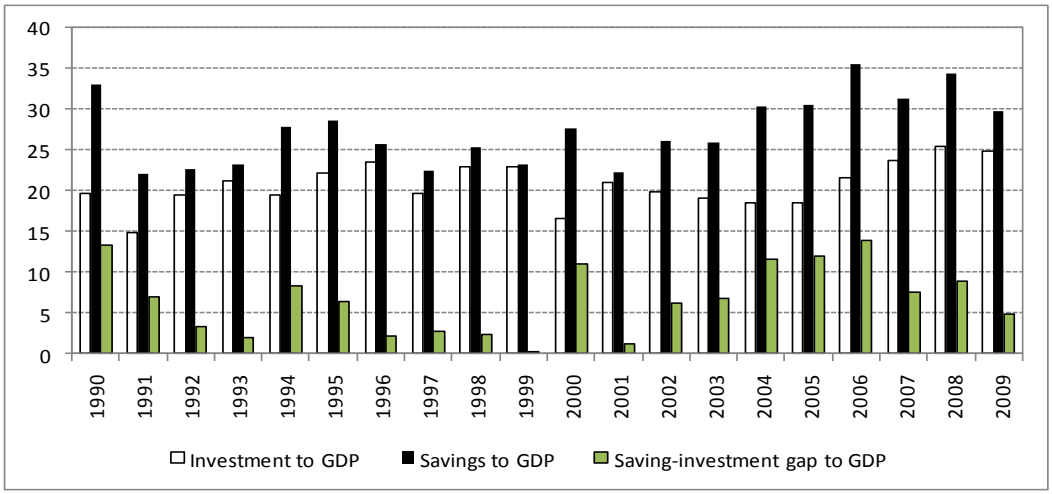
Source: Computed using data from the Bank of Namibia

Savings, investment and saving-investment gap as ratios of GDP are plotted in Figure 4. The excess of saving over investment is a particular characteristic of the Namibian economy, and shows that Namibia has not been able to use its entire savings for investment. The excess saving led to capital outflows or lending to other countries, especially to the South African financial markets. The highest ratio of saving to GDP was recorded in 2006 and 2008. It increased from 30 percent in 2005 to 35 percent in 2006 before declining slightly to 34 percent in 2008. According to Bank of Namibia (2009), the increase in saving is attributed better fiscal management and strong growth in tax revenue which led to an increase general government gross saving during that period. The average ratio of saving to GDP during 1990 to 2009 was 27 percent.

Although Namibia has not been able to turn its abundance of savings into investment, the average investment to GDP ratio was 20 percent during the same period (see Figure 4). The average excess saving over investment or saving-investment gap was 6.6 of GDP during 1990 to 2009. Bank of Namibia (2009) states this ratio is expected to increase over the next few years as the economy recovers from the global

economic crisis. The continued excess of savings over investment suggests that measures aimed at curbing capital outflows have not been particularly successful at boosting investment in the local economy.

Figure 4. Domestic savings investment, and the saving-investment gap (percent of GDP)



Source: Data obtained from the Bank of Namibia

2.3 Unemployment rate

Unemployment rate is plotted is plotted in Figure 5. Figure shows that unemployment has been on an increasing trend between 1971 and 1985. It decreased and stabilised between 1987 and 1999. It increased sharply between 2000 and 2009. Unemployment increased to 36 percent in 2009. Although Namibia achieved moderate growth during the period 1990 to 2009, it was not sufficient to generate much-needed jobs and unemployment rate continued to increase.

Figure 5. Unemployment rate

Data for the figure sourced from Hartman (1988); Ministry of Labour and Social Welfare (1997; 2000; 2002; 2004; 2008)

3. THEORETICAL FRAMEWORK

This is a neoclassical theoretical framework and the study adopts the Cobb-Douglas production (Cobb and Douglas, 1928). It is based on the assumption of constant returns to scale for labour and capital inputs. Constant returns to scale suggests that if the amount of inputs is doubled, output will also double. Despite criticism in the theoretical literature (such as Barro, 1990; 1991), neoclassical models are still used extensively to estimate macroeconometric models of both developed and developing countries.

3.1 Specification of the Model

3.1.1 Aggregate Supply (Production)

The formulation of aggregate supply function relates output to the inputs of capital and labour, as well as technological progress. Total output is modelled using the Cobb-Douglas production function with constant returns to scale. It is specified as follows:

$$Y_t = A(CAP)_t^{\alpha} L_t^{1-\alpha}, \quad (1)$$

where *Y, CAP, A* and *L* are output, capital, technological progress and labour. Equation (1) is estimated in log-linearised form. Capital and labour are expected to have positive impact on the level of output. However, as pointed (by Damoense-Azevedo, forthcoming and Musila, 2002), they exhibit diminishing returns and this suggests that technological progress is required to accelerate economic growth.

3.1.2 Demand for Labour

The demand for labour equation is specified as:

$$L_t = f(Y_t, W_t, PROD_t) \quad (2)$$

Where *L, Y, W, PROD* are labour or employed people, real output (real GDP), wages and labour productivity. Labour productivity is computed as output divided by labour. Increase in real output is expected to increase the demand for labour. A rise in wages and labour productivity can cause demand for labour to decrease. The coefficients of real output is expected to be positive, while those of wages and labour are expected to be negative.

3.1.3 Investment

Investment is estimated according to the neoclassical model of domestic investment. This is based on Jorgenson (1963). The investment function is determined by the user cost of capital, savings, real output and the level of financial development. The equation is specified as follows:

$$INV_t = f(UCC_t, S_t, Y_t, FD_t) \quad (3)$$

Where *UCC, S, Y, FD* are user cost of capital, savings, real output and level of financial development. The user cost of capital is computed following Eita and Du Toit (2009), while the level of financial development is derived in accordance with Eita (2009). The user cost of capital impacts negatively on investment. Increase in user cost of capital is expected to increase the cost of financing investment (Eita and Du Toit, 2009; Akanbi and du Toit, 2011). A rise in savings, real GDP and financial development are expected impact positively on investment. In their estimation of the investment function for Namibia, Eita and Du Toit (2009) did not include financial development as one of the explanatory variables. This study differs from Eita and Du Toit (2009) in the sense that the impact of financial development on investment is investigated.

3.1.4 Capital Stock

Capital stock is computed as:

$$CAP_t = (1 - dep)CAP_{t-1} + INV_t \quad (4)$$

Where *CAP, dep* are capital stock and rate of depreciation. *INV* is as defined before.

3.1.5 Financial Development

Following a review of the theoretical and empirical literature (such as Heger et al., 2007; Law and Habibullah, 2009, Damoense-Azevedo, forthcoming) financial development is determined by investment to GDP ratio, real income, openness of the economy, financial liberalisation and human capital. Inflation is also expected to have an influence on financial development. The financial development equation is specified as follows:

$$FD_t = f(INV_t, Y_t, OPEN_t, P_t, IR_t) \quad (5)$$

Where *OPEN, P, IR* are openness of the economy, price level (inflation) and interest rate. *FD, INV* and *Y* are as previously defined.

3.1.6 Price level

The price levels (consumer prices) are determined by wages, exchange rate, nominal user cost of capital, import prices. The price equation is specified as:

$$P_t = f(W_t, EXCH_t, UCC_t, IMP_t) \quad (6)$$

Where *P, EXCH, IMP* are consumer prices, exchange rate and import prices. *UCC* and *W* are as previously defined. Increases in these variables are expected to drive up consumer prices.

3.1.7 Wages

Wages are determined by labour productivity and the price level and the equation is estimated as:

$$W_t = f(P_t, PROD_t) \quad (7)$$

Where *PROD* is computed as:

$$PROD_t = \frac{Y_t}{L_t}$$

Consumer prices and a rise in labour productivity have a positive impact on wages.

4. EMPIRICAL FRAMEWORK

4.1 Econometric Methodology

The availability of data determines the appropriate econometric methodology to be employed. This study uses data set that has few observations, and this means that a number of feasible econometric methods is limited. This is a time-series econometric study. The study adopts the Engle-Granger two steps econometric methodology. This econometric methodology is widely used in the literature of macro-econometric modelling. It is useful in the sense that it avoids the problem of spurious regression. Spurious regression gives an impression of good econometric results even though there is no meaningful relationship between variables.

Despite its potential defects, the Engle and Granger (1987) two steps was chosen to estimate the supply side macroeconometric model of the Namibian Economy. This technique involves estimation of the long-run cointegrating or economic equilibrium relationship between variables by means of testing stationarity of the residuals. Augmented Dickey Fuller (ADF) test statistic is employed to test if the residuals from the long run equation are stationary. The null hypothesis of no cointegration is tested by comparing the ADF statistic with MacKinnon critical values. If the null hypothesis of no cointegration is rejected, then there is cointegration. An error correction model (ECM) consisting of stationary residuals from the long-run cointegration equation can be estimated. The stationanry residuals must be lagged by one period and is expected to have a negative sign. This allows for the system to adjust towards long-run equilibrium. The coefficient of the ECM represents the speed of adjustment to equilibrium.

4.2 Data

This is a time series data analysis study. It uses annual data for the period 1971 to 2009. The description and sources of data used in the study are presented in Table 1.

Table 1. Data sources and description

Variable	Variable description	Source
lnCAP	Fixed capital stock	Bank of Namibia, Hartman (1988); Cornwell *et al.* (1991).
dep	rate of depreciation	Bank of Namibia; Hartman (1988); Cornwell *et al.* (1991)
DUMIND	Dummy for Namibia's independence in 1990 (It takes value of 0 before 1990 and 1 after 1990)	Computed
DUMUN	Dummy variable for political and economic uncertainty in 1987 -1989 (value of 1 in 1987-1989 and 0 elsewhere)	Computed
lnEXCH	Exchange rate of the Namibia dollar (N$) to the USA dollar	Bank of Namibia; IMF's International Financial Statistics
lnED	Excess demand computed as $\frac{Gross\ domestic\ \exp enditure}{real\ GDP}$	Computed from data obtained from Bank of Namibia; Hartman (1988)
lnFD	Financial development proxied by total credit extended to the private sector as ratio of GDP	Computed using data sourced from Bank of Namibia; Hartman (1988); Cornwell *et al.* (1991)
lnIMP	Import prices proxied by import price index	Computed using data sourced from Bank of Namibia; Hartman (1988); Cornwell *et al.* (1991)
lnIR	Interest rate (proxied by lending rate)	Bank of Namibia; IMF's International Financial Statistics
lnINV	Investment (gross fixed capital formation)	Bank of Namibia; Hartman (1988); Cornwell *et al.* (1991)
lnINVGDP	Ratio of investment to GDP	Computed using data from Bank of Namibia; Hartman (1988); Cornwell *et al.* (1991)
lnL	Labour or the number of people employed	Bank of Namibia; Hartman (1988); Cornwell *et al.* (1991); Ministry of Labour and Social Welfare (1997; 2000; 2004; 2008); World Bank Development Indicators
lnOPEN	Openness of the economy (sum of import and export divided by GDP)	Computed using data from Bank of Namibia; Hartman (1988); Cornwell *et al.* (1991)
lnP	Consumer Price Index	Bank of Namibia; Hartman (1988); Cornwell *et al.* (1991)
lnPROD	Labour productivity computed as $\frac{real\,GDP}{Labour}$	Computed using data from Bank of Namibia; Hartman (1988); Cornwell *et al.* (1991); Ministry of Labour and Social Welfare (1997; 2000; 2004; 2008); World Bank Development Indicators
lnS	Savings (gross domestic savings)	Bank of Namibia; Hartman (1988); Cornwell *et al.* (1991)
lnUCC	User cost of capital computed following Eita and Du Toit (2009)	Computed using the data from Bank of Namibia; Hartman (1988); Cornwell *et al.* (1991)
lnW	Wages (proxied by remuneration of employees in the Namibian economy)	Bank of Namibia; Hartman (1988); Cornwell *et al.* (1991)
lnY	Real GDP	Bank of Namibia; Hartman (1988); Cornwell *et al.* (1991)

T	Time trend	Computed

5. EMPRIRICAL RESULTS

5.1 Unit Root Test

Univariate characteristics of the data which involves unit root test is the first step before estimation of the equations. This study uses ADF test and Phillips-Perron (PP) test statistics to establish the univariate characteristics of the data. These two test statistics have been criticised that they have low power in the sense that sometimes under-reject the null hypothesis of unit root even when the variable is stationary. A more powerful test for unit root, Kwiatkowski-Phillips-Schmidt-Shin (KPSS) is also used in this study in order to ensure that the results are robust. The unit root test results are presented in Table 2. The results in Table 2 indicate that according to ADF and Phillips-Perron (PP) test statistics, all variable are nonstationary (contain unit root) in levels but become stationary on first differences (with the exception of capital stock and consumer prices). This means that the null hypothesis of unit root is not rejected for variables in levels. The null hypothesis is rejected for variables for all variables in first differences. The results of KPSS statistic which uses the null hypothesis of stationarity (no unit root) show that the null hypothesis of stationarity is rejected for all variables (except openness) in levels. This null hypothesis of stationarity is not rejected for variables in first differences. This indicates that according to KPSS test statistic, variables are nonstationary in levels but become stationary on first differences. KPSS results are consistent with those of ADF and PP.

Table 2. Unit root test results

		LEVELS			FIRST DIFFERENCE		
Variable	Model	ADF	PP	KPSS	ADF	PP	KPSS
ln *CAP*	Constant	-0.29	-0.99	0.78###	-2.38	-2.43	0.18
	Constant & trend	-2.05	-2.03	0.12#	-2.32	-2.29	0.18
	none	1.42	2.56		-1.88*	-1.84*	
ln *EXCH*	Constant	-0.68	-0.66	0.73###	-5.64***	-5.60***	0.10
	Constant & trend	-2.23	-2.30	0.09	-5.54***	-5.48***	0.10
	none	1.15	1.09		-4.99***	-4.50***	
ln *ED*	Constant	1.18	1.53	0.76###	-4.91***	-4.87***	0.27
	Constant & trend	-0.47	-0.52	0.16##	-5.01***	-4.91***	0.14
	none	3.84	3.80		-3.77***	-3.74***	
ln *FD*	Constant	-1.88	-1.57	0.24	-3.15**	-3.09**	0.39
	Constant & trend	-2.87	-2.21	0.15##	-3.50*	-3.47*	0.17
	none	-0.40	-0.49		-3.19***	-3.12***	
ln *IMP*	Constant	-2.32	-2.75*	0.76###	-5.98***	-6.00***	0.46
	Constant & trend	-1.43	-1.34	0.18##	-7.02***	-7.06***	0.06
	none	4.67	3.56		-1.96**	-3.53***	
ln *IR*	Constant	-2.09	-1.90	0.26	-4.96***	-4.84***	0.31
	Constant & trend	-1.78	-1.36	0.21##	-5.43***	-8.55***	0.34
	none	-0.46	-0.35		-5.04***	-4.95***	
ln *INV*	Constant	0.02	0.18	0.48##	-5.45***	-6.45***	0.26
	Constant & trend	-0.88	0.78	0.17##	-6.78***	-6.79***	0.10
	none	1.55	1.66		-6.22***	-6.21***	
ln *L*	Constant	0.53	0.31	0.75###	-3.03**	-2.86*	0.16
	Constant & trend	-0.92	-1.24	0.17##	-2.87	-2.68	0.11
	none	2.41	7.28		-1.32	-1.82*	
ln *OPEN*	Constant	-2.24	-2.31	0.14	-6.31***	-6.32***	0.11
	Constant & trend	-2.18	-2.26	0.09	-6.23***	-6.23***	0.10
	none	-0.99	-1.06		-6.35***	-6.36***	
ln *P*	Constant	-2.51	-1.90	0.75###	-0.69	-1.33	0.43
	Constant & trend	3.41	1.86	0.18###	-2.52	-2.19	0.20
	none	-1.07	4.42		-0.63	0.72	
ln *PROD*	Constant	-1.13	-0.87	0.82###	-5.93***	-5.60***	0.16
	Constant & trend	-2.72	-2.69	0.14##	-5.87***	-5.92***	0.15
	none	1.60	2.71		-5.44***	-5.46***	
ln *S*	Constant	-2.18	-2.02	0.36#	-8.29***	-9.26***	0.30
	Constant & trend	-2.66	-2.54	0.17##	-8.21***	-10.22***	0.47##
	none	0.11	0.69		-8.34***	-9.04***	
ln *UCC*	Constant	-1.96	-2.19	0.71###	-5.00***	-5.00***	0.46
	Constant & trend	-0.44	0.02	0.18###	-5.51***	-5.84***	0.14
	none	1.595	1.15		-4.15***	-4.15***	
ln *W*	Constant	1.67	0.98	0.77###	-1.94	-2.05	0.24
	Constant & trend	0.74	-0.83	0.10	-2.06	-1.84	0.15
	none	1.81	2.88		-1.12	-0.55	

Notes: KPSS uses the null hypothesis of stationary (no unit root), while ADF and PP use the null hypothesis of nonstationary (there is unit root).

#, ##, ### indicates rejection of the null hypothesis of stationary (no unit root) at 1%, 5% and 10% significance levels.

*, **, *** indicates rejection of the null hypothesis of nonstationarity (there is unit root) at 1%/5%/10% significance level respectively.

5.2 Estimation Results

The long-run estimation results are presented in Table 3. Short-run or error correction model results are in Table 4.

5.2.1 Production

The results of Equation (1) shown in Table 3 and Table 4 indicate that a one percent increase capital stock causes real GDP to increase by 0.32 percent. Increase in labour by one percent causes real GDP to increase by 0.68 percent. Technological progress denoted by the time trend (T) results in real GDP to rise by 0.01 percent. These results are consistent with theoretical expectations. The null hypothesis of no cointegration was rejected because the residuals from the long-run equation are stationary. This means that the variables are cointegrated and it is appropriate to proceed to the error correction model or short-run estimation. The short-run results show that the coefficient of the ECM is negative and statistically significant. The ECM coefficient represents the speed of adjustment. It indicates that there is adjustment to equilibrium. It shows that 76 percent of disequilibrium is corrected every year. The short-run results passed all diagnostic statistics (such as normality, heteroscedasticity, autocorrelation, stability, serial correlation) suggesting that there is no violation of the assumptions of the classical linear regression model. The diagnostic statistics for the production and all other equations are not presented here but are available from the author on request.

5.2.2 Demand for Labour

Long-run results show that wages and labour productivity are associated with a decrease in employment. A one percent increase in wages causes labour demand to decrease by 0.11 percent. Labour demand decrease by 1.61 percent if productivity increases by one percent. Real GDP is associated with an increase in labour demand. An increase in real GDP by one percent cause labour demand to increase by 1.7 percent. The dummy variable for Namibia's independence in 1990 was added to the labour equation as additional explanatory variable, and shows that the post-independence period is associated with an increase in labour demand. The results are consistent with theoretical expectations. The null hypothesis of no cointegration is rejected because the residuals from the long-run equation are stationary, which means that there is a long-run equilibrium relationship between variables in the labour equation. The short-run results indicate that the coefficient of the ECM is negative and statistically significant. This suggests that there is adjustment to long-run equilibrium. About 5 percent of deviations in the short run are corrected every year in order to bring the labour market to equilibrium. The equation passes all diagnostic statistics. There is no violation of the assumptions of the classical linear regression model.

5.2.3 Investment

Investment is determined by real GDP, user cost of capital, savings and level of financial development. The long-run results show that increases in real GDP, savings and financial development by one percent are associated with a rise in investment by 1.54, 0.07, and 0.31 percent. However, the coefficient of savings is not statistically significant. This may suggests that savings is necessary but not sufficient for investment in Namibia. This in line with the results of Figure 3 and Figure 4, which show that Namibia has excess savings over investment. The excess savings did not result in higher investment, but caused capital outflows mainly to the South African financial markets. The user cost of capital has a negative effect on investment. A one percent increase in the user cost of capital causes investment to decrease by 0.26 percent. This is in line with theoretical expectations that a rise in the user cost of capital makes the cost of investment expensive, resulting in investment to decrease. The residuals from the long-run equation were tested for stationarity and indicated that they are stationary. This means that the null hypothesis of unit root is rejected. There is cointegration between the variables in the investment equation. It is now appropriate to proceed with the error correction model or short-run estimation. The short-run results indicate that the coefficient of the ECM is negative and statistically significant. This suggests that the dynamics of the investment equation adjust to the long-run equilibrium. It shows that 65 percent of the deviations from equilibrium are corrected every year. Diagnostic tests show that there is no violation of the Gaussian assumptions.

5.2.4 Financial Development

The long- run results shows that an increase in investment ratio to GDP and real output by one percent causes the level of financial development to increase by 0.5 and 0.33 percent. Consumer prices and interest rates are associated with a decrease in the level of financial development. A one percent increase in consumer prices cause the level of financial development to decrease by 0.31 percent. Increase in interest rates by one percent results in the level of financial development to decrease by 3.56 percent. These results are consistent with theoretical expectations. The null hypothesis of no cointegration between variables is rejected. This means that the variables in the financial development equation are cointegrated. The short-run results indicate that the coefficient of the ECM is negative and statistically significant. This indicates that the dynamics of the financial development equation adjust to long-run equilibrium. The speed of adjustment shows that 13 percent of disequilibrium is corrected every year. No violations of the assumption of the classical linear regression model as the short-run results passed all diagnostic statistics.

5.2.5 Price Level

The overall level of prices is determined by nominal wages, nominal user cost of capital, exchange rate and import prices. Increase in nominal wages, nominal user cost of capital and import prices by one percent causes overall price level or consumer prices to increase by 0.23, 0.07, and 0.40 percent. A depreciation of the exchange rate by one percent causes consumer prices to increase by 0.32 percent.

These results are consistent with theoretical expectations. The null hypothesis of no cointegration was rejected because the residuals from the long-run results are stationary, and this suggests that it is appropriate to proceed to the estimation of the short-run equation. Short-run results show that the coefficient of the ECM is negative and statistically significant, implying that there is adjustment to equilibrium. About 28 percent of deviation from equilibrium is corrected every year. Diagnostic statistics indicate that there is no violation of Gaussian assumptions.

5.2.6 Wages

The long-run results indicate that productivity and prices have positive impact on the wages. A one percent increase in labour productivity causes wages to increase by 0.89 percent. Increase in consumer prices by one percent cause wages to increase by 0.15 percent. The dummy variable for political and uncertainty in 1987-1989 was added as possible additional explanatory variables that can explain variations in the Namibian wages. It has negative impact on wages. The null hypothesis of no cointegration was rejected in favour of long-run equilibrium relationship between variables. It is appropriate to proceed to the error correction model. Short-run results that the speed of adjustment is 0.30, suggesting that 30 percent of disequilibrium is corrected every year. The dynamics of the wages equation adjust to long-run equilibrium instead of moving away from it. The wage equation passed all diagnostic statistics and there is no violation of the classical linear regression model.

Table 3. Long-run estimation results

Equation (1): Production

$$\ln Y_t = \underset{(-19.71)}{-3.02} + \underset{(4.58)}{0.32}\ln CAP_t + \underset{(15.50)}{(1-0.32)}\ln L + 0.01T$$

Adjusted R-squared: 0.97

Equation (2): Labour

$$\ln L_t = \underset{(-7.50)}{-0.11}\ln W_t + \underset{(194.58)}{1.66}\ln Y_t - \underset{(-16.34)}{1.61}\ln PROD_t + \underset{(0.57)}{0.02}\ln DUMIND$$

Adjusted R-squared: 0.97

Equation (3): Investment

$$\ln INV_t = \underset{(-3.56)}{-7.46} + \underset{(5.90)}{1.54}\ln Y_t - \underset{(-3.88)}{0.26}\ln UCC_t + \underset{(1.30)}{0.07}\ln S_t + \underset{(3.77)}{0.31}\ln FD_t$$

Adjusted R-squared: 0.79

Equation (5): Financial Development

$$\ln FD_t = \underset{(2.40)}{0.50}\ln INVGDP_t + \underset{(2.81)}{0.33}\ln Y_t - \underset{(-2.38)}{0.31}\ln P_t - \underset{(-2.37)}{3.56}\ln IR_t + \underset{(4.44)}{1.08}DUMIND$$

Adjusted R-squared: 0.61

Equation (6): Price level

$$\ln P_t = \underset{(6.27)}{0.23}\ln W_t + \underset{(1.67)}{0.07}\ln UCC_t + \underset{(7.11)}{0.32}\ln EXCH_t + \underset{(4.43)}{0.40}\ln IMP_t$$

Adjusted R-squared: 0.98

Equation (7): Wages

$$\ln W_t = \underset{(38.33)}{0.89} + \underset{(3.49)}{0.89}\ln PROD_t + \underset{(4.59)}{0.15}\ln P_t - \underset{(-0.97)}{0.07}DUMUN$$

Adjusted R-squared: 0.88

Note: t-statistics in brackets

Table 4. Short-run (Error Correction Model) results

Error correction model for Equation (1): Production

$$\Delta \ln Y_t = -0.76 ECM_{t-1} + 0.46 \Delta \ln CAP_t + 0.40 \Delta \ln Y_{t-1}$$
$$(-4.77) \qquad (2.75) \qquad (2.59)$$

Adjusted: R-squared: 0.30

Error correction model for Equation (2): Labour

$$\Delta \ln L_t = -0.05 ECM_{t-1} - 0.09 \Delta \ln W + 0.02 DUMIND - 0.18 \Delta \ln W_{t-3} + 0.03 \Delta \ln INV_{t-1}$$
$$(-1.88) \qquad (-3.12) \qquad (2.57) \qquad (-4.15) \qquad (2.78)$$
$$- 0.07 \Delta \ln Y_{t-2} - 0.07 \Delta \ln Y_{t-4} + 0.01 DUMUN + 0.02$$
$$(-1.85) \qquad (-2.12) \qquad (1.19) \qquad (7.13)$$

Adjusted R-squared: 0.57

Error correction model for Equation (3): Investment

$$\Delta \ln INV_t = -0.65 ECM_{t-1} + 1.92 \Delta \ln CAP_{t-1} + 0.08 \Delta \ln S_{t-2} - 1.34 \Delta \ln Y_{t-1} + 0.07 DUMIND$$
$$(-6.06) \qquad (4.68) \qquad (2.89) \qquad (-3.71) \qquad (2.70)$$

Adjusted R-squared: 0.63

Error correction model for Equation (5): Financial development

$$\Delta \ln FD_t = -0.13 ECM_{t-1} + 0.22 \Delta \ln INVGDP - 0.41 \Delta \ln OPEN_t + 0.34 DUMIND + 0.26 DUMUN$$
$$(-2.48) \qquad (2.64) \qquad (-2.77) \qquad (4.50) \qquad (4.42)$$
$$- 0.10$$
$$(-4.28)$$

Adjusted R-squared: 0.60

Error correction model for Equation (6): Price level

$$\Delta \ln P_t = -0.28 ECM_{t-1} + 0.29 \Delta \ln P_{t-1} + 0.71 \Delta \ln P_{t-2} + 0.50 \Delta \ln P_{t-3} + 0.21 \Delta \ln W_{t-2} + 0.08 \Delta \ln ED_{t-2}$$
$$(-5.99) \qquad (2.42) \qquad (4.75) \qquad (3.45) \qquad (3.03) \qquad (1.95)$$
$$+ 0.08 \Delta \ln ED_{t-3} - 0.12 \Delta \ln ED_{t-4} - 0.05 \Delta \ln UCC_{t-1} - 0.06 \Delta \ln UCC_{t-2} - 0.04 \Delta \ln UCC_{t-4}$$
$$(1.94) \qquad (-3.66) \qquad (-2.52) \qquad (-2.99) \qquad (-2.65)$$
$$- 0.07$$
$$(-4.03)$$

Adjusted R-squared: 0.85

Error correction model for Equation (7): Wages

$$\Delta \ln W_t = \underset{(-1.83)}{-0.30} ECM_{t-1} \underset{(-4.85)}{-2.18} \Delta \ln P_{t-1} \underset{(3.08)}{+0.74} \Delta \ln W_{t-2} \underset{(4.00)}{+1.23} \Delta \ln W_{t-3} \underset{(2.16)}{+0.64} \Delta \ln W_{t-4} +$$
$$\underset{(3.64)}{0.70} \Delta \ln PROD_{t-2} \underset{(4.06)}{+0.99} \Delta \ln PROD_{t-3} \underset{(2.73)}{+0.53} \Delta \ln PROD_{t-4} \underset{(-2.25)}{-1.17} \Delta \ln P_{t-1} \underset{(4.11)}{+2.73} \Delta \ln P_{t-3}$$
$$\underset{(2.09)}{+1.28} \Delta \ln P_{t-4} \underset{(1.53)}{-0.05} DUMUN \underset{(-1.99)}{-0.15}$$

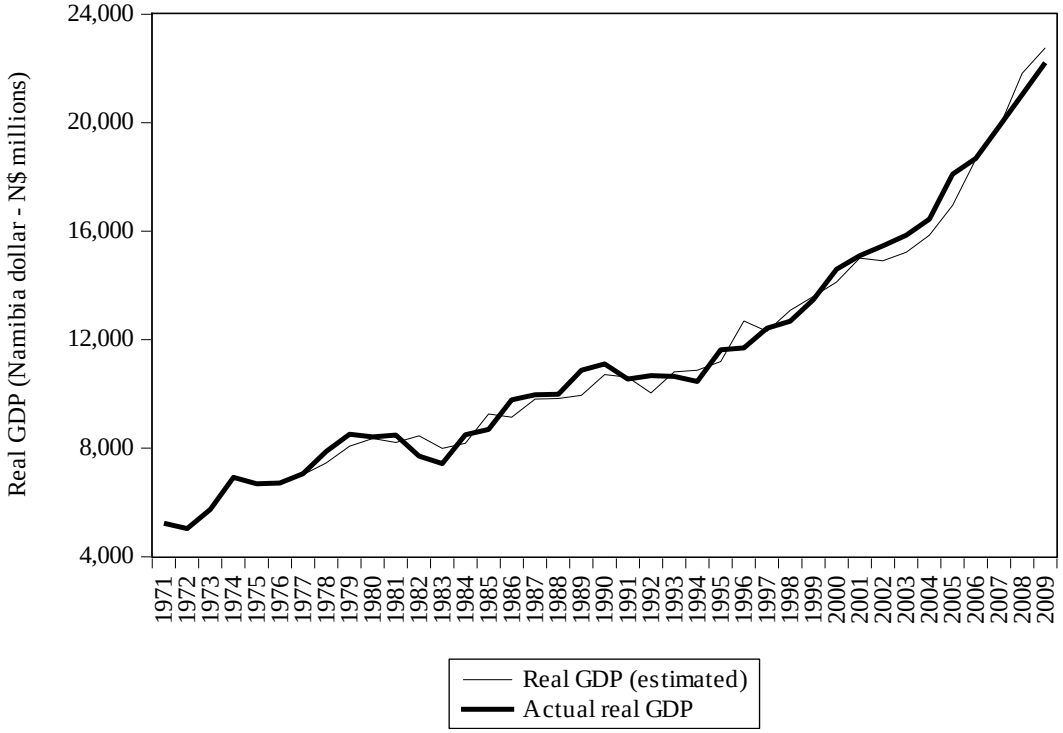
Adjusted R-squared: 0.63

Note: t-statistics are in brackets

5.3 Closing the Model

Closure of the model is the final step in macroeconometric model of the economy. The six behavioural equations (production, labour, investment, financial development, price level and wages) were combined into a supply side or neoclassical growth model of the Namibian economy. In order to ensure that the system is fully dynamic, a number of identities and definitions were introduced to link all the endogenous variables. The macroeconomic model comprising of behavioural equations, identities and definitions was simulated and the results are presented in Figure 6. Figure 6 shows the model is a good fit and can be useful for forecasting and policy simulation.

Figure 6. Actual and estimated real GDP



6. CONCLUSION

This paper developed and estimated the supply side macroeconometric model of the Namibian economy using annual data for the period 1971 to 2009. The model consists of six behavioural equations (production, labour, investment, wages, prices and financial development). The six behavioural equations were estimated individually and were combined and incorporated in to a macroeconometric model of the Namibian economy. Endogenous variables in the model were linked by a number identities and definitions. This was done in order to ensure that the system is fully dynamic. The complete model was simulated and the results indicate that the estimated values closely follow or approximate the actual values. This is an indication that the estimated macroeconometric model is a good fit and there is a long-run equilibrium relationship between variables that are included in the macroeconometric model.

Labour is positively determined by real GDP and negatively influenced by wages and productivity, and this suggests that policies aimed at promoting economic growth and reduce the cost of employment should be encouraged in order to generate the much-needed jobs. Investment is promoted by raising real GDP and the level of financial development. Savings has an insignificant effect on investment in Namibia. Saving is necessary but not sufficient for investment in Namibia. Hence, the country has excess saving over investment. Measures that reduce constraints to investment such as a low level of user cost of capital should be implemented. Accelerating the level of financial development further stimulates investment.

The level of financial development in Namibia is positively determined by high ratio of investment to GDP, openness of the economy and real GDP. However, it is negatively affected by increase in inflation and interest rate. It is important to promote investment, achieve high level of economic growth in order to enhance financial development. Maintaining macroeconomic stability can also enhance financial development. Continuing increase in the wages, user cost of capital, depreciation of the Namibia dollar and rising import prices are the main drivers of inflation in Namibia. Increase in productivity and inflation are the main drivers of high wages in Namibia. Since the estimated values are approximate of the actual values, the model is a good fit and can serve as a useful tool for policy simulation and forecasting.

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