Determinants of House Prices and New Construction Activity: An Empirical Investigation of the Namibian Housing Market

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NUST, Namibia, UKZN, South Africa

2016

DETERMINANTS OF HOUSE PRICES AND NEW CONSTRUCTION ACTIVITY: AN EMPIRICAL INVESTIGATION OF THE NAMIBIAN HOUSING MARKET

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ABSTRACT

The demand for and supply of housing are heterogeneous and differ across countries, provinces and cities. In the Namibian context, the housing market has experienced a substantial increase in house prices. Such an unexpected growth rate in house prices suggests that the Namibian housing market may not be sustainable in the long term. This means that there is a high probability of a housing price bubble in Namibia if the house prices continue to increase. The aim of this study was to conduct an econometric analysis of endogenous and exogenous determinants of house prices and new construction activity in Namibia. This study also attempted to establish whether there is evidence of overvaluation of house prices in the Namibian housing market and this is important in identifying the possibility of a housing price bubble in Namibia. In addition, the study is relevant during the current period where Namibia is faced with a continuous increase in house prices. A restricted VAR model with a Johansen cointegration approach was used to analyse monthly data from January 2000 to December 2014. The selection of the data set was aimed at providing representatives for various housing demand drivers and housing supply determinants. For modelling on the supply side, new construction investment as a percentage of GDP was employed. The other variables incorporated as exogenous variables include the economic growth rate, the consumer price index, nominal wages as a percentage of GDP, the short-term interest rate, mortgage loans as a share of GDP and population in the 15-64 cohort as a percentage of GDP. Results show that the house price index in Namibia has proved more sensitive to changes in population, mortgage loans and inflation; whereas the construction activities were found to be more sensitive to the house price index and inflation. Granger causality results show that there is a bidirectional causality between the house price index and new construction activity in Namibia. The study therefore found evidence of overvaluation of house prices in the Namibian housing market, which may lead to a house price bubble in the Namibian economy. Namibian policymakers, through the Bank of Namibia, should come up with policies which ensure that the majority of mortgages given by the banks are for constructing new houses instead of financing the purchase of existing houses.

JEL Classifications: C32; E37; D40
Key words: house prices, property market, cointegration, VAR model, Namibia
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INTRODUCTION

The housing market attracts a large volume of investment because houses are among the key assets treasured by households and firms. The real estate market provides positive externalities in terms of protection, public health and economic development (Panagiotidis and Printzis, 2015). Thus, houses are often regarded as a good investment, considering that a property does not depreciate. However, this changed during the 2007 global financial crisis, which had a tremendous impact on the housing market in countries all over the world. Since then the housing sector has been kept under continuous observation for its potentially disruptive influence on financial stability and economic growth (Renigier-Biłozor and Wiśniewski, 2012). This means that fluctuations in housing prices tend to have a bigger wealth effect on the economy than financial assets do (Glindro, 2008). Hence, studies on determinants of house prices have been the subject of a growing body of analysis. The identified determinants of house prices include supply factors such as the availability of land and construction activities, and demand factors such as interest rates, inflation, wages or income, mortgage loans and the population (Hofmann, 2004; Tsatsaronis and Zhu, 2004; Stepanyan, 2010).

The demand for and supply of housing are heterogeneous and differ across countries, provinces and cities. In the Namibian context, the housing market has experienced a substantial increase in house prices (Stepanyan et al., 2010; Brown, 2013). In 2015 for example, the Namibian housing market experienced the second highest increase in house prices in the world, after Dubai, owing to the large disparity between demand and supply of houses (Affirmative repositioning, 2015). The price level of housing and mortgage loans in Namibia had increased over time, and house prices increased on average by 29 percent year on year until the year 2014 (Grobler, 2016). Such an unexpected growth rate in house prices suggests that the Namibian housing market may not be sustainable in the long term (Hattingh, 2006). This means that there is a high probability of a housing price bubble in Namibia if the housing markets continue to increase (New Era, 2016). A price bubble occurs when the price of an asset deviates from its intrinsic or fair value for an extended period (Hattingh, 2006; Stigitz 1990). A bubble bust in the Namibian housing market could result in a collapse of the construction and real estate sectors, and this could lead to job cuts in these sectors and low liquidity in the banking sector (Grobler, 2016).

Although the Namibian government has developed policy interventions to increase housing supply (Sweeney-Bindels, 2011), people's capacity to acquire houses continues to trend downward as fewer houses are traded monthly, and demand for houses continues to increase (Affirmative Repositioning, 2015). The drastic increase in domestic house prices and the shortage in the supply of housing over the past decade have set the stage for various reactive effects within the Namibian housing market (Napier, 2011). In 2015, an estimated 800 000 Namibians lived in debt, with mortgage loans making up a high fraction of household debt (Affirmative Repositioning, 2015). Despite such a high fraction of mortgage-related household debt, less than 10 percent of the Namibian population had the funds for a house in the lower price segment in late 2014 (Kaira, 2014). Thus, the supply of reasonably priced housing to low- and middle-income households in Namibia has not been increasing rapidly enough to meet the housing demand profile.

In addition to a shortage in supply of houses, the increasing house prices can be explained by high housing demand. Stepanyan (2010) recognized that the housing prices in Namibia can be explained by demand-side factors such as the real GDP, interest rates, consumer price index, nominal wages, mortgage loans and the population growth. This suggests that the Namibian housing market is influenced by internal factors, mostly related to a shortage of housing supply, and external macroeconomic factors, which mostly affect the housing demand. Thus, the determinants of housing prices in Namibia should be analysed from both supply and demand sides. The aim of this study is, therefore, to conduct an econometric analysis of endogenous and exogenous determinants of the Namibian housing market. This study also attempted to establish whether there is evidence of overvaluation of house prices in the Namibian housing market and this is important in identifying the possibility of a housing price bubble in Namibia. This study is relevant during the current period where Namibia is faced with a continuous increase in house prices. It is therefore important to idetentify the factors that affect house prices and new construction activity in Namibia. To achive this, a restricted VAR model with a Johansen cointegration approach was used to analyse monthly data from January 2000 to December 2014.

LITERATURE REVIEW

Conceptualisation of housing supply and demand

The housing market is affected by both supply and demand sides. To have reasonably priced housing, there should be enough supply to meet the housing demand (Brown, 2013). However, the supply side of the housing market tends to be inflexible because of the shortage of land and the time frame needed for new construction to be completed (Stepanyan et al., 2010). Housing supply relies on housing quantity offered in the previous period and the quantity of new dwellings offered in the present period (Myrmo, 2012). This means that new houses have to be built in order to maintain a sustainable increase in housing supply. Hence, supply of houses tends to be inelastic in the short term because the construction of new houses takes time. Such an inelastic housing supply, therefore, explains the increase in house prices as being due to mismatches between housing supply and demand.

The supply of houses is also affected by the increase in the costs of building materials, which usually contribute to the increase in the cost of constructing new houses (Mosha, 2011; Napier, 2011). For example, the cost of building new houses in Namibia increased considerably between 2008 and 2009 because of a hike in the prices of building materials, like cement, when building activities in neighbouring countries (Angola and South Africa) were at their highest in preparation for the African Nations and World Cup football tournaments (Mosha, 2011). In the long run, construction costs and prices of new houses play an important role in analysing housing prices (Jacobsen et al., 2005). Construction expenses include the price of construction materials and the cost of the labour force used in building new houses or maintaining existing ones. High construction costs result in a decrease in the construction of new houses, ultimately leading to an increase in house prices (Xu and Tang, 2014). This means increases in construction costs are transferred to final consumers or house buyers. Thus, new construction investment is a key factor in modelling the supply side of the housing market.

The demand side of the housing market is affected by factors such as economic growth, general price level, the cost of borrowing, availability of loans, income or wages and the population growth (Tsatsaronis and Zhu, 2004; Kalili, 2008; Stepanyan, 2010; Madsen, 2012; Myrmo, 2012). Changes in economic growth affect households' consumption and firms' production and eventually, the demand for housing. For example, a decline in Gross Domestic Product (GDP) leads to a decrease in the demand for housing as a result of a decline in firms' revenue and household income (Iacoviello and Neri, 2008). This means that a decrease in economic growth reduces the ability of households and firms to secure mortgage loans. The demand for housing is also negatively related to the price level. The increase in the price level tends to weaken the purchasing power of households and eventually the demand for housing decreases as households adjust their spending patterns (Goodhart and Hofmann, 2008). Expenses on housing (including utilities) comprise the second largest household expense, after food and beverages, suggesting that changes in purchasing power would considerably affect spending on housing (Kalili, 2008). Hence, economic growth and the price level are among the key determinants of demand for housing.

In addition to economic growth and price levels, the demand for houses is also affected by the changes in interest rates and the availability of mortgage loans. The relationship between house prices and interest rates on loans is negative and is subject to the level of competition in the banking sector. The influence of interest rates on house prices is of considerable importance, and some researchers (Tsatsaronis and Zhu, 2004; Goodhart and Hofmann, 2008) argue that the interest rate is one of the most vital macroeconomic aspects of the housing market. This is so because most of the houses are purchased through mortgage bonds, which are sensitive to changes in interest rates. When interest rates rise, the cost of borrowing also tends to rise and potential property buyers become discouraged (Panagiotidis and Printzis, 2015). Interest rates also play a key role in the demand for mortgages, as higher interest rates negatively affect the demand for a mortgage loan (borrowing) and eventually reduce the real price of a house (Xu and Tang, 2014). Any decline in real prices of houses decreases the banks' capital, limits lending ability and therefore discourages investments in the housing market (Case et al., 2000). Thus, an increase in interest rates is expected to increase the costs of acquiring houses and of rental (Sweeney-Bindels, 2011).

The demand for housing also changes with demographic factors such as households' nominal wages and population growth. Real house prices do indeed have a positive correlation with households' disposable income because increased real income is associated with an increase in demand for houses (Xu and Tang, 2014). This means that the disposable income is a proxy of affordability in the housing market. Besides the real income, the demand for housing also increases with population growth. Mankiw and Weil (1989) and Lai (2016) analysed the relationship between housing markets and demographics and found that an increase in population leads to an increase in demand for new houses, especially in the long run. The population also has an effect on demand for housing through the process of urbanization. The majority of the population migrates to urban areas on the premise of accessing better living conditions and employment opportunities (Todaro and Smith, 2011). Urbanization is therefore associated with an increase in demand for houses in urban areas. In the Namibian context, the urbanization trend, observed since the 1990s, is seen as one of the key factors that led to the incremental demand for housing in major cities, especially in Windhoek (Napier, 2011). The overall effect of population on housing prices thus tends to be higher in the urban regions than in the rural regions (Todaro and Smith, 2011).

Empirical literature

Housing markets have various characteristics and are affected by different factors. Some empirical studies (Hofmann, 2004; Tsatsaronis and Zhu, 2004, Renigier-Biłozor & Wiśniewski, 2012; Lai, 2016) have tested how house price fluctuations respond to construction costs and a set of macroeconomic variables such as economic growth, inflation, interest rates, bank lending and equity prices. In comparative multi-country studies, Hofmann (2004) found that house prices are generally driven by income growth and interest rates. Addionally, the author observed that in some studies from developed economies other factors such as inflation, bank lending rate and equity prices had significant explanatory power on housing prices. Similarly, Stepanyan (2010) found that house prices are associated with real income, interest rates, unemployment, financial deepening, population, primary fiscal balance and current accounts. Stepanyan's (2010) findings highlighted that the real interest rate is the key determinant of housing prices in the short run. Furthermore, Apergis, (2003) and Xu and Tang (2014) found that the real house prices in Greece and the United Kingdom (UK), respectively are negatively affected by short-run changes in the real interest rate.

With regard to the interaction between economic growth rate and property prices, Iacoviello and Neri (2008) found that a decline in home prices negatively affected consumption and the real GDP. This was supported by other studies (Goodhart and Hofmann, 2008; Madsen, 2012), which found a strong short-term relationship between economic growth and housing prices. Renigier-Biłozor and Wiśniewski (2012) found that the condition of the economy has a significant effect on housing prices. Considering that changes in economic conditions are followed by changes in prices, the net effect of economic growth on housing prices can be reduced if the economic growth is accompanied by an increase in price levels or inflation. This was confirmed by studies (Apergis, 2003; Borowiecki, 2009; Agnello and Schuknechtin, 2011) which established that increases in price levels have a negative effect on the demand for houses.

House prices respond to changes in interest rate and the availability of mortgage loans, according to different empirical studies (Apergis, 2003; Agnello and Schuknechtin 2011; Xu and Tang, 2014; Panagiotidis and Printzis, 2015). The interest rate has therefore been found to be among the key determinants of demand for housing as most houses are financed through loans. For example, Xu and Tang (2014) found the interest to be the key determinant of UK house prices and indicated that households and firms make their investments in the housing market based on the changes in interest rates. This means that the interest rate also affects the demand for housing through the availability of mortgage loans as investors or loan providers tend to adjust their investments when interest rates change. Hence, Apergis (2003) found that the mortgage loan rate is among the key determinants of housing prices in the European Monetary Union. This was also confirmed by Agnello and Schuknechtin (2011) and Panagiotidis and Printzis (2015), who found the mortgage loans to be among the key factors that explain changes in house prices. Thus, the increase in the availability of loans can increase construction activities and eventually, the housing supply. A study by Borowiecki (2009) found that construction activity is sensitive to the mortgage market. This means that interest and mortgage bonds do affect the demand and supply sides of the housing market.

Contrary to common empirical findings, some studies did not find a significant relationship between housing prices and some of the aforementioned macroeconomic variables. For example, Borowiecki (2009) found that real GDP had a minor short-run impact on Swiss house prices. Ong (2013) analysed the macroeconomic determinants of the Malaysian housing market and found that the inflation rate had no explanatory power on house prices. Borowiecki (2009) also found that the interest rate had a low explanatory effect on house prices in Switzerland. This means that, in countries with a relatively stable and low-interest rate, like Switzerland, the effect of the interest rate on the housing market can be limited. Thus, the determinants of house prices are sensitive to a country's economic policy and should be analysed within a specific macroeconomic context. This means that there is need to analyse the determinants of house price in the Namibian macroeconomic context.

THE DATA AND METHODOLOGY

Sample period and data sources

The study used a quantitative analysis of a monthly price index series, from January 2000 to December 2014. The selection of the data set was aimed at providing representatives for various housing demand drivers and housing supply determinants, and the number of observations is comparable with the study by Meese and Wallace (2003). The study used the monthly house price index series from First National Bank (FNB) to represent the demand for houses in Namibia. For modelling on the supply side, new construction investment as a percentage of GDP was employed.

TABLE 1. DATA SOURCES

Variable	Variable name	Source
HPI	House price index	FNB
NCON	New construction investment (activity) as a % of GDP	BoN
GDP	Economic growth rate	BoN
INF	Inflation rates	NSA and BoN
INT	Interest rates	BoN
MORT	Mortgage loans as a percentage of GDP	BoN
POP	Population in the 15-64 cohort as a % of total population	WDI and NSA

The other variables that are incorporated as exogenous variables include the economic growth rate, the consumer price index, nominal wages as a percentage of GDP, the short-term interest rate, mortgage loans as a share of GDP and population in the 15-64 cohort as a percentage of GDP. The sources and abbreviations of all employed variables used in the study are provided in Table 1. It should be noted that all the data employed in this study, other than the house price index, were sourced from the Bank of Namibia (BoN), Namibia Statical Agency (NSA) and the World Development Indicators (WDI).

Econometric models

It should be noted that individual country studies are principally based on cointegration and error correction models and the vector autoregressive (VAR) systems, while studies based on a group of countries use dynamic Ordinary Least Squares (OLS) regressions (Borowiecki, 2009). Frequently, panel studies are more preferred by virtue of the fact that it is possible to use more observations, thus enabling more robust results. Borowiecki (2009) added that country specific conclusions based on panel parameter estimates may raise the problem of homogeneity assumptions which are quite risky. It is against this background that the current study adopted the VAR/VECM methodology as the methodology of the current study. In Table 2, the structure of the restricted VAR that clearly shows both the endogenous and exogenous variables in levels is provided. The variables are differenced if they are found to be integrated of order one, I (1). It is expected that the house price index and the new construction activity as a percentage of GDP are positively related (Borowiecki, 2009). It is also logical to assume that economic growth rate, consumer price index, mortgage as a percentage of GDP, nominal wage as a percentage of GDP and the population in the 15-64 cohort as a percentage of total population are all positively related to the endogenous variables (Borowiecki, 2009; Panagiotidis and Printzis, 2015;

Sivitanides, 2015). However, short-term interest rates are expected to be negatively related to both endogenous variables (Panagiotidis and Printzis, 2015; Sivitanides, 2015).

TABLE 2. ENDOGENOUS AND EXOGENOUS VARIABLES

Nature of variables	**Variables**
Endogenous	LNHPI, LNNCON
Exogenous	LNGDP, LNCPI, LNINT LNMORT, LNPOP

The model and Granger causality

The study tests the hypothesis that house prices in Namibia are explained by lags of house prices, new construction activity, economic growth, inflation, interest rates, mortgages and the population. In the same vein new construction activity is explained by lags of itself, house prices, economic growth, inflation, interest rates, mortgages, and the population. The current study, therefore, uses the complete information developed above to construct the following VECM system with a lag order of *n*:

$$\Delta LNHPI_t = \alpha_0 + \lambda_1 e_t + \sum_{i=1}^{n} a_{1i} \Delta LNHPI_{t-i} + \sum_{j=1}^{n} \alpha_{1j} \Delta LNNCON_{t-j} + \alpha_1 \Phi + \varepsilon_{1t} \qquad (1)$$

$$\Delta LNNCON_t = \beta_0 + \lambda_2 e_t + \sum_{i=1}^{n} \beta_{2i} \Delta LNHPI_{t-i} + \sum_{j=1}^{n} \beta_{2j} \Delta LNNCON_{t-j} + \beta_2 \psi + \varepsilon_{2t} \qquad (2)$$

where, Δ denotes the difference operator, λ is the coefficient of the error correction term, e_t is the error correction term, LNHPI and LNNCON are the logarithms of the house price index and new construction as a percentage of GDP, respectively. Φ and ψ are the set of exogenous variables which both denote economic growth rate, the consumer price index, nominal wages as a percentage of GDP, interest rates, mortgage loans as a percentage of GDP and population in the 15-64 cohort as a percentage of total population. Although cointegration signals the presence of Granger causality in at least one direction, it does not signify the direction of causality between variables. The direction of causality can only be established with the Wald tests in equations 1 and 2 above (Zhao & Du, 2007; Andraz & Rodrigues, 2010; Shahbaz & Mafizur Rahman, 2014; Nyasha & Odhiambo, 2015). The Wald and the F-tests, which are measures of short-term (or weak) Granger causality are used to test for joint significance of the independent variables that explain the dependent variable (Enders, 2015).

To test the null hypotheses LNNCON does not Granger cause LNHPI and LNHPI does not Granger cause LNNCON, the following standard F-test restrictions (Enders, 2015; Koop, 2005) were used:

$$\alpha_{11} = \alpha_{12} = - - - - = \alpha_{1n} = \lambda_1 = 0 \text{ and } \beta_{21} = \beta_{22} = - - - = \beta_{2n} = \lambda_2 = 0$$

Similarly, the Granger causality test also allows the testing of whether lags of LNNCON and LNHPI Granger cause LNNCON and LNHPI, respectively (Koop, 2005). The study also carried out necessary tests such as unit root tests, lag order selection and cointegration tests before the data were used in the VECM estimations and the other related tests.

The validity and reliability of the study are assured by the pre-testing of the VAR and the post-testing of the VECM models estimated for autocorrelation and parameter stability. For the models to be deemed valid and reliable there should be no autocorrelation in the residuals of the model and the parameters of the models should be stable. Additionally, the VAR/VECM validity and reliability are also ensured by a high coefficient of determination, the Durbin-Watson statistic for autocorrelation, the ARCH test for heteroscedasticity and the CUSUM test for stability. If all these additional tests perform as hypothesised, then it can be reasonably assumed that the results are valid and reliable.

Possible criticisms

VAR models like the one we constructed are attractive, among other reasons, because of their limited size and detailed attention to dynamics. Whether the models are well suited for policy analysis has recently been questioned. Jacobs et al. (2003) note three criticisms: (i) VARs might be misspecified because of omission of crucial variables; (ii) the Lucas critique applies even more to reduced form VAR systems than to Simultaneous Equations Models (SEM); (iii) VARs trivialize macroeconomic policies and cannot be used to analyse alternative policies. Nevertheless, VAR systems can be informative, if used properly, on broad macroeconomic issues. VARs can be used to analyse short-run dynamics and the speed of adjustment towards equilibrium. Also, VARs indicate the sources of shocks. Variance decompositions give the percentage of the forecast variance due to shocks to each of the variables. Variance decompositions depend on the way the shocks are identified, and hence can change dramatically if another assumption is employed.

EMPIRICAL RESULTS

Unit Root Testing

The results from unit root testing of the underlying variables, which are based on the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, are presented in Table 3. The overall results support the previous empirical findings (e.g. Panagiotidis and Printzis, 2015; Sivitanides, 2015). Both the Augmented Dickey-Fuller (ADF) and the Phillips-Peron (PP) tests show that all the variables are integrated of order one, implying that all the variables need to be differenced once to become stationary. It should be noted that to use the VAR and VECM methodologies, the variables in the model all have to be stationary after first differencing. In other words, the variables should be integrated of order one or me(1).

TABLE 3. STATIONARITY TESTS

Variable	Model	ADF		Phillips-Perron Test (PP)		Decision
		Levels	First Difference	Levels	First Difference	
LNHPI	Constant	-0.18821	-13.994***	-0.17896	-14.027***	I(1)
	Trend	-1.92556	-13.988***	-1.97657	-14.022***	
	None	---	-12.560***	---	-12.924***	
LNNCON	Constant	---	-5.7017***	---	-9.7027***	I(1)
	Trend	-1.4889	-5.8439***	-1.4266	-9.8489***	
	None	---	-5.2020***	---	-9.2972***	
LNGDP	Constant	-2.07862	-3.6332***	-2.8113*	-9.7307***	I(1)
	Trend	-2.03125	-3.6062**	-2.86788	-9.8097***	
	None	---	-1.1066	-1.07247	-6.4596***	
LNCPI	Constant	---	-5.0569***	-0.12146	-8.5924***	I(1)
	Trend	-2.32693	-3.7430**	-1.79836	-8.2855***	
	None	---	-5.5638***	---	-3.7364*	
LNINT	Constant	-1.54997	-5.5290***	-1.48881	-10.538***	I(1)
	Trend	-2.23932	-5.5128***	-1.90746	-10.516***	
	None	-1.14412	-5.4680***	-1.09018	-10.491***	
LNMORT	Constant	-2.19416	-6.0861***	-3.59***	-10.647***	I(1)
	Trend	-2.42536	-6.0670***	-2.1885	-10.636***	
	None	---	-2.2999**	---	-9.5226***	
LNPOP	Constant	-1.3821	-3.4920***	-0.8413	-8.9668***	I(1)
	Trend	-0.6942	-3.7388**	-0.8038	-8.9909***	
	None	---	-0.4971	---	-2.4624**	

Values reported are the t-stats, and (***), (**), (*) indicate 1%, 5% and 10% level of significance, respectively.

Lag order selection

The estimation of the lag order, p, in a VAR (p) system, is based on lag order selection statistics. As it is unlikely that impulses of any of the series incorporated in the VAR will significantly affect the system after more than eight months, the maximum lag-order is restricted to eight.

TABLE 4. LAG ORDER SELECTION FOR VAR

Lag	LR	FPE	AIC	SC	HQ
0	NA	0.000128	-3.289938	-3.106944	-3.215693
1	1230.902	7.70e-08	-10.70344	-10.44725*	-10.59949
2	19.22873	7.17e-08	-10.77489	-10.44550	-10.64125*
3	11.63925*	6.99e-08*	-10.80067*	-10.39809	-10.63734
4	5.505663	7.08e-08	-10.78879	-10.31301	-10.59575
5	0.691903	7.38e-08	-10.74669	-10.19770	-10.52395
6	6.231349	7.43e-08	-10.74038	-10.11820	-10.48794
7	2.429374	7.67e-08	-10.70974	-10.01437	-10.42761
8	1.657301	7.95e-08	-10.67421	-9.905632	-10.36238

***Note**: * indicates the suggested lag order*

Table 4 indicates the LR, FPE, AIC, SC and HQ test statistics for all of the full VARs of order less than or equal to eight. The LR, FPE and AIC tests suggest a lag length of three while the SC and HQ tests suggest a lag length of one and two respectively. The VAR model that performed best in terms of the autocorrelation and stability tests is the one with a lag order of three. Therefore, the study uses a VAR (3) model.

Cointegration Results

Since there is a unit root in both endogenous series and they have the same order of integration, I(1), Johansen cointegration tests can be conducted. The results of the Johansen's cointegration tests are depicted in Table 5. The likelihood ratio trace test rejects the null hypothesis of no cointegration, i.e. r=0. Likewise, the maximum eigenvalue test also rejects the null hypothesis of no cointegration. In summary, both tests indicate that there is one cointegrating equation for the endogenous variables during the sample period. Therefore, the study constructs and estimates the vector error correction model (VECM), as alluded to previously.

TABLE 5. COINTEGRATION TESTING

$\mathbf{H_{null}}$	$\mathbf{H_{alternative}}$	Trace statistic	Critical values (5%)
$r = 0$	$r \geq 0$	18.71131	15.49471
$r \leq 1$	$r \geq 1$	0.520467	3.841466
H_{null}	$H_{alternative}$	Maximum eigenvalue statistic	Critical values (5%)
$r = 0$	$r \geq 0$	18.19084	14.26460
$r \leq 1$	$r \geq 1$	0.520467	3.841466

Note: *The reported results are for the tests with no deterministic trend and intercept. Similar outcomes were obtained when linear or restricted trends are included and when intercepts are allowed.*

Post Testing The Whole Model

Table 6 summarizes the results for an autocorrelation test of the disturbance terms for the entire model. The Lagrange Multiplier test fails to reject the null hypothesis of no autocorrelation of residuals. Table 7 shows the entire model's estimated stability results. The VECM specification used imposes one unit root, and the rest of the roots in the model have moduli that are less than one. The latter result implies that the model estimated is stable.

TABLE 6. LAGRANGE MULTIPLIER TEST FOR AUTOCORRELATION

Lags	**LM-Stat**	**Probability**
1	2.910803	0.5729
2	0.263446	0.9921
3	0.115492	0.9984
4	1.103596	0.8937

TABLE 7. ROOTS OF CHARACTERISTIC POLYNOMIAL

Root	Modulus
1.000000	1.000000
0.925714	0.925714
0.711253	0.711253
0.100964 - 0.442440i	0.453814
0.100964 + 0.442440i	0.453814
-0.253190 - 0.248864i	0.355018
-0.253190 + 0.248864i	0.355018
-0.281830	0.281830

The VECM specification imposes 1 unit root.

The estimated parameters of the modelling technique used are reported in the second and fourth columns of Table 8. Despite the possible weaknesses highlighted in section 3.2.2, reasonable and significant results are attained. The results show that a 1 percent increase in population growth in the 15-64 age cohort results in 0.60 percent higher house price index growth. This is assumed to be mainly caused by the critically constrained house supply. Thus, the market can adjust in the short run only by increasing house prices. The second most important house price driver is the change in house mortgage loans. A 1 percent increase in mortgage loans leads to an approximately 0.77 percent increase in the house price index. The latter occurs also because of the critical shortage of houses in Namibia, which means that the banks are giving mortgages mainly to finance existing houses. Such a situation results in astronomically high house prices, as witnessed in Namibia. Next a 1 percent rise in inflation results in a 0.23 percent increase in the house price index in Namibia. The other variables that significantly affect the house price index are the economic growth rate and the second lag of new construction investment. Both the economic growth rate and new construction activity positively influence the house price index as theoretically anticipated.

TABLE 8. VECM MODEL RESULTS

Variables	1. Dependent variable: ΔLNHPI		2. Dependent variable: ΔLNNCON	
	Coefficient	p-value	Coefficient	p-value
e_{t-1}	-0.132377	0.0001***	-0.180263	0.7460
Constant	-1.100478	0.0002***	0.809637	0.5132
$\Delta LNHPI_{t-1}$	0.049186	0.5173	1.740902	0.0067**
$\Delta LNHPI_{t-2}$	0.045181	0.5539	0.580631	0.3657
$\Delta LNHPI_{t-3}$	-0.028359	0.7110	0.541794	0.4000
$\Delta LNNCON_{t-1}$	-0.005258	0.5712	0.225731	0.0040***
$\Delta LNNCON_{t-2}$	-0.022403	0.0052***	0.163643	0.0387**
$\Delta LNNCON_{t-3}$	-0.002947	0.7527	0.091898	0.0844*
$\Delta LNGDP_{t-1}$	0.011055	0.0002***	0.033456	0.0643
$\Delta LNINF_{t-1}$	0.233206	0.0104**	0.107097	0.0045***

$\Delta LNMORT_{t-1}$	0.771784	0.0843*	0.043836	0.3111
$\Delta LNINT_{t-1}$	-0.001773	0.7245	-0.004199	0.92090
$\Delta LNPOP_{t-1}$	0.605034	0.0001***	0.381549	0.0002***
Diagnostic tests				
R-squared	76.88		58.65	
DW	1.9875		2.0001	
LM-test	0.511823 (0.7742)		0.416078 (0.8122)	
ARCH	0.478316 (0.4892)		0.064461(0.7996)	
CUSUM test	Stable**		Stable**	

Note: **, **, *** indicate 10%, 5%, and 1% significance level, respectively. The figures in parenthesis on the diagnostic tests are the probability values.*

Additionally, the error correction term has a negative coefficient that is significant at the 1 percent level of significance. The latter means that the house price index adjusts towards its long-run equilibrium at the rate of 13.24 percent in the following month, implying that it will reach its full equilibrium in approximately eight months. The construction index is significantly driven by the house price index, the population, the construction index and inflation. The results indicate that a 1 percent increase in the first lag of the house price index leads to a 1.74 percent increase in new construction investment. This means that the house price index of new construction investment is relatively more elastic. Next, the population elasticity of new construction investment is equal to 0.38, meaning that a 1 percent increase in the 15-64 population cohort leads to a 0.38 percent increase in new construction investment. The results also show that a 1 percent increase in inflation results in an 11 percent increase in new construction investment. Lastly, the first, second and third lags of new construction activity significantly explain the current new construction activity at the 1, 5, and 10 percent levels of significance, respectively. The results summarised in this section clearly indicate the factors that affect house prices and new construction activity in Namibia and those that are unimportant.

The diagnostic tests of the LNHPI and LNNCON models indicate that the coefficients of determination are 76.88 and 58.65 respectively, and this shows that the independent variables included in the models explain the greater portions of the variations in the variables. The Durbin-Watson (DW) statistic and the LM-test fail to reject the null hypothesis of no autocorrelation. In the same vein, the ARCH test also fails to reject the null hypothesis of no heteroskedasticity. Lastly, the CUSUM test suggests that the two models estimated are stable at the 5 percent level of significance. In summary, the performance of these diagnostic tests suggests that the results obtained are valid and reliable which ascertains the rigour of the analysis undertaken.

TABLE 9. GRANGER CAUSALITY USING THE WALD TEST

Independent variables	**Dependent variables**	
	ΔLNHPI	**ΔLNNCON**
ΔLNHPI (p-value)	$a_{11} = a_{12} = a_{13} = \lambda_1 = 0$ (0.0008)	$\alpha_{11} = \alpha_{12} = \alpha_{13} = \lambda_1 = 0$ (0.0001)
ΔLNNCON (p-value)	$b_{21} = b_{22} = b_{23} = \lambda_2 = 0$ (0.0359)	$\beta_{21} = \beta_{22} = \beta_{23} = \lambda_2 = 0$ (0.0000)

Table 9 summarizes the Granger causality results of the two endogenous variables in the VECM model estimates. First, the results show that the lags of the house price index Granger cause the house price index at the 1 percent level of significance. Second, lags of new construction activity Granger cause the house price index at the 1 percent level of significance. Third, lags of the house price index Granger cause new construction activity at the 5 percent level of significance. Lastly, lags of new construction activity Granger cause new construction activity at the 1 percent level of significance. As demonstrated, the results show that there is a bidirectional causality between the house price index and new construction activity in Namibia. These results are similar to those of Nikolic (2015). The Granger causality results are in support of the results in Table table 8 which showed that LNHPI and LNNCON are explained by lags of LNNCON and LNHPI, respectively.

Variance decomposition analysis of the housing market

Table 10 shows the variance decomposition results. Firstly, in the first month, 100 percent of the variation in the house price index is explained by shocks to the house price index. However, in the 10th month about 77 percent and 23 percent of the variation in house price index is explained by shocks to the house price index and new construction activity, respectively. Moreover, in the 60th month (long run), 50 percent of the variation in the house price index is explained by shocks to the house price index and another 50 percent is explained by shocks to new construction activity. Secondly, in the first month, about 7 percent of the variations in new construction activity is explained by shocks to the house price index and the other 93 percent is explained by new construction activity. Additionally, in the 60th month, about 36 percent of the variation in new construction activity is explained by shocks to the house price index and the other 64 percent is explained by shocks to new construction activity. In brief, these results appear to corroborate with Granger causality results which in turn corroborate the VECM results in Table 8.

TABLE 10. VARIANCE DECOMPOSITION RESULTS

Time	Variance decomposition of ΔLNHPI		Variance decomposition of ΔLNNCON	
	ΔLNHPI	ΔLNNCON	ΔLNHPI	ΔLNNCON
1	100.0000	0.000000	6.902714	93.09729
2	99.40808	0.591916	7.937336	92.06266
10	76.64445	23.35555	26.91562	73.08438
20	64.96852	35.03148	31.77926	68.22074
30	58.70593	41.29407	33.66546	66.33454
40	54.79933	45.20067	34.66710	65.33290
50	52.12971	47.87029	35.28822	64.71178
60	50.18987	49.81013	35.71106	64.28894

Note: *Cholesky Ordering: LNHPI LNNCON*

Evidence of over-valuation of houses

Figures 1 and 2 depict the predicted and actual development of the house price index and new construction activities, respectively. The figures show that the fitted values are a good prediction of the housing market up to 2008, which suggests appropriate model specification for the period before 2008. The only exceptions are the divergences that take place in the house price index after 2008, and new construction activity after 2009. The latter is caused presumably by the fact that new construction activity is lower than the housing mortgages in Namibia, as suggested earlier, indicating that the greater volume of the mortgages are financing already existing properties. Such a scenario leads to a house price bubble in the economy, and this appears to be what is happening in Namibia. The estimated prediction suggests that the house prices in Namibia are overvalued. However, from 2009 onwards, construction activity signifies an under-supply of houses in Namibia. These results appear to suggest that there should be genuine concerns about future over-valuation of houses in Namibia as more and more prospective buyers become middle and higher income earners, thus increasing the demand for houses. It should be noted that between 2002 and 2006 actual construction activity was greater than the predicted construction activity, which was good for the economy at the time since there was not much demand pressure on the housing market.

FIGURE 1. PREDICTED AND ACTUAL HOUSE PRICE DYNAMICS

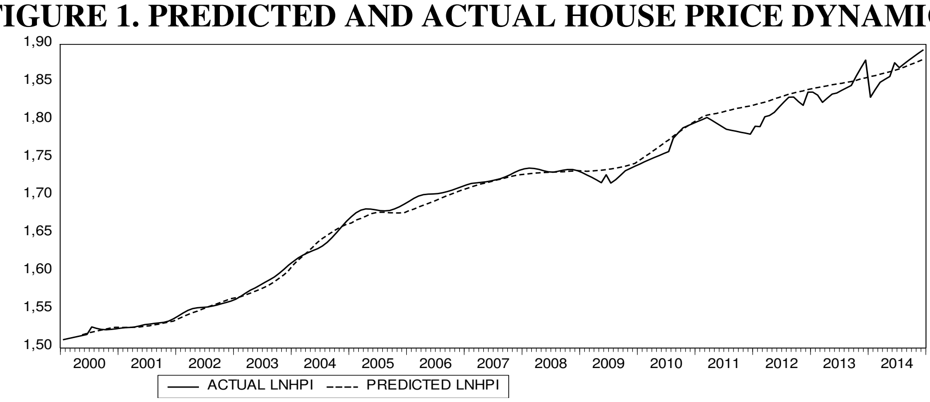
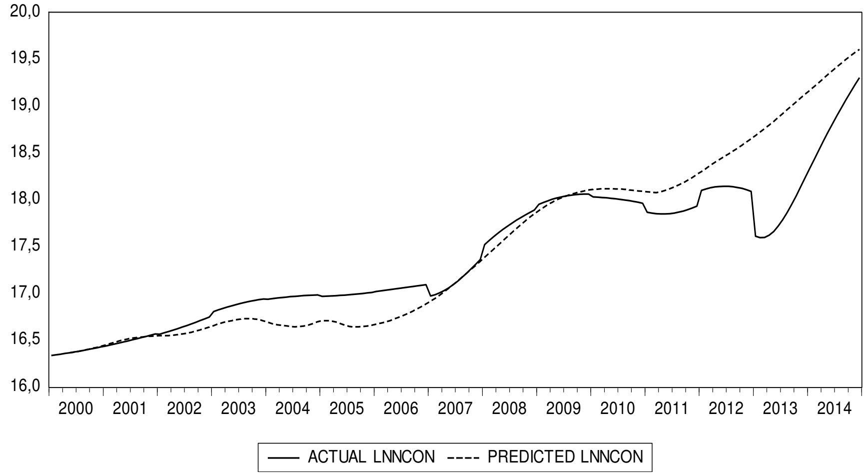


FIGURE 2. PREDICTED AND ACTUAL NEW CONSTRUCTION ACTIVITY



DISCUSSIONS AND CONCLUSIONS

This article contributes principally as an econometric study of the Namibian housing market based on 180 monthly observations. The results show that the house price index in Namibia has been proved to be more sensitive to changes in population, mortgage loans and inflation. Next, construction activity is shown to be more sensitive to the house price index, the previous values of itself and inflation. Although the economic growth rate significantly explains the house price index, it is not significant in explaining the new construction activity in Namibia. This finding is similar to that of Borowiecki (2009), but it is contrary to other studies (Hofman, 2004; Goodhart and Hofmann, 2008; Madsen, 2012; Renigier-Biłozor and Wiśniewski, 2012; Lai, 2016), which found a strong relationship between economic growth and house prices. The Granger causal analysis of the endogenous variables in the VECM shows that there is a bidirectional causality between the house price index and new construction activity. The latter result is bolstered by the variance decomposition analysis, which shows that shocks to both the house price index and construction activity explain the variations in both the house price index and new construction activity.

The study also attempted to establish whether there is evidence of overvaluation of house prices in the Namibian housing market by using the predicted and actual values of the house price index and construction activity. The fact that the value of new construction activity is lower than the value of housing mortgages in Namibia suggests that the greater proportion of the mortgages are financing already existing properties. Such a scenario leads to a house price bubble in the economy, and this appears to be what is happening in Namibia. The gap between the predicted and the actual house price index suggests that the house prices in Namibia are overvalued since the predicted housing price index is greater than the actual house price index. These findings confirm studies by Mosha (2011) and Napier (2011), which warned about the creation of a housing bubble in the Nambian housing market. The findings also suggest that from 2009 onwards, the construction activity signifies under-supply of houses in Namibia. These findings appear to suggest that there should be genuine concerns about the continued future of over-valued houses in Namibia as more and more prospective buyers become middle- and higher-income earners, thus further increasing the demand for houses (Rust, 2011). On the policy front, the government of Namibia, through the Bank of Namibia, should come up with rules which ensure that the majority of mortgages given by the banks are for constructing new houses and not for financing the purchase of existing properties. The latter is only possible if the government, through the local authorities, makes serviced stands available to the low- and middle-income earners in Namibia. Currently, the latter categories of income earners cannot afford the exorbitant house prices that are prevailing in the Namibian real estate market. When all is said and done, the gap between housing demand and supply in Namibia must be bridged through government policies and facilitation of new construction, or else the Namibian housing market will continue to experience exorbitant price increases. Further research is necessary for a better understanding of the determinants of house prices of the different kinds of properties and the differences in the regional house prices.

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