INTERNATIONAL MONETARY FUND

IMF Country Report No. 15/277

NAMIBIA

SELECTED ISSUES

October 2015

This Selected Issues paper on Namibia was prepared by a staff team of the International Monetary Fund. It is based on the information available at the time it was completed on September 1, 2015.

Copies of this report are available to the public from

International Monetary Fund • Publication Services
PO Box 92780 • Washington, D.C. 20090
Telephone: (202) 623-7430 • Fax: (202) 623-7201
E-mail: publications@imf.org Web: http://www.imf.org
Price: $18.00 per printed copy

International Monetary Fund
Washington, D.C.

INTERNATIONAL MONETARY FUND

NAMIBIA

SELECTED ISSUES

September 1, 2015

Approved By
African Department

Prepared By Daniela Marchettini

CONTENTS

NAMIBIA: MACRO-FINANCIAL RISKS ASSOCIATED WITH HOUSING BOOM

A. Introduction

1. Namibia has enjoyed stable and steady progress in financial sector developments, but vulnerabilities might have built up. In recent years, both the banking sector and nonbank financial institutions have grown fast, contributing to Namibia's robust growth rates and progress in poverty reduction. At present, Namibia's financial system is broadly stable, well capitalized, and profitable. At the same time, the rapid financial sector development might have been accompanied by a buildup of vulnerabilities—vigorous credit growth, rising assets prices, and strong financial sector interconnectedness.

2. Potential risks to financial stability could arise from the prolonged rapid growth in house prices, which raises concerns of a potential housing bubble. Despite some softening in recent months, real estate prices have risen significantly over the past years. Between 2009 and 2014 prices in the residential segment have increased by about 85 percent (Figure 1 upper left panel).[1] Cross-country evidence shows that increases of a similar magnitude may end up with a severe bust in the housing market, as experienced during the recent financial crisis (Figure 1 upper right panel). Potential risks to financial stability could arise from banks' high exposure to the real estate sector, particularly in the residential segment (Figure 1 lower left panel). This risk is heightened by high estimated household debt[2] (Figure 1 lower right panel).

3. In this light, this paper assesses whether these developments are conducive of build-up of systemic risk. Specifically it focuses on the risks stemming from the developments in the real estate markets and (i) assesses the over-evaluation in property prices, (ii) quantifies the potential impact of a housing bust on banks' solvency and (iii) assesses the possible feedback effects on the real economy.[3]

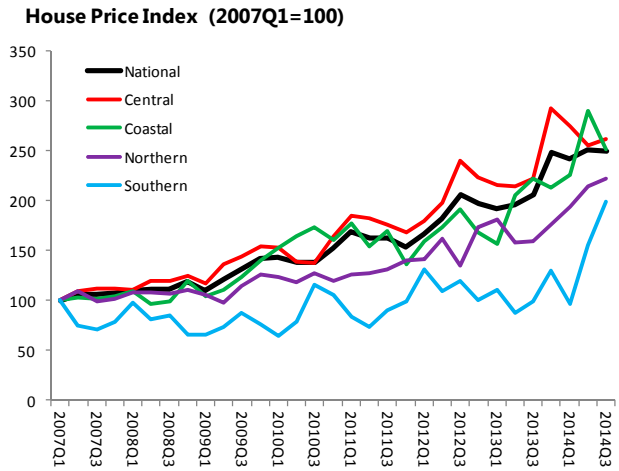
[1] The house price index, collected and estimated by a commercial bank (First National Bank - FNB), records residential price developments based on bonds registered for natural persons at the Deeds office. The index is computed as the weighted average of the median mortgage values in the four regions—central, coastal, northern, and southern—and is estimated on a monthly basis. This indicator captures only residential house prices and does not cover the commercial property segment. The lack of data on commercial real estate prices makes it difficult to assess the extent of price and volume increase in the commercial segment but anecdotal information suggests similar dynamics.

[2] Currently, no measure of household debt is available in Namibia. Due to lack of such measure, the Bank of Namibia uses a measure derived from total credit by formal financial institutions as a proxy of debt (Bank of Namibia, 2014).

[3] This study relies on various sources of information, including authorities' data, IMF's external and internal databases, and market information. Where information is not available or historical series are too short, the case of Namibia is benchmarked against the evidence of comparable countries. Choice of countries in figures, tables, and regressions is based on data availability and relevance. This SIP relies also on the findings of MCM TA missions on "Strengthening Financial Stability and Stress Testing Training" and "Establishing a Macroprudential Policy Framework", that took place in February and June 2015, respectively.

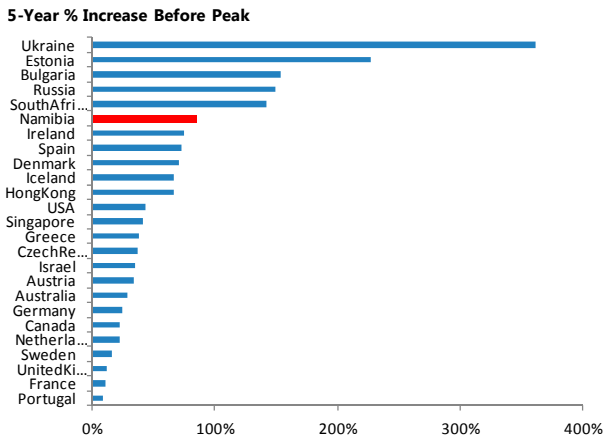
Figure 1. Namibia: Mortgage Loans, Household Debt, and Housing Market

Namibia's housing prices have been on an upward trend for a number of years, but with large difference among regions and property types.



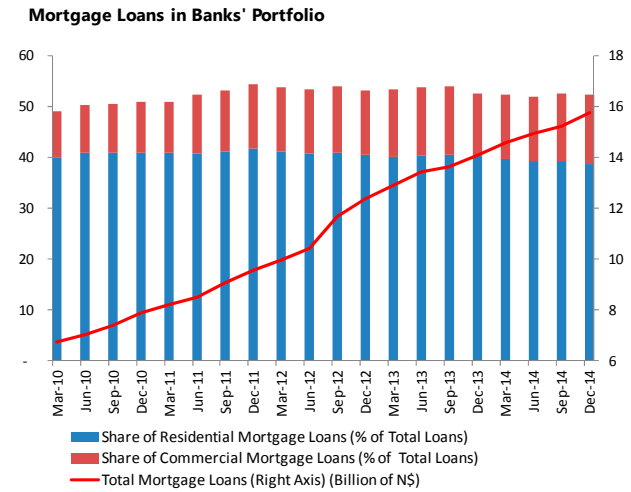
Source: FNB House Price Index.

Most countries that recorded a 5-year price increase similar to Namibia experienced a severe housing bust during the recent financial crisis.



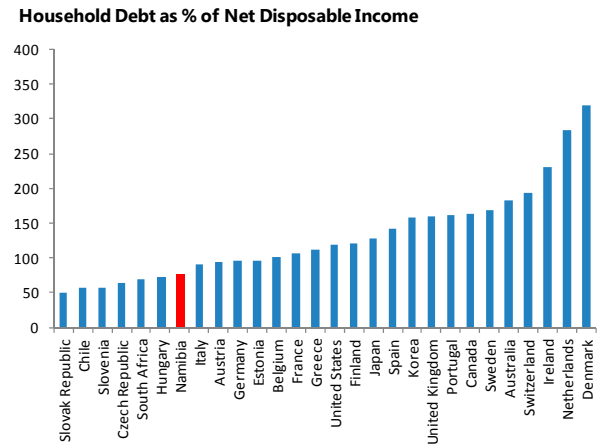
Source: IMF Internal Database (RES Real Estate Market Module).

Banks' lending is highly concentrated in mortgage loans. Residential mortgages remain dominant but commercial mortgages are on the rise.



Source: Bank of Namibia.

Household Debt is relatively high compared to other EMs but inferior to AEs' household debt



Source: OECD, Bank of Namibia, and South African Reserve Bank.

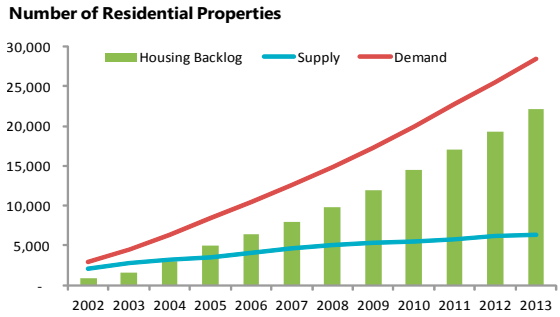
B. Assessment of House Prices in Namibia

4. The recent evolution of Namibia's house prices raises a question as to whether the prices reflect economic fundamentals. Though in recent months house price growth somewhat decelerated, prices remain high, raising concerns for a possible real estate bubble. This section explores factors contributing to rising house prices and assesses the extent of over-valuation

following two analytical approaches: *i*) an indicator-based analysis using common housing ratios (e.g., price-to-income, price-to-rent ratios), and *ii*) a model-based analysis using time-series data.

5. Multiple factors—fundamental, cyclical, and speculative—have contributed to soaring house prices. Specifically these factors include: (*i*) urbanization and migration of population from rural areas to major cities; (*ii*) increase in disposable income; (*iii*) acute shortage of supply[4] (Text Figure 1) mainly due to the slow provision of serviced land by local authorities; (*iv*) low interest rates that have lowered the cost of housing finance; (*v*) generalized fiscal expansion and government incentive programs for home loans; and (*vi*) home purchases for investment purposes, including some cash buying by foreigners.[5]

Text Figure 1: Housing Demand and Supply in Windhoek



Source: Bank of Namibia, Namibia Statistics Agency, IMF's Calculations

Note: Housing demand and supply in Windhoek are estimated based on population growth projections and completed residential building plans, respectively. Housing backlog is assumed null in 2001.

6. Also credit expansion has likely contributed to pushing house prices above fundamentals, but other factors have also played a role. In terms of GDP, Namibia's mortgage market is one of the largest in the African continent (Figure 2 Upper Left Panel). This may seem to suggest that the housing bubble has been fuelled by a parallel credit boom. However, a further analysis on the mortgage market shows that the high value of overall outstanding loans is driven mainly by the elevated unit cost of housing in Namibia rather than widespread access to mortgage credit (Figure 2 Upper Right Panel).[6] The analysis of the credit-to-GDP gap seems to confirm this assessment, as the credit-to-GDP ratio has been below its historical trend over the past few years (see Figure 2 Bottom Panel). This, however, may reflect the very rapid credit growth following independence that likely has biased upward the long-term trend.[7]

[4] Housing backlog (excess demand) was estimated at about 100,000 dwelling in 2013 (R. Brown, 2013).

[5] The role of cash buyers, mainly foreigners, seems to have declined over the past years due to a combination of regulatory and economic factors. For example, the previously strong cash purchases from Angola seem to have weakened against the backdrop of declining oil prices, the de-dollarization of the Angolan economy and switch to the non-convertible Angolan kwanza, and stronger AML enforcement, all of which make cash purchases more difficult.

[6] Banks' internal guidelines suggest conservative lending standards. According to market participants almost exclusively the middle- and high-income segments of population can access mortgage credit from a formal financial institution. Individuals belonging to these income segments could however be high indebted as they supposedly frequently borrow for a second, third, fourth, or fifth house for investment purposes.

[7] As argued by a number of studies (Geršl and Seidler, 2012; IMF, 2014), the credit-to-GDP gap can give misleading signals in the case of structural changes, such as rapid credit growth in low income countries and emerging markets due to financial deepening. The signaling power of the credit-to-GDP gap would not be compromised only if financial deepening occurs at a steady pace, as this would be embedded in the long-term trend and would not impact on the gap (Drehmann and Tsatsaronis, 2014).

7. Owing to a lack of long historical series for the house price index, the assessment based on common housing ratios has been performed benchmarking the case of Namibia against the evidence of other countries. Compared with other countries, Namibia's housing ratios suggest an average overvaluation of about 20 percent at peak (Box 1), although results should be interpreted with caution. Housing indicators can be misleading as other factors can influence them. In the case of Namibia the ongoing process of urbanization could for instance justify higher ratios compared to advanced economies and other emerging markets.

8. Model-based estimates also confirm an over-evaluation of about 20 percent at peak. Econometric analysis permits to test for asset bubbles by computing the gap between the real house prices and the fitted values derived from fundamentals. In the case of Namibia, econometric estimates suggest a price-misalignment of the same magnitude of indicator-based estimates (Box 2). Also regression results should be taken with caution as subject to substantial uncertainties. Estimates are derived from a very short time series that captures only the upswing of the housing cycle, likely biasing upward the real long-term relation between house prices and fundamentals. In addition, estimated fitted values are derived exclusively from demand side factors, given lack of a well-suited variable to proxy supply shortage at the national level.

9. In terms of overvaluation, there are significant differences among segments. The pattern of price movements in the residential market has not been uniform among regions and property values. The overvaluation is expected to be especially acute in the lower and middle segments of the residential property market and in urban areas, because the housing backlog is mainly concentrated in this segment, where consequently prices and rents continue to trend upward. This in turn has attracted speculative investments driven by the possibility of high returns and large capital gains.[8] The provision of affordable housing is also hampered by poor access and non-affordability of land, especially in the urban areas.[9] The government is trying to address this challenge with different housing programs for low and middle income households, including the Mass Housing Development Initiative launched in 2013.[10] This should help addressing the supply constraint in the lower segments.

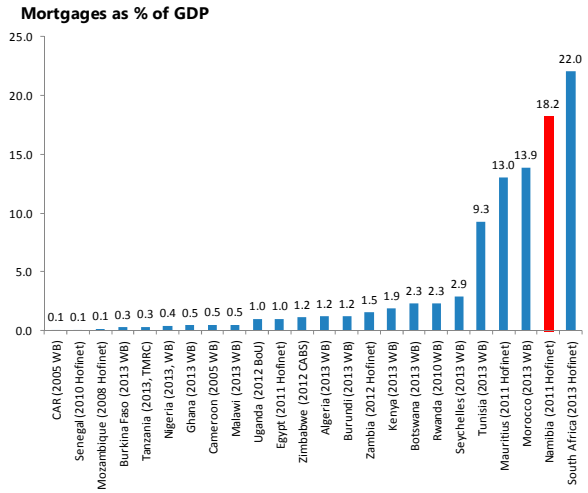
[8] Anecdotal evidence suggests that capital gains in the low- and middle-value segments (below NAD 1.5 million) can reach up to 25 percent in one year.

[9] Competition for land delivery in low/middle-range areas is increasing as proved by the recent auction of 49 plots in the area of Academia (Windhoek). The plots with an average municipal value of N$200 000 were sold for over N$1 million each.

[10] The Mass Housing Scheme is aimed to construct 185 000 units by 2030. On average, 10 278 houses are expected to be constructed on a yearly basis (National Housing Enterprise, 2013). The implementation of the program, however, has been delayed.

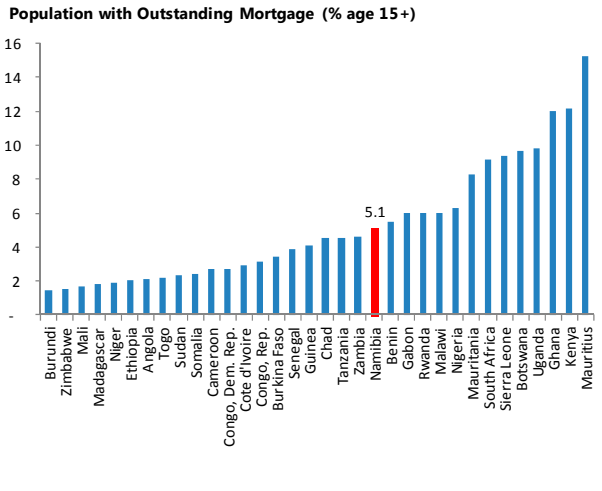
Figure 2. Namibia: Size of the Mortgage Market in Namibia and Credit Developments

Despite the large size of Namibia's mortgage market…



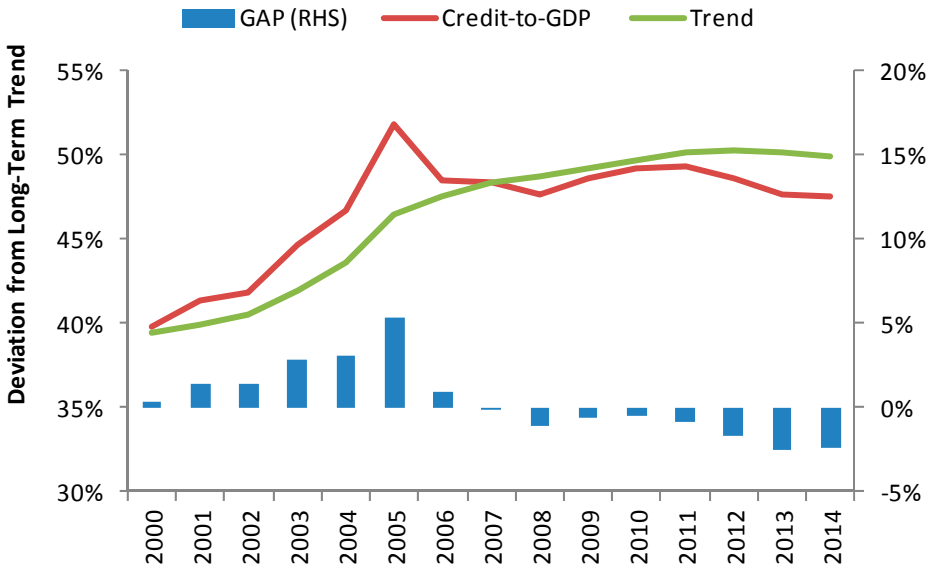
Source: Center for Affordable Housing Finance in Africa, 2013.

Access to mortgage finance is rather limited in Namibia



Source: Findex, 2014.

Over the past few years the credit-to-GDP ratio has been below its historical trend, but this could reflect very fast growth in the first years after independence



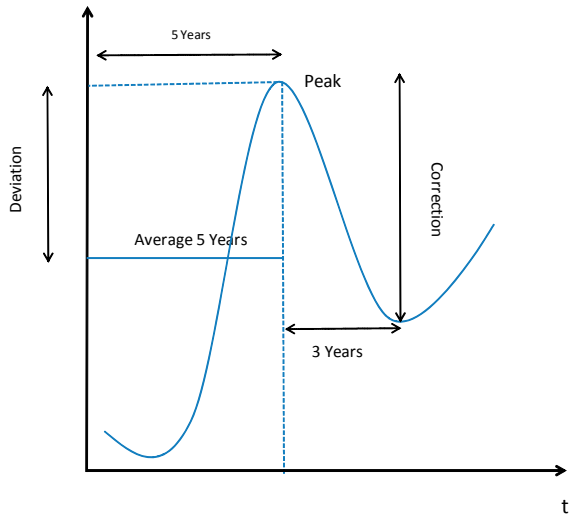
Source: IMF International Financial Statistics, Author's Calculation

Note: The estimates of the long-term trend are obtained by using a one-sided (backward-looking) HP filter on annual data starting in 1995. The smoothing parameter λ is set equal to 1600.

Box 1. Estimation of Namibia's House Price Misalignment Based on Common Housing Ratios

The analysis uses two indicators:[1] the price-to-GDP-per-capita ratio,[2] as a measure of house affordability, and the price-to-rent ratio, as a basic indicator of return on housing. The difference between current values of these ratios and their long-term averages is commonly used as a *prima facie* assessment of the extent of overvaluation of the housing market. Namibia's house price index, however, is only available from 2007, and the lack of a long data series impedes contrasting indicators against their long-term trend. The house price misalignment has thus been estimated by benchmarking Namibia's case against the evidence of other countries.

Box Figure 1: Indicator Deviation from 5-year Average and Subsequent Correction



The analysis has been conducted in three steps. First, for each country it has been identified the peak of the price-to-GDP-per-capita and of the price-to-rent ratios over the period 2000Q1-2014Q3, and it has been computed the percentage deviation of the peak from the average of the previous 5 years. Second, for each country it has been identified the drop in the two indicators three years after the peak (Box Figure 1). Finally, it has been estimated a linear model that relates indicators' deviation at peak and the size of the correction after bust (Box Figure 2 bottom panels).

Based on the cross-country linear regressions described above, it is possible to derive an estimate of the correction to which Namibia would be exposed in case of a bust.[3]

- The price-to-GDP per capita shows that at the peak of the housing cycle countries in the sample recorded an average deviation of 11.6 percent from the average of the previous 5 years (Box Figure 2, Upper Left Panel). Countries that experienced boom/bust episodes in the housing market recorded however higher misalignments. Namibia shows an exceptional deviation of 38 percent in 2014:Q2, when the house price index peaked. Based on this indicator, the expected correction for Namibia would be 18 percent.
- The average deviation recorded by the price-to-rent at peak ratio was 12.6 percent in the sample (Box Figure 2, Upper Right Panel). Countries that underwent a sever bust in the housing market recorded higher deviations. Also in this case Namibia stands out, recording a 45 percent misalignment in 2014:Q2. Based on this indicator, Namibia would record a correction of 17 percent from peak.

1/ Samples for the two indicators are different depending on data availability.

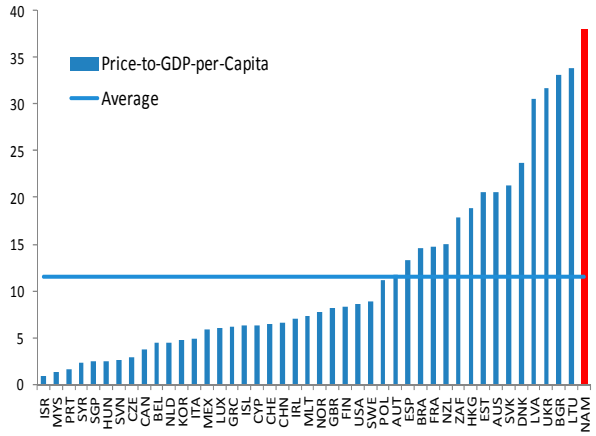
2/ Traditionally the analysis is conducted using the price-to-income ratio. As in Namibia a measure of income is not available, the analysis has been performed using price-to-GDP-per-capita ratios.

3/ Assuming that GDP-per-capita and rent (denominators) remain stable in the three years after the crisis, the correction of the indicator corresponds to a correction of house prices (numerator).

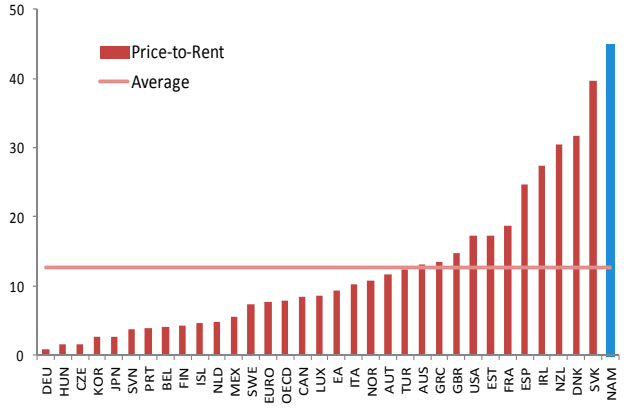
Box 1. Estimation of Namibia's House Price Misalignment Based on Common Housing Ratios (concluded)

Box Figure 2: Cross-Country Comparison of Indicators' Deviations and Corrections

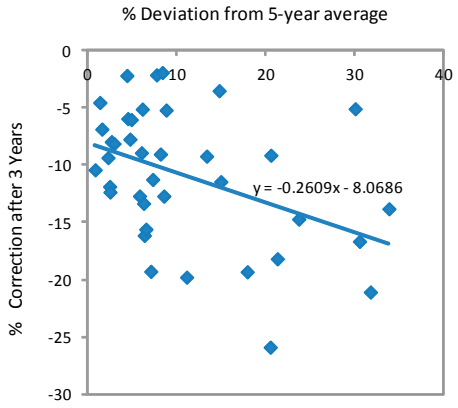
Deviation of the Price-to-GDP-per-capita ratio at peak from 5-year average is 38 percent in Namibia



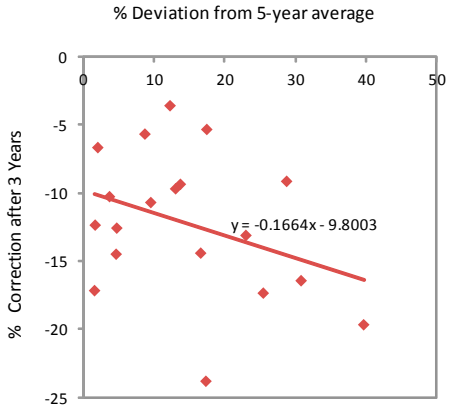
Deviation of the Price-to-rent ratio at peak from 5-year average is 45 percent in Namibia



scatter-plot of % deviation of the Price-to-GDP-per-capita ratio at peak and subsequent % correction.



scatter-plot of % deviation of the Price-to-rent ratio at peak and subsequent % correction.



Source: Bank of Namibia, Namibia Statistical Agency, OECD and IMF Internal Database (RES Real Estate Market Module).

Box 2. Estimation of Namibia's House Price Misalignment Based on Econometric Analysis

Using quarterly house price data, three econometric models are explored to estimate the deviations from the "fundamental" housing price, as determined by demand factors (GDP per capita, urbanization, credit).[1] The analysis, based on a sub-sample of available data (2007:Q1-2013:Q3), estimates the relation between real house prices and these variables. Using these estimated coefficients, the presence of price misalignment has then been assessed by computing the gap between observed and predicted prices in the period 2013:Q4-2014:Q3 (out-of-sample).

- Model 1 is a simple OLS regression of real house prices (LOG_R_HP) against real GDP per capita (LOG_R_GDP_CA) and urban population growth (URB_POP_GR). Variables are in logarithms with the exception of urban population growth. Parameters are significant and enter with the expected sign; however, correlation among variables could be induced by the presence of a deterministic or stochastic trend (spurious regression). Integration tests prove indeed that variables are I(1). The Johansen trace and maximum eigenvalue tests confirm the existence of one cointegrated linear combination of the three variables. This could be interpreted as the existence of a long-term relation among variables.[2]
- Model 2 uses the Johansen method to estimate this relation within a VECM (with two lags) framework. Also in this case parameters are significant and enter with the expected sign.
- Finally, Model 3 estimates an OLS regression of real house prices against real mortgage credit extension (LOG_R_MORT), real GDP per capita (LOG_R_GDP_CA), and urban population growth (UBR_POP_GR). The coefficient of real mortgage credit extension is strongly significant and positive, while other parameters are not significant suggesting the possibility of twin booms: a real estate bubble fueled by a credit boom. Credit alone, however, is not sufficient to explain the overall price level as highlighted by the fact that predicted values are lower than actual values.[3] Additional factors, thus, contribute to very high house prices.

All models confirm the presence of a positive price misalignment (i.e. over-evaluation), though, it is correcting over time. This empirical analysis, however, has limitations owing to the absence of a long data series for Namibia's house price index. These results should thus be interpreted with caution.

Box Table 2.1. Namibia: House Price Valuation Based on Alternative Econometric Models

Model 1: OLS Levels without Mortgage Credit								
Dep.Var.					Over-evaluation			
LOG_R_HP		LOG_ R_GDP_CA	URB_POP_GR		2013Q4	2014Q1	2014Q2	2014Q3
		1.2***	0.48***		17.7%	12.7%	15.2%	3.7%
		(0.06)	(0.14)					
		[18.94]	[3.33]					
Model 2: VECM with two Lags								
Dep.Var.					Over-evaluation			
D(LOG_R_HP)	LOG_R_HP	LOG_ R_GDP_CA	URB_POP_GR	EC Term	2013Q4	2014Q1	2014Q2	2014Q3
	1	-1.27***	-0.32***	-0.75**	19.8%	16.2%	19.1%	6.9%
		(-0.03)	(-0.07)	(-0.37)				
		[-41.6]	[-4.65]	[-2.06]				
Model 3: OLS Levels with Mortgage Credit								
Dep.Var.					Over-evaluation			
LOG_R_HP	LOG_R_MORT	LOG_ R_GDP_CA	URB_POP_GR		2013Q4	2014Q1	2014Q2	2014Q3
	0.77***	Not Significant	Not Significant		19.9%	13.8%	14.0%	9.2%
	(0.01)							
	[1378.84.6]							

1/ The "fundamental" price should be derived from a model that considers both demand and supply factors. In the case of Namibia, however, a measure to proxy supply (land availability, cost of land, etc.) is not readily available. The mission tried to use the "number of completed building in Windhoek" as proxy of supply within a VECM model; the estimated coefficient however was non-significant, likely reflecting the fact that this indicator is ill-suited to proxy supply shortage at the national level.
2/ Given the short available time series, the interpretation of the cointegration equation as a long-term relation must be taken cautiously.
3/ It must be noted that we have found no evidence of within-sample Granger-causality between nominal house prices growth and nominal credit growth.

C. Potential Impact of Shocks to the Banking Sector and the Economy

10. The discussion in the previous section suggests that banks are exposed to the risk of a potential house price correction. There are ample international experiences in which house price swings are associated with financial instability. Reinhart and Rogoff (2009) show that the six major historical episodes of banking crises in advanced economies since the mid-1970s were all associated with a housing bust. This pattern can also be found in many emerging market crises, such as the Asian financial crisis of 1997-98 and the crisis of the Central and Eastern European and the Baltic countries in 2008-09. Crowe et al. (2013) show that of the 46 systemic banking crises for which house price data are available more than two-thirds were preceded by boom–bust patterns in house prices. By contrast, only about half the crises followed a boom–bust in stock prices.

11. It is important to note, however, that not all housing busts end in a financial crisis. There are examples of severe housing busts that left the financial sector largely unscathed (e.g., Hong Kong SAR in the 1990s). The degree to which house prices boom/bust have led to widespread financial stress differs between countries. Empirical evidence suggests that the different impact depends on a number of factors, including (i) the presence of twin booms credit/housing (Crowe et. Al, 2013), (ii) the level of households' leverage (Crowe *et. al*, 2013), (iii) the extent of banks' exposure to real estate (Gan, 2007; Allen *et al.*, 2009), (iv) the presence of government incentive schemes (IMF, 2011), and (v) the size of liquidity and solvency buffers at the time of the bust.

12. "Twin booms" in real estate and credit markets amplify adverse consequences. A distinguishing feature of "bad" real estate boom–bust episodes appears to be the coincidence between housing boom and rapid credit expansion. Twin booms lead to the increase in leverage and real estate exposure of households, developers, and financial intermediaries (Borio and Lowe, 2002; Davis and Zhu, 2011; Crowe *et. al*, 2013). In the most recent episode, all the countries with "twin booms" in real estate and credit markets ended up suffering from a financial crisis and most also a severe drop in GDP (Crowe *et al.*, 2013). In contrast, of the seven countries that experienced a real estate boom, but not a credit boom, only two (29 percent) went through a systemic crisis and these countries, on average, had relatively mild recessions (Table 1).

Table 1. Boom, Crises, and Financial Performance

Boom	Followed by a financial crisis (%)	Followed by poor performance (%)	Followed by financial crisis or poor performance (%)	Followed by financial crisis and poor performance (%)	Number of countries
Real Estate	53	77	87	43	30
Credit	67	78	93	52	27
Real Estate but not credit	29	71	71	29	7
Real Estate and Credit	100	75	100	75	4
No Real Estate or Credit	61	78	91	48	23

Source: Crowe *et al.*, 2013.

13. A sharp reversal of the current house price trend could impact on Namibia's financial sector and economy through a number of channels. In particular, banks' balance sheets and economic activity would be affected through:

i. Credit risk. The impact of a large decline in house prices on household capacity to repay would be direct when households have borrowed to buy a property for investment purposes (especially in case of overstretched balance sheets), as rental income is included (with a haircut) in gross income in the Debt Service to Income (DSTI) ratios used by banks in the mortgage extension procedure. Indirectly, household capacity to repay would be impacted if the widespread decline in housing prices is associated with the contraction of the construction sector (among the major contributors to domestic employment), and thus with a general economic slowdown and higher unemployment.

ii. Under-provisioning and low recovery rates. The devaluation of properties would require banks to increase specific provisions for mortgage NPLs. In addition, with declining property prices and overvalued appraisal,[11] collateral may not adequately support the mortgage transaction, and for non-recourse mortgages,[12] the recovery rate would be less than 100 percent.

iii. Higher banks' funding costs. Deterioration in asset quality and lower profitability connected to the housing bust could impact on banks' funding cost and availability.

iv. Banks' deleveraging. When facing losses, banks are expected to reduce lending to the economy due to rising difficulties to attract funds and the need to improve capital ratios, creating negative feedback loops between the real economic activity and weak bank and household balance sheets.

v. Households' deleveraging. Reduced economic activity and credit tightening are likely to create a need for deleveraging that, in turn, would depress consumer spending.

[11] In the absence of legal standards for and regulation of home appraisals, home valuations might be inflated, particularly for banks' best clients, and, LTV ratios understated. This adds to procyclicality if prices were to decline because collateral for NPLs is marked-to-market, while collateral for performing loans is mainly book-valued.

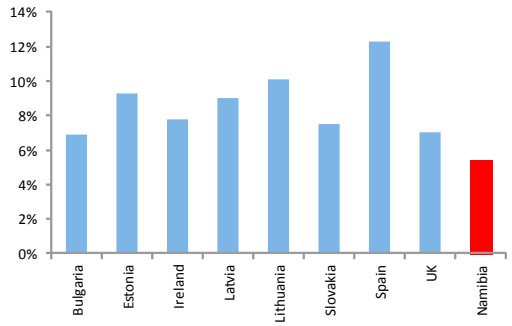
[12] While the typical residential mortgage product offered by commercial banks is a full recourse mortgage loan, for properties registered in Closed Corporations (CC) (with the physical persons forming the group having limited liability), banks will only have recourse to the assets of the CC, unless they have specifically requested personal surety. Such properties therefore heighten banks' exposure to adverse real estate market developments—an important concern given that, according to market participants, CCs constitute a large share of the high-end residential real estate market.

14. In Namibia, limited data availability complicates systemic risk assessment[13] but cross-country comparison suggests that a number of risk amplifying factors are at play.

- Rapid credit growth and large concentration of banks' loan books in the mortgage sector (52 percent of total loans at end-2014, Figure 1) represent major sources of concern. This mimics the situation of countries that experienced systemic crises following a bust. For instance, in Thailand, in the period 1994-1996, credit to construction and real estate increased by an average of 35 percent a year and in mid-1997 the financial sector reached an exposure to these sectors of more than 30 percent of total loans (Hilbers et al., 2001). Analogously, in the U.S., commercial banks' exposure to real estate grew rapidly in the 2000s, reaching 54 percent in 2007 (Igan and Pinheiro, 2010). In Central and Eastern Europe (CEE), mortgage lending expanded on average by almost 60% per year between 2000 and 2006, despite a relatively low share in total credit (Égert and Mihaljek, 2007).

- In addition, in line with countries that experienced a severe housing bust during the recent financial crisis, in Namibia the boom in the housing market has been accompanied by the rapid expansion of the construction sector, which between 2009 and 2014 grew 100 percent in real value terms, being a major driver of economic growth. The share of the construction sector in GDP (5.4 percent in 2014) remains however lower than in countries that experienced a triple-boom—in the housing market, construction sector and credit—and underwent a severe financial crisis and sharp contraction in economic activity during the recent financial crisis (Sun et. al., 2013) (Text Figure 2).

Text Figure 2: Share of the Construction Sector in GDP



Source: Haver Analytics

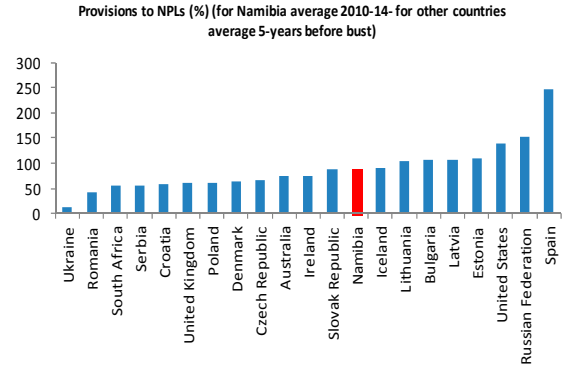
Note: Value for Namibia refers to 2014, values for other countries refer to 2007.

- Finally, the capacity of Namibian banks to withstand a crisis could be challenged by a number of factors. In particular, high maturity transformation and over-evaluation of real-estate collateral are sources of concern in the event of a crisis. Banks have large holdings of illiquid assets that could not be disposed during a crisis period. Liquid assets are a very small portion of short-term liabilities (Figure 3 top panels). This situation is aggravated by the fact that banks rely extensively on wholesale deposits. In addition, while the coverage ratio of NPLs, measured as total provisions to nonperforming loans, was close to 100 percent in the period 2010–14, specific provisions are much lower than general provisions given the deductibility of highly valued collateral (see details in paragraph 20).

[13] In Namibia the historical series of core indicators to assess systemic risk stemming from a housing bubble, namely residential mortgage loans and house prices, are very short and don't allow the computation of a long-term trend. Additional indicators that could help quantify risks (income, household indebtedness, house affordability, exposure of non-bank financial institutions to real estate, commercial real estate prices, etc.) are not available at all. (IMF, 2014)

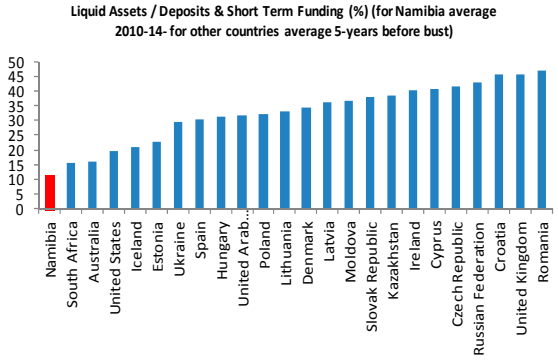
Figure 3. Namibia: Factors that Might Amplify or Mitigate the Impact of a Housing Bust

While the coverage ratio is close to 100 percent, this masks low specific provisions (on average 25% of NPLs)



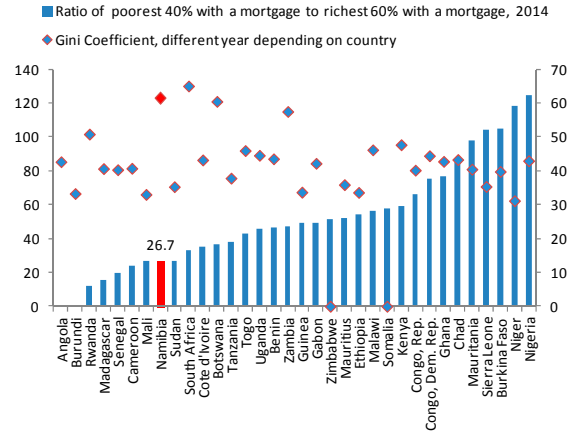
Source: Bankscope - Bureau Van Dijk (from Finstats Database).

Maturity transformation is extremely high in Namibia's banking sector



Source: Bankscope - Bureau Van Dijk (from Finstats Database).

Access of the poor to mortgage finance is very low in Namibia, both in absolute terms .....

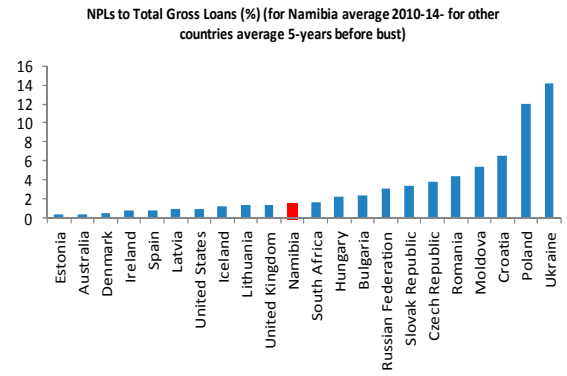


Source: Findex and WDIs.

...and in international comparison

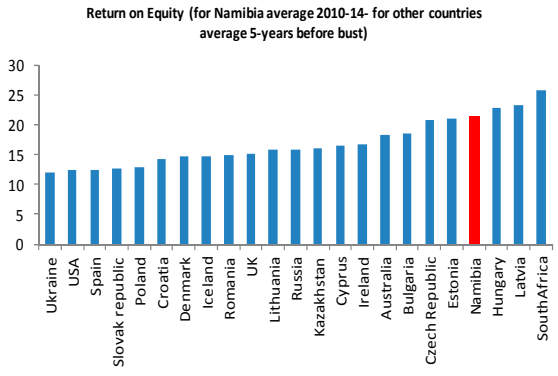
Source: Findex.

Asset quality compares well with countries that underwent financial stress due to a housing bust...



Source: IMF Global Financial Stability Report Database.

.. and profitability is very high



Source: IMF Global Financial Stability Report Database.

15. In Namibia, risks are mitigated by the strong capital base, limited exposure to foreign exchange risk, evidence of strict lending standards, and banks' strong asset quality and elevated profitability. Differently from a number of countries where the exposure to the real estate market was aggravated by the high share of loans in foreign currency (CEE, some East-Asian countries), in Namibia borrowers are not exposed to currency risk as mortgage loans are denominated in local currency. Also, despite the fact that precise estimates of household indebtedness by income group are absent, there is anecdotal evidence of strict lending standards, with very limited access to mortgage financing for low income households. This evidence is supported by the recent Findex survey according which the share of poorest population (lowest 40 percent of income distribution) with an outstanding mortgage is only one-fourth of the share of the richest population (highest 60 percent of the income distribution) with a mortgage. This is very low by both African and international standards (Figure 3 central panels). In addition, Namibia compares well to countries that experienced a boom/bust episode in the housing market in terms of asset quality and profitability (Figure 3 bottom panels).

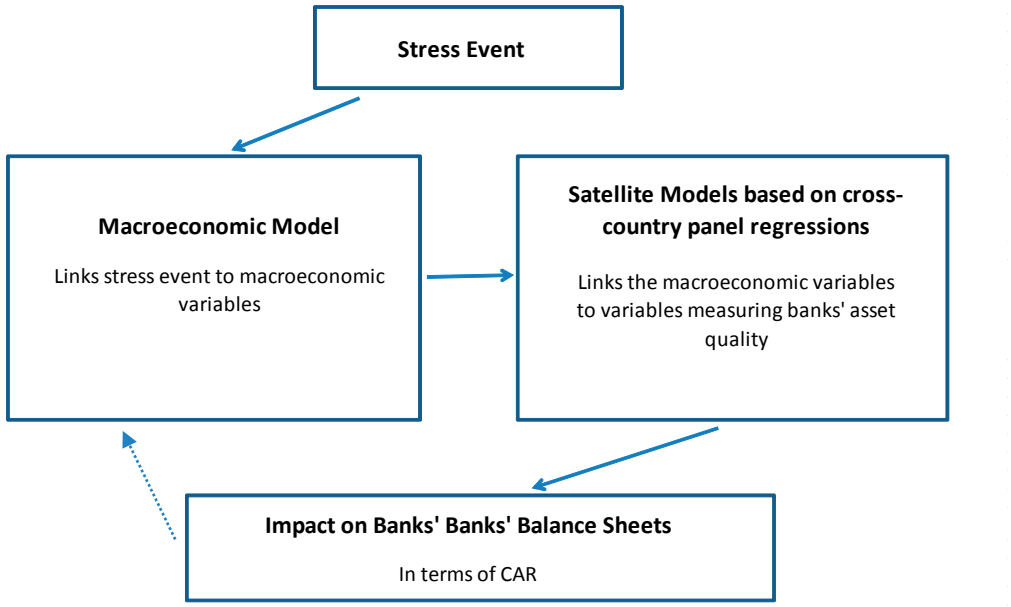
16. In addition to making risk assessment more difficult, data limitations represent a major obstacle for precise stress-testing for the banking sector. Banks are not required to report probabilities of default (PDs) and loss given default (LGD) in Namibia.[14] Projections of losses based on past mortgage delinquency patterns would not help because Namibia never experienced a crisis and projections would not capture the non-linearities that are typical of period of intense stress, likely leading to an under-forecasting of delinquencies.[15] In addition, estimates of household indebtedness along the income distribution are not available, thus preventing from assessing the impact of different shocks on the ability of different household groups to service debt.

17. In absence of relevant historical information on the potential impact of severe stress on Namibia's bank balance sheets, the approach for stress testing used in this note will be based on cross-country evidence. Figure 4 illustrates the stress-testing framework adopted in this note which includes: i) a macroeconomic model, mapping shocks into macroeconomic variables, and ii) a "satellite" model, mapping macroeconomic variables into financial sector measures of asset quality (overall NPLs). For this exercise the macroeconomic and satellite models are estimated using cross-country evidence rather than Namibia's historical data. The countries included in the regressions experienced, with different severity, boom/bust episodes in housing market during the recent financial crisis (Box 3). This allows to capture the non-linearities connected to a bust that could not be observed calibrating the models with Namibia's historical data.

[14] BON did an attempt to estimate PDs and LGDs based on historical NPLs and sectoral analysis, respectively, within a (modified version) of the CR+ framework (See BON, 2014). Calibration however didn't provide results that could be considered useful for stress testing purposes. In particular, LGDs derived from sectoral analysis were extremely low, ranging from 0.09 percent in fishing and mining to 1.24 percent in manufacturing.

[15] The linear approximation may be reasonable when shocks are small, but non-linearities are likely to be important for large shocks: doubling the size of the shock may more than double its impact. Indeed, micro-level credit risk models often find a non-linear relationship between the scale of shocks and the likelihood of default; for macroeconomic shocks.

Figure 4. Namibia's Macro Stress-Testing Framework



18. The four stress scenarios analyzed in this note are increasingly adverse and are based on the most plausible shocks that could trigger a decline in Namibia's house prices. These include: *i*) a decline in commodity prices, *ii*) an increase in interest rates, and iii) a generalized recession (Table 5 provides a detailed description of the scenarios.).

- The decline in commodity prices (Scenarios 1–3) would impact on house prices through two channels: *i*) it would reduce purchases from Angola[16], and *ii*) it would decrease deposits of mining companies in commercial banks thus reducing funding for housing finance.
  - Scenario 1 assumes only a decline in oil prices and a consequent reduction in purchases from Angolans. The corresponding decline in house prices in this scenario is assumed to be in the lower bound of the estimated overvaluation range (5 percent).
  - Scenario 2 and 3, instead, assume a generalized decline in commodity prices that impacts on Namibia's mining sector.[17] In these scenarios both the transmission channels are operating and the decline in house prices is expected to be slightly higher (10 and 15 percent respectively).

[16] See footnote 5.

[17] The decline in mining sector activity is based on the highest historical shock recorded in the sector (see Box 3).

- The increase in interest rates would impact house prices though the reduced borrowers' ability to repay their loans that, combined with the previous shocks, would lead to a sharper reduction in credit growth (Scenarios 3 and 4). The consequent decline in house prices is assumed at 15 percent (Scenario 3).

- Finally, a generalized decline in economic activity, combined with an increase in interest rate, is assumed to put the highest downward pressures on the housing market and prices would decline by 20 percent (Scenario 4).

19. The shocks are mapped into macroeconomic variables based on a macroeconomic model, and cross-country and Namibia's historical evidence.

- In scenarios 1–3 the assumed decline in house prices is mapped into reduced economic activity in the construction and real estate sector through the elasticity estimated in the macroeconomic model (equation 3.1). The overall impact on GDP growth is then computed considering the contribution of the shocked sectors–mining (exogenous) and construction and real estate (endogenous) – to GDP. In scenario 4 the decline in economic activity is not model-based but reproduces the average GDP contraction experienced by countries that experienced a triple boom (credit/housing/construction) during the recent financial crisis (see sample in Box Table 3.1.).

- Credit growth is an exogenous variable based on cross-country evidence (See Box Table 3.3) until the capital of a bank doesn't fall under the minimum CAR. When losses bring capital below minimum, banks are assumed to deleverage in a measure sufficient to bring capital (together with profits) back to the 10 percent threshold. This mechanism allows considering feedback loops from the banking sector to the economy (through equation 3.1) in the most adverse scenarios (3 and 4) after the second year (dotted arrow in Figure 4).

- Adverse scenarios are contrasted against a baseline scenario that assumes macroeconomic developments in line with the 2015 Article IV macroeconomic projections.

Box 3 provides a detailed description of how macroeconomic forecasts are derived in the baseline and adverse scenarios.

20. The solvency stress test considers the impact of the materialization of credit and interest rate risks one-to-three years ahead. The metric used for the solvency stress test is the capital adequacy ratio (CAR) that in Namibia must be superior to 10 percent of risk-weighted assets (RWAs). The stress test covered the four biggest Namibian banks, accounting for about 95 percent of total assets in the banking sector, based on end-2014 data. The stress test uses a balance sheet approach by using (a modified version of) the Cihak framework. As the model is single-period, to test for the impact of shocks one-to-three years ahead and account for feedback effects from the financial sector to the economy and back to the financial sector, the stress test has been run three times using cumulative shocks one-to-three years ahead, as obtained by the macroeconomic and satellite models (Eq. 3.1. and Eq. 4.1.) and based on the assumptions in Box Table 3.3.

21. Before conducting the stress test, capital has been adjusted to account for under-provisioning. The coverage ratio, measured as total provisions to NPLs, was 90 percent at end-2014, accounting mainly for general provisions. Specific provisions instead were low, corresponding to 26 percent of NPLs. In part, this derives from the fact that two banks provisioned NPLs below the minimum requirements. An adjustment has thus been introduced to ensure that all banks provision existing NPLs according to the regulatory provisioning rates. Even with this correction, specific provisions remain low (30 percent of total NPLs). This reflects the fact that NPLs are mainly secured by residential or commercial property whose value is deducted from the value of the NPLs before applying the corresponding provisioning rate. Despite regulation invites banks to apply a conservative approach in the valuation of collateral of problem loans (see Table 2 footnote), the discount applied by banks on the market value of collateral seems to be minimal (Table 2). In the baseline and adverse scenarios we mark-to-market the value of collateral by adjusting it according to the assumed changes in market house prices.

Table 2. Expected Specific Provisioning in Absence of Collateral Against Actual Specific Provisioning
(N$ Thousands)

		Pass	Special Mention	Substandard	Doubtful	Loss	Total
Residential Mortgages	Expected Provisioning without deducting collateral (A)	245,083	6,976	15,458	40,220	227,143	534,880
	Actual Provisioning (B)	256,474	19,820	13,477	3,043	14,755	307,569
	Difference (B-A)	11,392	12,844	-1,981	-37,177	-212,389	-227,311
	% Difference [(B-A)/A*100]	5	184	-13	-92	-94	-42
Comcercial Real Estate Mortgages	Expected Provisioning without deducting collateral	85,275	27	608	341	22,610	108,862
	Actual Provisioning	992,170	17	913	0	570	93,670
	Difference	6,895	-10	305	-341	-22,040	-15,192
	% Difference [(B-A)/A*100]	8	-38	50	-100	-97	-14
Memorandum Items	Assumed Provisioning Rates (%)	1%	2%	10%	50%	100%	

Note: According to the BoN General Notice No. 278 (2003): "A more conservative approach should be adopted for valuing the collateral of problem loans. This is because, in practice, the forced sale value, rather than the open market value, is likely to be closer to what eventually may be realized from an asset sale when the market conditions are unfavorable. Therefore, a discount to the estimate market value should be applied where appropriate." (see https://www.bon.com.na/CMSTemplates/Bon/Files/bon.com.na/5d/5dfae274-bfb5-48c6-98a5-cf7345c34075.pdf).

22. The stress test accounts for both direct and indirect effects of an increase in interest rates but, due to data limitation, the indirect effect is based on *ad hoc* assumptions. The direct impact has been computed considering the changes in net interest income due to the re-pricing of asset and liabilities in case of an increase in interest rates. While this impact is typically negative as banks tend to operate maturity transformation, with long-term assets (and thus non-interest-rate-sensitive) and short-term liabilities (interest-rate-sensitive), in the case of Namibia the impact on net-interest margin results positive. This reflect the fact that Namibian banks' assets are mainly interest-rate sensitive because the absolute majority of mortgage loans are Adjustable Rate

Mortgages (ARMs) with the interest rate tied to the prime rate set by the BoN. As regards the indirect impact of increases in interest rates, this operates through changes in borrowers' ability to repay their debt obligation (credit risk). To successfully investigate for this risk, additional information would be needed (such as granular information on probabilities of default for mortgage loans), as cross-country analysis could not provide significant estimates (see Box 4). Against this backdrop, the expected negative impact on NPLs has been computed by introducing an amplifying factor to the estimates obtained from equation 4.1. (see details in Box 4).

23. The results of the stress test exercise are reported considering three different assumptions. Figure 5–7 illustrate the results of the solvency stress test one to three years after shock. For each year results are reported under three different assumptions: 1) banks dip into capital to face losses and the impact of changes in credit growth on RWAs is not considered (upper panels); 2) banks dip into capital and the impact of changes in credit growth on RWAs is considered (middle panes); 3) banks use profits as first line of defense and the impact of changes in credit growth on RWAs is considered (bottom panels). Disregarding profits in the first two assumptions is in line with the views of some papers according which it is more prudent to measure shocks directly against capital (Blaschke *et al.*, 2001). This situation would be compatible with a situation where profits are exposed to an exogenous shock and banks cannot dispose of it to face losses. The changes in credit growth used in assumptions 2) and 3) are as described in Box Table 3.3. The value of the profit buffer used in 3) is based on the average annual profits over the last five years.

24. The results of the solvency stress test suggest some resilience of the banking sector. Owing to large capital buffers, banks could withstand moderate-to-medium stress, as described by Scenarios 1-3. However, under a very adverse Scenario, entailing a generalized recession and a triple bust (credit/housing/construction) (Scenario 4), some banks may face difficulty in complying with the statutory minimum capital requirement of 10 percent of RWAs. In this scenario, at the end of the three years, the system-wide CAR would fall to 8.4 percent against a pre-shock CAR of almost 15 percent (Figure 7 upper panel). Using the large profit buffers and some deleveraging,[18] the system-wide CAR would remain above minimum over the three years of crisis (Figure 7 lower panels). In this case, system-wide capital (11.9 percent) would remain above the minimum but average results mask significant differences among individual banks.

[18] In the third year, we assume a 26 percent reduction in credit from the most vulnerable bank in scenario 3. This contraction corresponds to the deleveraging needed to bring the capital (plus profit) to the 10 percent threshold should losses stay as at the end of the second year. In scenario 4, however, losses are too high to bring back the capital requirement at the 10 percent threshold without recapitalization.

Table 3. Results of the Solvency Stress-Testing- Impact on System-Wide CAR

One-Year Post-Shock					
Assumptions	**Baseline**	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
Only Capital	15.0	14.4	13.9	13.8	13.6
Capital + Credit	14.1	13.5	13.6	13.8	14.5
Capital + Credit +Profits	16.1	15.6	15.7	16.0	16.8
Two-Year Post-Shock					
	Baseline	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
Only Capital	15.2	13.8	13.0	11.9	8.7
Capital + Credit	13.4	12.7	12.5	11.9	9.3
Capital + Credit +Profits	15.3	14.7	14.6	14.1	11.7
Three-Year Post-Shock					
	Baseline	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
Only Capital	15.5	13.7	12.8	10.4	8.4
Capital + Credit	12.7	12.2	12.0	11.2	9.4
Capital + Credit +Profits	14.5	14.2	14.0	13.6	11.9
Memorandum Item: CAR Pre-Shock:		14.7%			

25. To compute the breakeven point for the solvency rule of individual banks, a reverse stress test was also used. To find the scenario that would cause each bank to cross the 10 percent CAR frontier, progressively more adverse shocks have been applied to individual banks. The strongest bank would cross the threshold when overall NPLs increase above 770 percent compared to the pre-shock status, the weakest bank would become not compliant with a 95 increase in NPLs.

26. The stress test exercise illustrated in this note and based on cross-country evidence has some caveats worth mentioning:

i. In the absence of information on sectorial NPLs, the measure of asset quality used in the cross-country satellite model was overall NPLs (See Box 4). A housing bust, however, is expected to impact mainly mortgages and construction loans. The impact of the bust on overall NPLs will then depend on the exposure of each country's banking system to the real estate sector. In this respect, while all the countries included in the sample experienced a housing boom/bust episode, the exposure of their banking sectors to the housing market

was in many cases inferior to Namibia's (see Text Table). The elasticities obtained from the panel regression (Box Table 4.1.) could thus underestimate the impact that a housing bust would have on Namibia's overall NPLs due to the average higher exposure of its banks to the real estate sector.

ii. For the same reason, the exercise could misrepresent the vulnerability of individual banks. The stress test tends to penalize banks that have the highest overall NPLs and the lowest buffers pre-shock. While these factors are of great importance, the composition of the loan portfolio, in particular the exposure to the real estate sector, is at least as important. The bank starting with the highest overall NPLs could indeed have a low exposure to the housing market and thus would be less impacted by a bust. This feature would not be captured by our exercise. Fortunately, this caveat has scarce relevance in the case of Namibia as all the banks have a similar business model and the exposure to the real estate market is roughly the same.

Text Table

Share of Housing Loans in Private Sector Credit, 2006	
Bulgaria	13
Croatia	20
Czech Republic	27
Estonia	49
Hungary	20
Lithuania	27
Denmark	58
Iraland	39
Spain	36

Source: Égert and Mihaljek

27. The analysis in this note suggests that the impact of a housing bust, and related financial stress, on Namibia's economy could be sizable, through the main channels described in paragraph 13:

i. Direct impact through the construction and real estate sectors. A decline in house price would reduce economic activity in the construction and real estate sectors, which are among the major contributors to Namibia's value added and employment.

ii. An indirect impact through banks' and household deleveraging. When facing losses banks are expected to reduce lending to the economy because of rising difficulties to attract funds and need to improve capital ratios. A plunge in home prices affects household balance sheets in two distinct ways—it causes both an increase in leverage and a decline in overall wealth. In an environment of reduced economic activity and credit tightening, this is expected to create a need for deleveraging that, in turn, would depress consumer spending.

Table 4. Impact on GDP Growth over the Three-Year Period

	Baseline	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Real GDP Growth over the Three-Year Period (%) [(GDP2017-GDP2014)/GDP2014)]	16.9%	13.3%	2.6%	1.6%	-9.9%
Percentage Points Difference from Baseline	-	-3.4	-14.1	-15.2	-26.7

Overall, estimates based on cross-country evidence of countries that experienced a boom/bust episode in the housing sector suggest that Namibia's real economic growth could be 3 to 27 percentage points lower than under the baseline scenario over a 3-year period. Under the most adverse scenario, in particular, GDP is expected to contract 9.9 percent in real terms over the three-year projection period (Table 4 and Box 3).

Box 3. Stress Test Calibration—Macroeconomic Assumptions

Cross-Country Sample used to calibrate the stress testing exercise.
Macroeconomic and satellite models were estimated using panel regressions on a sample of countries that experienced, with different severity, boom/bust episodes in housing market during the recent financial crisis (Box Table 3.1.). The inclusion of countries in individual regressions is based on data availability and relevance.

Box Table 3.1 – Countries used to estimate macroeconomic and satellite models[#]

Australia	Denmark*	**Latvia**[*,○]	**Slovak republic**[○]	USA*
Bulgaria[○]	**Estonia**[○]	**Lithuania**[○]	South Africa	
Croatia[○]	Hungary*	Poland	**Spain**[*,○]	
Cyprus^	Iceland*	Russia*	**UK**[*,○]	
Czech Republic	**Ireland**[*,○]	Serbia	Ukraine*	

[#] Countries in bold, which experienced a triple boom/bust episode (credit/housing/construction), were used to estimate the macroeconomic model (Equation 3.1.). All countries in the Table were used to estimate the satellite model (Equation 4.1.).
* The country experienced a systemic crisis according to the Laeven and Valencia (LV) database (2013). ^ Cyprus experienced a systemic banking crisis in 2013 but is not included in LV database that covers the period 1970-2011. ○ The country experienced a boom/bust episode in the construction sector, based on Sun *et. al.* (2013).

Macroeconomic assumptions.
Projections are one-to-three-year ahead and consider feedback loops from the financial sector to the economy and back to the financial sector.

The baseline scenario assumes

i) An average increase in house prices of the same magnitude of nominal GDP growth;
ii) GDP growth in line with Namibia's macroeconomic framework;
iii) Increase in interest rates as in South Africa's market implied forecasts (as of May 2015);
iv) Credit growth in line with Namibia's macroeconomic framework.

Adverse scenario 1 assumes a drop in oil prices that impacts on macroeconomic variables as follows:

1. House prices decline because of reduced cash buying by foreigners. In absence of other shocks the correction in house prices is assumed to be 5 percent, corresponding to ¼ of the estimated over-valuation peak. House price correction is expected to take place over 2 years: 60 percent of the correction occurs in 2015 and 40 percent in 2016.
2. The decline in house prices has an indirect impact on the construction and real estate sectors. The contraction in these sectors is estimated through a cross-country panel regression (Eq. 3.1) of a sub-set of the countries listed in Box Table 3.1., which, according to Sun *et. al.* (2013), experienced a boom-bust episode in the construction sector during the recent financial crisis:

$$\Delta CONSTR_{i,t} = c \quad + \alpha \cdot \Delta CR_{i,t} + \beta \cdot \Delta HP_{i,t-1} + \varepsilon_{i,t} \qquad \text{(Eq. 3.1)}$$

where $\Delta\mathrm{CONSTR}_{i,t}$ is the percentage change in the value added of the construction sector of country *i* in year *t*, $\Delta\mathrm{CR}_{i,t}$ is the percentage change in credit of country *i* in year *t* and $\Delta\mathrm{HP}_{i,t-1}$ is the percentage change in house price index of country *i* in year *t*-1. Box Table 3.2. reports the results of the estimates, which confirm that the construction sector is vulnerable to house price correction with some lagged effects.
3. Credit growth is assumed in line with baseline.

Adverse scenario 2 assumes a generalized drop in commodities prices. This implies:

1. A direct effect on Namibia's mining sector. In 2015 we replicate the maximum shock observed in the mining sector in Namibia during the period (2007-2014), corresponding to a 32 percent contraction in the value added of the sector (recorded in 2009 when diamond prices declined a rough 20 percent with respect to the previous year). In 2016 we assume smaller contraction (-16 percent) and in 2017 a rebound (+8 percent).

Box 3. Stress Test Calibration—Macroeconomic Assumptions (continued)

2. The correction in house prices is assumed to be slightly higher than in scenario 1 because, in addition to reduce housing purchases from foreigners, the contraction of the mining sector implies a reduction in mining companies' bank deposits and a contraction in lending. The contraction is assumed to be 10 percent over 2015-16, distributed 60 and 40 percent between the two years.
3. The indirect effect on the construction and real estate sectors is estimated using the elasticities in Equation 3.1.
4. Credit growth is expected to contract due to banks' will to limit the share of NPLs that have started to increase, asymmetric information on borrowers' capacity to repay loans, rising difficulties for banks to attract funds.

Adverse scenario 3 assumes an increase in interest rates to defend the peg with the SA rand (+300bp), in addition to lower commodity prices. Assumptions in this scenario are as follows:

1. The correction in house prices is assumed to be 15 percent, higher than in scenario 1 and 2 because, in addition to reduced purchases by foreigners, also domestic demand for housing declines because of higher cost of credit. The contraction is assumed to take place over 2015-16, distributed 60 and 40 percent between the two years.
2. The indirect effect on the construction and real estate sectors is estimated using the elasticities in Equation 3.1.
3. Credit growth contracts more than in scenario 2 due to reduced demand for credit and higher difficulties for banks to attract funds and because at the end of 2016 banks need to deleverage to face losses.

Finally, adverse scenario 4 assumes a generalized decline in economic activity.

1. The decline in GDP is estimated by using the average decline recorded by the countries in the sample in the year of the housing bust and in the two years after.
2. House prices are assumed to correct 20 percent over the period 2015-16.
3. Credit growth turns negative in 2015, it stalls in 2016 and falls again in 2017 due to the fact that one bank has become insolvent.

Box Table 3.3. synthesizes the macroeconomic assumptions in the baseline and adverse scenarios.

Box Table 3.2. – Panel Regression to estimate the impact of a housing bust on the construction sector

	Random-effects	**GLS regression**			Number of obs =	76
Group variable:	Country				Number of groups =	9
R-sq: within =	0.3604				Obs per group:	
between =	0.4977				min =	3
overall =	0.3564				avg =	8.4
					max =	10
					Wald chi2(3) =	40.42
corr(u_i, X) = 0	(assumed)				Prob > chi2 =	0.0000

Δ_CONSTR	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Δ_CR	.441***	.098	4.50	0.000	.249	.633
Δ_HP(-1) .	.160*	.095	1.69	0.092	-.026	.345
_cons -	-3.446**	1.824	-1.89	0.059	-7.021	.128

sigma_u	0	
sigma_e	12.695	
rho	0	(fraction of variance due to u_i)

*** 1% significance level, ** 5% significance level, * 10% significance level.

Box 3. Stress Test Calibration—Macroeconomic Assumptions (concluded)

	House price	Real GDP growth	Policy rate	Credit Growth	Notes
Baseline					House prices are assumed to grow in line with nominal GDP. GDP and credit growth rates are as in the macroeconomic framework. Interest rate increases are based on South Africa's market implied interest rates forecasts (using forward rate agreements)
2015	11.2%	4.8 %	+75bp	9.5%	
2016	11.3%	5.0%	+75bp	9.0%	
2017	12.4%	6.2%	Stable	10.4%	
Scenario 1					Construction, real estate, and mining growth rates for 2015 projected at 3.1%, 3.1% (from Eq. 1), and 1.2% (as in baseline), for 2016 at -2.5%, -2.5% (from Eq. 1), and 18% (as in baseline), for 2017 at –2.4%, -2.4% (from Eq. 1), and 31.3% (as in baseline). Interest rates as in baseline. Credit growth for 2015 is as in baseline, estimates for 2016-17 are based on Hardy *et al.* (2013) rules' of thumb for EM (medium stress).
2015	-3.2%	4.0%	+75bp	9.5%	
2016	-2.1%	3.3%	+75bp	3.2%	
2017	0%	5.5%	Stable	3.2%	
Scenario 2					Construction, real estate, and mining growth rates for 2015 projected at 0.3% (from Eq. 1), 0.3% (from Eq. 1), and -32% (maximum historical drop), for 2016 at -3.0%, -3.0% (from Eq. 1), and -16%, for 2017 at -2.7%, -2.7% (from Eq. 1), and 8%. Interest rates as in baseline. Credit growth estimates for 2015-16 based on Hardy *et al.* (2013) rules' of thumb for EM (medium stress), in 2017 credit is assumed to stall.
2015	-6.2%	0.1%	+75bp	3.2%	
2016	-4.1%	0.2%	+75bp	3.2%	
2017	0%	2.3%	Stable	0.0%	
Scenario 3					Construction, real estate, and mining growth rates for 2015 projected at –1.1% (from Eq. 1), -1.1% (from Eq. 1), and -32% (maximum historical drop), respectively.), for 2016 at -4.9%, -4.9% (from Eq. 1), and -16%, for 2017 at -7.0%, -7.0% (from Eq. 1), and 8%. Credit growth is assumed to stall in 2015-16 and to decline in 2017 due to banks' need to deleverage to face losses.
2015	-9.3%	-0.1%	+300bp	0%	
2016	-6.2%	0.0%	Stable	0%	
2017	0%	1.7%	Stable	-5.89%	
Scenario 4					GDP growth forecasts based on the average in countries that experienced boom/bust in housing and construction in the year of the bust and in the two years after. Credit growth estimates based on Hardy *et al.* (2013) rules' of thumb for EM (severe stress) in 2015. Credit is assumed to stall in 2016 and to drop severely in 2017 when a major bank becomes insolvent.
2015	-12.7%	0.9%	+300bp	-8.3%	
2016	-8.5%	-7.0%	Stable	0.0%	
2017	0%	-4.0%	Stable	-11.0%	

Box 4. Stress Test Calibration—Satellite Panel Regression Model

The baseline and adverse scenarios were translated into financial stress at the bank level by using a cross-country satellite model for NPLs. All countries included in the sample underwent a housing boom/bust episode in the housing sector; some experienced also a boom/bust in the construction sector and/or a systemic banking crisis (Box Table 3.1.). In the regression the change in NPLs was modeled as a function of changes in house prices, real GDP, and interest rates (Eq. 4.1):

$$\Delta NPL_{i,t} = c + \alpha \cdot \Delta HP_{i,t} + \beta \cdot \Delta RDGP_{i,t} + \gamma \cdot \Delta INT_{i,t} + EM_i + \varepsilon_{i,t} \qquad \text{(Eq. 4.1)}$$

where $\Delta NPL_{i,t}$ is the % change in NPLs of country *i* in year *t*, $\Delta HP_{i,t}$ is the % change in house price index of country *i* in year *t*, $\Delta RGDP_{i,t}$ is the percentage points change in real GDP growth of country *i* in year *t*, $\Delta INT_{i,t}$ is the percentage YoY change in lending rate, and EM_i is a dummy variables that takes value 1 for EMs and zero otherwise. Results of the regression are shown in Table 4.1.

Not surprisingly, changes in house prices and real GDP are highly significant and show the correct sign. The status of a mortgage loan depends indeed on both the ability and the willingness of the borrower to keep payments up-to-date. The ability to make mortgage payments is affected by life events, such as the loss of a job. This is why aggregate mortgage loan performance is tied to underlying economic conditions. As regards house prices, while a decline in house prices would not impact directly on the borrowers capacity to repay, when house prices fall and lending standards tighten, homeowners with low or negative equity mortgages are unable to refinance and will increasingly be driven to—or will choose to—default on their loans. Research has indeed shown that the an important factor explaining delinquencies is the decline in house prices, which affects both the ability and willingness of borrowers to keep loans current (Doms, Furlong, and Krainer 2007).

The coefficient for changes in interest rates is not significant in the regression. This derives from the fact that, during the period under observation (2004-2013), interest rates have remained generally low and thus have not contributed to the increase in household debt burden and subsequently increase in NPLs.[1] The interest rate transmission channel is however expected to play a role in the deterioration of banks loan portfolios in Namibia as the absolute majority of housing loans are ARMs with the interest rate tied to the prime rate set by the BoN. To account for this factor in Scenarios 3 and 4, the impact on NPLs derived from Eq. 4.1. is amplified by using the lower bound of the 95% confidence interval of the estimates of the coefficients that are significant in the regression.

Finally the coefficient of the dummy for EMs is not significant because, despite the fact that the increase in NPLs in these countries was higher than in AEs, the drop in house price and the contraction in economic activity were also higher.

Based on the estimated of Eq. 4.1. NPLs under the baseline and adverse scenarios are as in Box Table 4.2.

[1] It must be noted that households in a number of countries included in the sample underwent severe stress due to the fact that a large share of mortgage loans was denominated in foreign currency at the time the domestic currency depreciated. This provoked an increase in household debt burden.

Box 4. Stress Test Calibration—Satellite Panel Regression Model (concluded)

Box Table 4.1. Satellite Model to Estimate NPLs Post-Shock

Random-effects	**GLS regression**				Number of obs =	167
Group variable:	Country				Number of groups =	20
R-sq: within =	0.4190				Obs per group:	
between =	0.1686				min =	5
overall =	0.3885				avg =	8.3
					max =	10
					Wald chi2(3) =	105.28
corr(u_i, X) = 0	(assumed)				Prob > chi2 =	0.0000

Δ_NPLS	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Δ_HP	-2.446	.564	-4.34	0.000	-3.551	-1.341
Δ_HP(-1)	-.757	.345	-2.19	0.028	-1.434	-0.802
Δ_RGDP	-7.765	1.106	-7.02	0.000	-9.932	-5.598
Δ_INT	.506	.331	1.53	0.126	-.142	1.153
EM	-10.852	13.379	-0.81	0.417	-37.0752	15.370
_cons	21.299	9.997	2.13	0.033	1.704	40.893

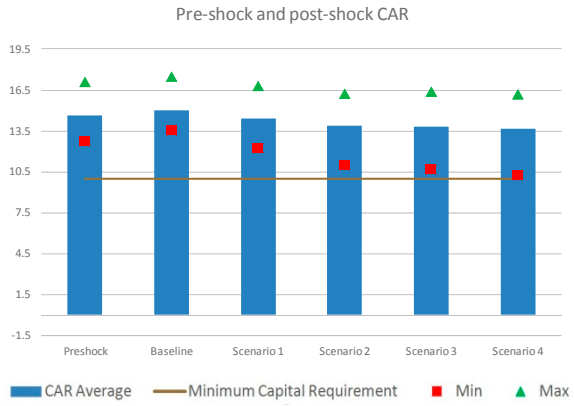
sigma_u	15.334	
sigma_e	68.686	
rho	.0472	(fraction of variance due to u_i)

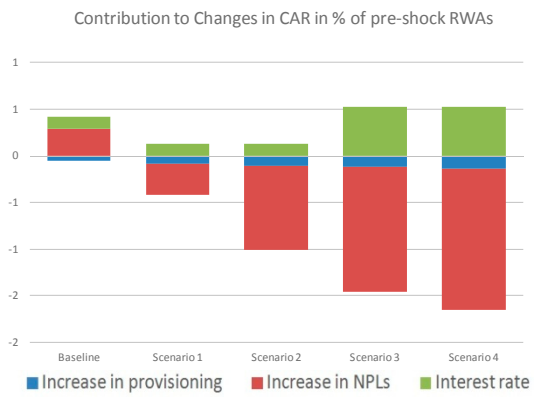
Box Table 4.2. –NPLs under Baseline and Adverse Scenarios – one-to-three years post shock

One-Year Post-Shock				
Baseline	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
1.2%	1.8%	2.4%	3.0%	3.0%
Two-Year Post-Shock				
Baseline	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
1.0%	2.5%	3.2%	5.2%	8.1%
Three-Year Post-Shock				
Baseline	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
0.7%	2.6%	3.5%	7.0%	8.4%
Memorandum Item: NPLs Pre-Shock: 1.5%				

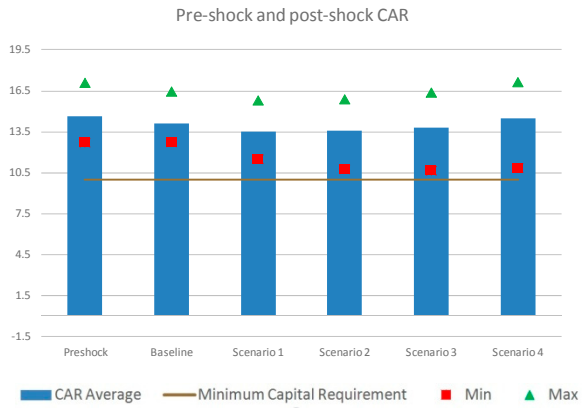
Figure 5. Results of Solvency Stress-Test—Impact on CAR—First Year Post-Shock

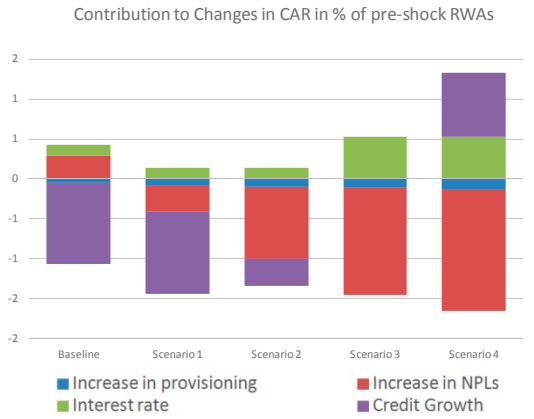
CAR Pre- and Post-Shock Excluding Profits and Impact of Credit Growth on RWAs



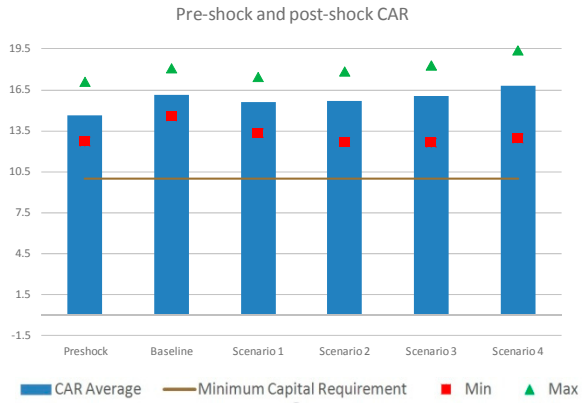


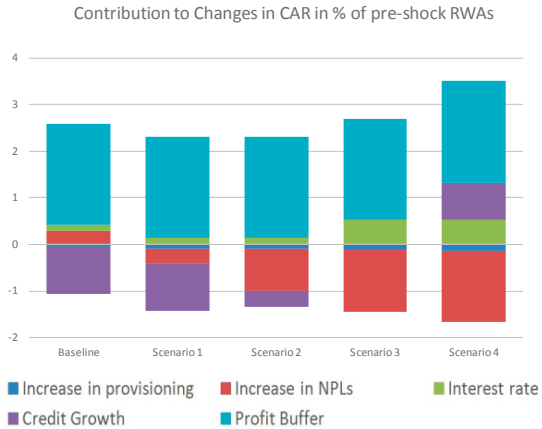
CAR Pre- and Post-Shock considering the Impact of Credit Growth on RWAs but Excluding Profits





CAR Pre- and Post-Shock considering the Impact of Credit Growth on RWAs and Using Profit Buffer as First Line of Defense

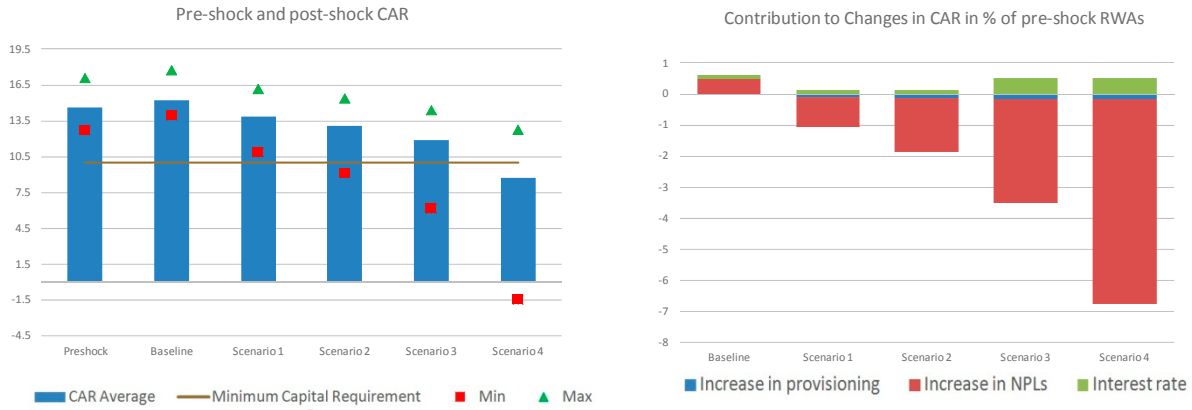




Sources: Bank of Namibia; and IMF staff estimates.

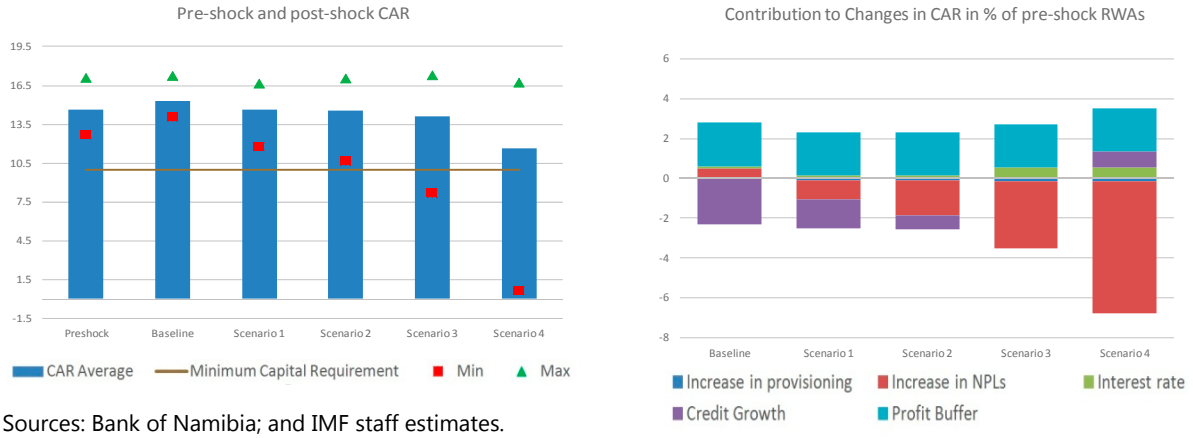
Figure 6. Results of Solvency Stress-Test—Impact on CAR—Second Year Post-Shock

CAR Pre- and Post-Shock Excluding Profits and Impact of Credit Growth on RWAs



CAR Pre- and Post-Shock considering the Impact of Credit Growth on RWAs but Excluding Profits

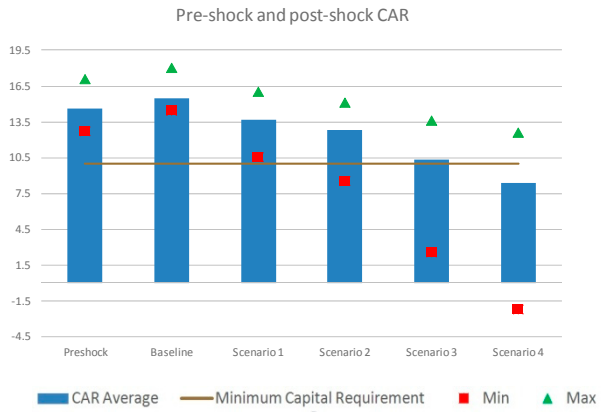
CAR Pre- and Post-Shock considering the Impact of Credit Growth on RWAs and Using Profit Buffer as First Line of Defense

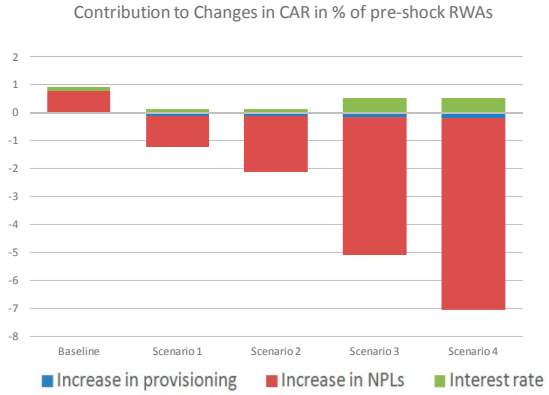


Sources: Bank of Namibia; and IMF staff estimates.

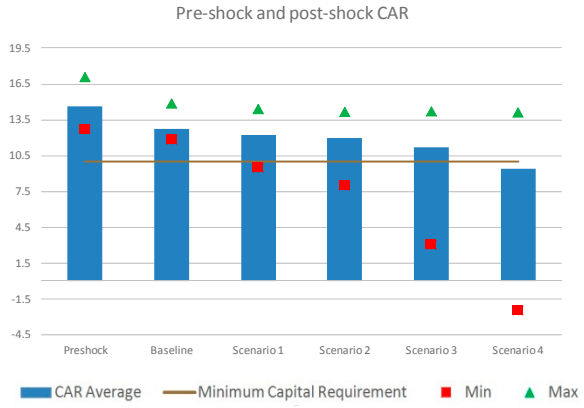
Figure 7. Results of Solvency Stress-Test—Impact on CAR—Third Year Post Shock

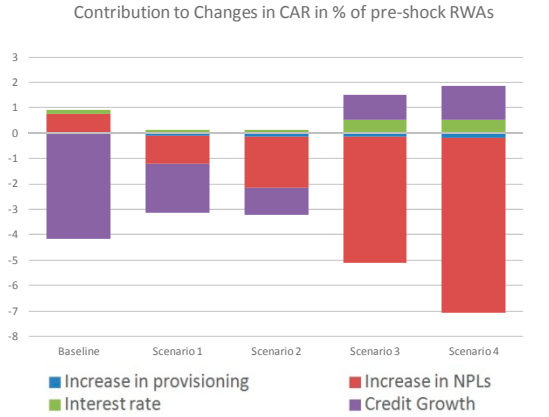
CAR Pre- and Post-Shock Excluding Profits and Impact of Credit Growth on RWAs



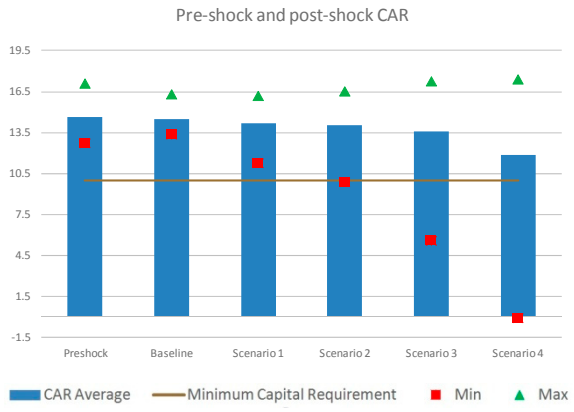


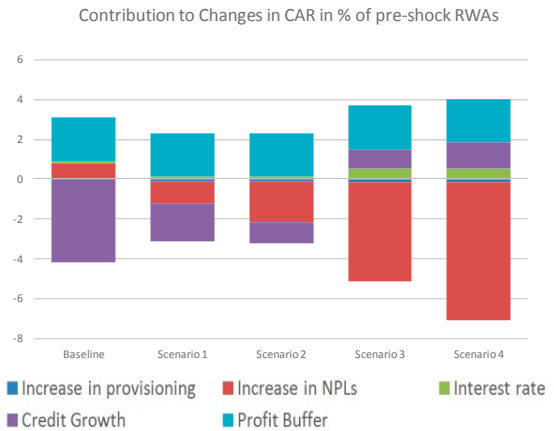
CAR Pre- and Post-Shock considering the Impact of Credit Growth on RWAs but Excluding Profits





CAR Pre- and Post-Shock considering the Impact of Credit Growth on RWAs and Using Profit Buffer as First Line of Defense





Sources: Bank of Namibia; and IMF staff estimates.

Table 5. Alternative Stress Test Scenarios

Scenario 1. Decline in International Oil Price		
Propagation Mechanism	Direct impact on Banks	Indirect Impact on Banks
Lower oil price reduces cash buying of properties from foreigners	**1.** Under-provisioning due to reduced value of collateral. **2.** Increase in NPLs in the construction and real estate sectors.	1. General increase in NPLs due to increased unemployment in construction and real estate; 2. Some reduction in lending due to both demand and supply reasons
Scenario 2: Generalized Decline in International Commodity Prices		
Propagation Mechanism	Direct impact on Banks	Indirect Impact on Banks
Lower Commodity Prices that have 2 effects: - Reduced cash buying of properties from foreigners - Reduced Activity in the Mining Sector	**1.** Under-provisioning due to reduced value of collateral. **2.** Increase in NPLs in the construction, real estate, and mining sectors. **3.** Decrease in deposits from mining companies.	1. General increase in NPLs due to increased unemployment (effect stronger than in scenario 1); 2. Reduction in Lending (effect stronger than in scenario 1 due to reduced funding from mining companies)
Scenario 3: Generalized Decline in International Commodity Prices+ Increase in Real Interest Rates		
Propagation Mechanism	Direct impact on Banks	Indirect Impact on Banks
4. Lower Commodity Prices that have 2 effects: -Reduced cash buying of properties from foreigners -Reduced Activity in the Mining Sector **5.** Increase in policy rates in SA to contrast depreciation of the rand	**6.** Under-provisioning due to reduced value of collateral **7.** Increase in NPLs in the construction, real estate **8.** Increase in mortgage NPLs due to increased debt service	1. General increase in NPLs due to increased unemployment (effect stronger than in scenario 1, given higher pressure on the real estate market); 2. Reduction in lending (effect stronger than in scenario 1 due to reduced demand for credit)
Scenario 4: Generalized Decline in International Commodity Prices+ Increase in Real Interest Rates + Generalized Decline in Economic Activity		
Propagation Mechanism	Direct impact on Banks	Indirect Impact on Banks
9. Lower Commodity Prices that have 2 effects: -Reduced cash buying of properties from foreigners -Reduced Activity in the Mining Sector **10.** Increase in policy rates in SA to contrast depreciation of the rand **11.** Reduced Economic Activity	**12.** Under-provisioning due to reduced value of collateral **13.** Generalized Increase in NPLs (higher than in Scenarios 1,2,3);	1. Reduction in lending (effect stronger than in scenario 1,2,3 due to reduced demand for credit and reduced funding source) 2. Reduction in wholesale deposits

References

Allen, M. T., J. Madura, and K. J. Wiant, 2009, "Commercial Bank Exposure and Sensitivity to the Real Estate Market," *Journal of Real Estate Research*, Volume 10 (2), pp. 129-140.

Badev, A., T. Beck, L. Vado, and S. Walley (2014) "Housing Finance Across Countries - New Data and Analysis", *World Bank Policy Research Working Paper*, No 6756.

Blaschke, W., M. T. Jones, G. Majnoni, and S. Martinez Peria (2001), "Stress Testing of Financial Systems: An Overview of Issues, Methodologies, and FSAP Experiences," *IMF Working Paper*, WP/01/88.

Bank of Namibia (2014) *Financial Stability Report*, March.

Bank of Namibia and NAMFISA (2015) *Financial Stability Report*, June.

Borio, C. and P. Lowe (2002) "Asset prices, financial and monetary stability: exploring the nexus", *BIS Working Papers* No 114.

Brown, R. (2013) *Housing Demand and Supply in Namibia*, presentation at Bank of Namibia, available at the link: http://www.ean.org.na/wp-content/uploads/2012/11/Housing-Demand-and-Supply-in-Namibia-R-Brown.pdf.

Center for Affordable Housing Finance (2013) *Housing Finance in Africa – A review of some of Africa's housing finance markets*, Finmark Trust, September.

Čihák M. (2007) "Introduction to Applied Stress Testing", *IMF WP*/07/59.

Crowe, C., G. Dell'Ariccia, D. Igan, P. Rabanal (2013) "How to deal with real estate booms: Lessons from country experiences", *Journal of Financial Stability*, 9, 300-319.

Davis, E. P., and Zhu, H. (2011) "Bank lending and commercial property cycles: Some cross-country evidence," *Journal of International Money and Finance*, vol. 30(1), 1-21.

Doms, M., F Furlong, J Krainer "Subprime mortgage delinquency rates" *Federal Reserve Bank of San Francisco Working Paper* No. 33.

Drehmann, M., and K. Tsatsaronis, 2014, "The credit-to-GDP gap and countercyclical capital buffers: question and answers," BIS Quarterly Review, March.

Égert, B. and D. Mihaljek (2007) "Determinants of house prices in central and eastern Europe", *BIS Working Papers*, No 236.

Gan, J. (2007), "The Real Effects of Asset Market Bubbles: Loan- and Firm-Level Evidence of a Lending Channel," Review of Financial Studies, Volume 20, pp.1941-1973.

Geršl A., and J Seidler (2012) "Excessive credit growth and countercyclical capital buffers in Basel III, an empirical evidence from central and east European countries," ACTA VSFS, University of Finance and Administration, vol. 6(2), 91-107.

Hardy, D. C. and C. Schmieder (2013) "Rules of Thumb for Bank Solvency Stress Testing", *IMF Working Paper*, WP/13/232

Hilbers, P., Q. Lei, and L. Zacho (2001) "Real estate Developments and Financial Sector Soundness", *IMF Working Paper*, WP/01/129.

Igan, D. and M. Pinheiro, 2010, "Exposure to Real Estate in Bank Portfolios," *Journal of Real Estate Research*, Volume 32 (1), pp. 47-74.

IMF (2011) "Housing Finance and Financial Stability—Back to Basics?"*Global Financial Stability Report - Durable Financial Stability: Getting There from Here*, April.

_____ (2014) Staff Guidance Note on Macroprudential Policy—Considerations for Low Income Countries.

_____ (2015) Namibia TA Report on "Strengthening Financial Stability and Stress Testing Training", March.

_____ (2015b) Namibia TA Report on "Establishing a Macroprudential Policy Framework", June.

National Housing Enterprise (2013) *Summary of Blue Print on Mass Housing Development Initiative in Namibia*, October.

Sun Y., P. Mitra, and A. Simone (2013) "The Driving Force behind the Boom and Bust in Construction in Europe", *IMF Working Paper*, WP/13/181.