





SOUTH AFRICA GOVERNMENT INFLATION-LINKED BOND INDEX GUIDE

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Contents

Introduction – Inflation-Linked Indices	2
Market overview	3
Index objectives	4
Index rules and characteristics	5
Bond inclusion criteria	5
Index characteristics	5
Index methodology	6
Index formulae	7
Foreign and hedged indices	10
Foreign currency indices	10
Hedged indices	10
The hedging calculation	11
Barclays Capital Inflation-Linked indices on Bloomberg	13
Accessing Barclays Capital Inflation-Linked indices	13

Barclays Capital/ABSA South Africa Government Inflation-Linked Bond Index – Index Guide

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Introduction – Inflation-Linked Indices

In October 1997 Barclays Capital launched its first Inflation-Linked Bond Index, which then included bonds from the five major government inflation-linked bond markets. This index, now known as the Barclays Capital World Government Inflation-Linked Bond Index, has grown to 10 sovereign markets, including in order of joining; the UK, Australia, Canada, Sweden, US, France, Italy, Japan, Germany and Greece.

Ten years after the launch of the original family of inflation-linked indices, Barclays Capital launched the Emerging Markets Government Inflation-Linked (EMGILB) and Universal Government Inflation-Linked Indices to complement the existing inflation-linked family of indices. The Barclays Capital Emerging Markets Government Inflation-Linked Index is designed to measure the total return performance of the Inflation-Linked bonds from the major emerging market issuers (see Figure 1 for EM market structure), while the Universal Government Inflation-Linked Bond Index comprises both the World Government Inflation-Linked and the Emerging Markets Government Inflation-Linked bond Indices with each market within the Universal Index weighted by market value.

Figure 1: Emerging Markets Inflation-Linked Index structure



Source: Barclays Capital

The Barclays Capital/ABSA South Africa Government Inflation-Linked bond Index is a component of the EEMEA sub-index, which rolls up to the overall EMGILB index. As of 31 May 2009, the South Africa Government Inflation-Linked Index included four bonds (see Figure 2) which represented 48% of the EEMEA Inflation-Linked Index, 7% of the EM index and 1% of the Universal Index.

This document serves as a comprehensive standalone guide for the South Africa Government Inflation-Linked Index which has followed the methodology and conventions synonymous with the Barclays Capital suite of Inflation-Linked Indices.

Market overview

Market size

South Africa issued its first inflation-linked government bond in March 2000 and has since become the third largest EM sovereign inflation linked issuer after Brazil and Mexico. As of the end of May 2009, total notional linker issuance was ZAR53.9bn across four bonds, the R189 maturing in March 2013, the R197 maturing in December 2023, the R210 – March 2028 and the R202 – December 2033. Linkers made up 13.6% of domestic bonds in issue. All four of these bonds are eligible for the Barclays Capital/ABSA South Africa Government Inflation-Linked Bond Index based on the rules detailed on page 5.

Reference CPI and market conventions

South African Government Inflation-Linked bonds reference the CPI for all urban areas – the "headline" CPI measure in place since January 2009, which uses a new methodology and basket with a base year of 2008. Previously, market conventions used the CPI for metropolitan areas (the old "headline" index), which used a methodology and baseline basket set in 2000 (2000 CPI = 100).

One other important difference in the new CPI measure is that housing costs are now measured using owners equivalent rent (with a weight of more than 12%) as compared to mortgage interest rates (11.4% weight) in the old index. This has eliminated the need for the CPIX (CPI for metropolitan and other urban areas excluding mortgage costs) as the targeted inflation measure for monetary policy. Consequently, the new headline CPI is the official inflation targeting measure with an inflation target band remaining unchanged at 3-6%.

The bonds have a Canadian format, ie, with prices and yields quoted in real terms then uplifted using a CPI index ratio. The daily interpolation for the South African index ratio involves a four-month lag to the first of the calendar month, rather than the threemonth lag used in other markets due to relatively late publication of South African inflation data.

Auction frequency and issuance

Government linkers were previously auctioned every second Friday with auction sizes averaging just over ZAR150mn. Larger government funding needs have seen an increase in the frequency and size of auctions recently. From April 2009 auctions are held every Friday with auction sizes of between ZAR500mn and ZAR1bn.

Market liquidity is poorer for linkers compared to the nominal South African government bond market with average annual turnover of about 0.5 x issue size against 11 x issue size for nominal bonds. However, liquidity is slowly improving, particularly as hedge funds and other active trading accounts are now participating in the market in addition to the traditional buy-and-hold investors. The increase in issuance is expected to lead to continued improvements in liquidity.

Index objectives

The Barclays Capital/ABSA South Africa Government inflation-linked bond index has been created to provide investors with an accurate benchmark for performance measurement, as well as offering discrete building blocks for market analysis and portfolio construction. The index provides an accurate, comprehensive depiction of the performance and fundamental characteristics of the South Africa Government inflation-linked bond market and is a sub-set of the Emerging Markets Government Inflation-Linked and Universal Government Inflation Indices. Key objectives in the construction of these indices include the following:

- Objective and transparent rules. Any index should be governed by a clear and transparent set of rules for market and security selection and exclusion, rebalancing and other market or issuer events. These rules must be well documented and widely available.
- Representative of the Investment Universe. In all markets there is a balance between investability and market coverage. Ideally, indices should reflect the actual investment opportunities available to managers. At the same time, they should reflect the overall economic importance of each security – the larger the issue, the higher the weight in the index. The goal is to find the right balance between completeness and investability.
- Non-overlapping and hierarchical. Where an index family can be broken down into sub-indices by different criteria, each stock in the broad market index should be in one and only one of the sub-indices for each criterion. Sub-indices should roll-up into the headline index.
- Minimise index turnover. Indices incur turnover as they are re-balanced in line with their stated methodology. If the methodology creates unnecessary or unwanted index turnover it may result in high management costs and difficulty in tracking. This index is designed to minimise unnecessary turnover.

Index rules and characteristics

Bond inclusion criteria

The criteria for inclusion of bonds in the Barclays Capital/ABSA South Africa Government Inflation-Linked Bond Index are:

- **Bond type** In order to be eligible bonds must be issued by Republic of South Africa, denominated in South African rand (ZAR) and linked to South Africa CPI.
- **Minimum issue size** The issue size must be equal to or in excess of ZAR400mn nominal value (not adjusted for inflation indexation).
 - **Coupon type** The notional coupon of a bond must be fixed or zero.
- **Maturity and issue** Bonds must have a minimum remaining life of greater than one year on the rebalancing date for inclusion next month.
 - **Issue date** Bonds and new supply must settle on or before the rebalancing date to be eligible for the index.
 - **Investability** Issues that are not available in whole or part to international institutional investors are not eligible for the index.

Index characteristics

- Base date 31 March 2000.
- Indices available The standard maturity breakdowns are 1-3y, 1-5y, 1-10y, 1-15y, 3-5y, 5-7y, 5-10y, 5-15y, >5y, 7-10y, 10-15y, >10y, >15y. Indices are available in local currency and hedged and unhedged into AUD, CAD, CHF, EUR, GBP, JPY, SEK, SGD and USD. Other currencies and maturity buckets are available on request.
 - Index pricingFrom index inception to 28 November 2005 the index used daily closing mid yieldsmethodologyfrom Barclays Capital market makers. From 28 November 2005 until 28 February 2009
the index used Bond Exchange of South Africa daily mark-to-market fixings. From 1
March 2009, the index uses ABSA Capital closing mid yields.
- Index coverage As of 31 May 2009 the index covers 100% of the South African Government inflation-Linked market.

Market Average Weight % Average real cap local Average life Modified Bonds overall yield Duration mn SAGB (R189) 6.25% 49753.07 45% 2.26 3.83 3.38 31 Mar 2013 SAGB (R197) 5.5% 7 40591.38 37% 2.67 14.51 10.56 Dec 2023 SAGB (R210) 2.6% 4214.122 4% 2.50 18.83 14.60 31 Mar 2028 SAGB (R202) 3.45% 16265.16 15% 2.27 24.51 17.18 7 Dec 2033

Figure 2: Index Constituent Profile as of 31 May 2009

Source: Barclays Capital

Indices	Market cap ZAR bn	Market cap \$ bn	Weight	No of issues	Average real yield	Average life	Average Modified Duration
South Africa Govt IL	113.1	14.1		4	2.47	11.77	8.53
1-5 Yrs	51.0	6.3	45.1%	1	2.26	3.83	3.42
>10 Yrs	62.1	7.7	54.9%	3	2.51	18.00	12.73

7

Figure 3: South Africa Index characteristics

Source: Barclays Capital

Figure 4: South Africa IL historical returns to 31 May 09



Figure 6: South Africa IL market capitalisation history



6

Figure 5: South Africa Index average real yield



South Africa All

Maturities

Figure 7: South Africa IL Index bond weights at 31 May 09



Source: Barclays Capital

Index methodology

The Barclays Capital/ABSA South Africa Government inflation-linked bond index is calculated based on the general methodology of the Barclays Capital Government Inflation-linked indices.

The index uses standard settlement and ex-dividend conventions for all calculations. Settlement conventions South African inflation-linked bonds presently settle on a T+3 basis and have an exdividend period of 10 calendar days.

The index is calculated daily and has a value for each calendar day. This allows for Index frequency and treatment of income simple calculation of returns without going to the bother of adjusting start and end dates according to the business calendar.

On non-business days the security price, accrued and analytical values are carried over unchanged from the previous day. This ensures that the index has no local currency performance on days when the local market is closed. Prior to 1 July 2006 income from coupon is reinvested in the index as soon as it is received. The index is always fully invested and its performance reflects only the performance of the bond market. From 1 July 2006 onwards income from coupon is held in cash and earns a return of JIBAR – 15bp on a daily basis until the next rebalancing date, when it's re-invested into the index. The JIBAR rate from the last business day of the previous month is used. Monthly review Once a month on the last calendar day the indices are reviewed and rebalanced based procedure on the criteria described above. Bonds entering the index for the first time must have settled on or before the index review date. Increases or buybacks to existing bonds are applied according to the same rule. Index holdings The index holding of each bond for the next month is set to the amount outstanding on the review date. The face value is used rather than an inflation-adjusted value. Weighting The indices are weighted using market capitalisation as standard. As detailed in the index formulae section, the weights adjusted daily to account for price changes, accrued interest and indexation whereas the holdings remain fixed for the whole of each month. Index publication Index values and statistics are published daily on UK and US business days. The index is published the "same day" after market close at approximately 5.30pm UK time. In the event of a market day in South Africa but not in UK or US, the index will be published on the next UK or US business day. Index formulae Notation The Barclays Capital return indices are calculated daily and are chain weighted for each day *t*, starting with a base value of 100 on the base date.

The following notations are used in the index formulae:

 $P_{i,t}$ – Clean settlement price of bond *i* at close of day *t*.

 $A_{i,t}$ – Accrued interest for settlement of bond *i* for trading on day *t*.

 $P_{i,b}$ – Clean settlement price of bond *i* at close of day *b*.

 $A_{i,b}$ – Accrued interest for settlement of bond *i* for trading on day *b*.

t – Business day on which the index is being calculated

t-1 – The previous business day

n – Number of calendar days since the previous business day t-1

b – Last business day of the previous month

 $R_{i,b}$ – The monthly re-investment rate for bond *i* on business day *b*, as given in Figure 8.

$$CH_t$$
 – Cash held on day t , where $CH_t = CH_{t-1} * (1+R_{i,b})^n + \sum_i (C_{i,t} * N_{i,b})$ Cash

held is reset to zero on date *b*;

 $N_{i,b} - \text{Face value amount outstanding of bond } i \text{ on day } t. Note this is not inflation$ adjusted but the face value.Ni, t-1 - Face value amount outstanding of bond <math>i on day t-1, post any capitalisation change. $C_{i,t}$ - Coupon paid on bond i on day t $X_{i,t}$ - Any ex-dividend coupon that will be received on bond i $Y_{i,t}$ - Gross redemption yield on bond i at the close of day t $D_{i,t}$ - The duration of bond i at the close of day t. $m_{i,t} = (P_{i,t} + A_{i,t}) * N_{i,b}$ - Market value of bond i on day t in cash terms. The notation $\sum_{i} x_{i,i}$ is intended to show a summation occurring over bonds i which are eligible to be included in the index on day t. Hence $\sum_{i} x_{i,b}$ would apply to the eligible list on day b. **Market capitalisation** The Total Market Capitalisation M_t of all the constituent bonds on day t is given by:

$$M_{t} = \sum_{i} m_{i,t}$$
 ,

Clean Price Index The Clean Price Index (CPI_t) is defined as:

$$CPI_{t} = CPI_{b} * \frac{\sum_{i} \left(P_{i,t} * N_{i,b}\right)}{\sum_{i} \left(P_{i,b} * N_{i,b}\right)}$$

The CPI is calculated daily as shown above for all eligible bonds.

Gross Price Index The Gross Price Index (GPI_t) is analogous to the clean price index and is defined as:

$$GPI_{t} = GPI_{b} * \frac{\sum_{i} ((P_{i,t} + A_{i,t} + X_{i,t}) * N_{i,b})}{\sum_{i} ((P_{i,b} + A_{i,b} + X_{i,b}) * N_{i,b})}$$

Total Return Index The Total Return Index (TRI_t) is calculated as:

$$TRI_{t} = TRI_{b} * \frac{\sum_{i} ((P_{i,t} + A_{i,t} + X_{i,t}) * N_{i,b}) + CH_{t}}{\sum_{i} ((P_{i,b} + A_{i,b} + X_{i,b}) * N_{i,b})}$$

Income Index The Income Index (I_t) is a cumulative figure of coupon income received in the year to date. It is reset to zero at the beginning of each calendar year. Coupons are added to the income index for each stock paying a coupon today that was in the index yesterday.

$$I_{t} = I_{b} + GPI_{b} * \frac{CH_{t}}{\sum_{i} (P_{i,b} + A_{i,b} + X_{i,b}) * N_{i,b}}$$

Defining the Income Index in this way ensures that the Total Return Index can also be calculated by the equation:

$$TRI_{t} = TRI_{b} * \frac{(GPI_{t} + \Delta I_{t})}{GPI_{b}}$$

where ΔI_t is the increase in income (if any) on day *t*.

Normally $\Delta I_t = I_t - I_b$ but, if *t* and *b* span a year-end, $\Delta I_t = I_t$

It can be shown that this calculation of the TRI is perfectly consistent with the previous equation stated above.

Average Real Yield (annual and semi-annual) To calculate the Average Real Yield (Y_t), the real gross redemption yield of each bond is weighted by its market capitalisation and its duration (Macaulay).

$$Y_{t} = \frac{\sum_{i} (Y_{i,t} * m_{i,t} * D_{i,t})}{\sum_{i} (m_{i,t} * D_{i,t})}$$

where:

 $Y_{i,t}$ is the real gross redemption yield (either on an annual or semi-annual basis) of bond *i* at the close of day *t*,

and $D_{i,t}$ is the duration (Macaulay).

This measure (which includes weighting by duration) is a better approximation of the true gross redemption yield of all the cash flows in the index, than weighting individual redemption yields by market capitalisation alone.

Average (Macaulay) To calculate the Average (Macaulay) Duration (*D*_t), the duration of each bond is weighted by its market capitalisation.

$$D_t = \frac{\sum_i D_{i,t} * m_{i,t}}{M_t}$$

where $D_{i,t}$ is the duration of bond *i* at the close of day *t*.

Average Modified Duration (annual and semi-annual)

$$W_t = \frac{\sum_{i} W_{i,t} * m_{i,t}}{M_t}$$

weighted by its market capitalisation.

where $W_{i,t}$ is the modified duration of bond *i* at the close of day *t*. Modified duration quoted is the sensitivity of the quoted price with respect to changes in real yields.

To calculate the Average Modified Duration (W_t), the modified duration of each bond is

Average life To calculate the average life (L_t) , the life in years of each bond is weighted by its face value.

$$L_t = \frac{\sum_{i} L_{i,t} * F_{i,t}}{\sum_{i} F_{i,t}}$$

where $L_{i,t}$ is the life in years of bond *i* at the close of day *t*,

and $F_{i,t}$ is the face value of the of bond *i* at the close of day *t*.

Face value To calculate the Face Value (F_t) of the index, the face value of each bond is summed across all bonds in the index.

$$F_t = \sum_i F_{i,t}$$

Clean market value

e To calculate the Clean Market Value (CV_t) of the index, the face value of each bond is multiplied by its clean price and this value is summed across all bonds in the index.

$$CV_t = \sum_i F_{i,t} * P_{i,t}$$

Foreign and hedged indices

The Barclays Capital/ABSA South Africa Government Inflation-Linked Index is available in local currency, foreign currency and hedged versions. The following sections provide a detailed explanation of how these versions of index are calculated coupled with a rationale for the choice of methodology employed.

Foreign currency indices

Total Return Index The foreign currency versions of the local currency index are calculated using the local index and the spot foreign exchange rate between the local and "foreign" currencies.

The formula below is used to calculate the foreign total return index. The same technique is used to calculate the associated clean and gross price indices.

$$TRI_{F,t} = TRI_{L,t} * \frac{S_{LF,t}}{S_{LF,c}}$$

Where:

*TRI*_{*F*,*t*} = Foreign Total Return Index at time *t*;

TRI $_{L,t}$ = Local Total Return Index at time t;

 $S_{LF,t}$ = Spot exchange rate between local and foreign currency on day *t*;

 $S_{{\scriptscriptstyle LF},c}$ = Spot exchange rate between local and foreign currency at commencement date of the index.

Hedged indices

Three different procedures were considered for calculating the hedged performance of the Index. While the differences between the three are minor, it was ultimately decided that the third option would be used for calculating the hedged returns. The decision was based on a number of factors including transparency, ease of understanding, and replication. The three options that were considered are presented below.

The perfect foresight method

The perfect foresight method is the easiest method for calculating hedged returns. The method assumes that the exchange rate used to convert the value of non-US dollar holdings into US dollars at the end of the month is simply the one-month forward rate from the previous month. This method inherently assumes that we hedge exactly the correct amount of each currency, and is, therefore, referred to as the "perfect foresight method".

This has the advantage of being the simplest method of the three to apply to the index; however, it has the major disadvantage that it would be impossible to replicate in

practice. As this method would violate the general principle that the index be replicable, the perfect foresight method is not used for calculating the hedged returns.

The expected The expected value method requires the calculation of the expected amount of the holdings at the end of the month. At the beginning of each month, the interest that will accrue and coupons that will be paid are calculated and added to the beginning-of-month holdings. This sum is then hedged into US dollars. This hedge covers the current value of the Index plus the predictable components of the change in value.

This method is better in theory than the current value method, as it provides a better match to the true currency exposure. This increase in accuracy involves significantly more complex calculations to estimate the end-of-month currency exposure, but only provides a marginal reduction in the currency mismatch.

The current The final method considered was to hedge only the amount outstanding in each of the currencies at the end of each month after any re-weighting of the index constituents. This is referred to as the "current-value method". This does not assume perfect foresight so there will be an element of currency mismatch at the end of the month if the value of the portfolio holdings in the currency changes. This residual currency exposure will then have to be converted into US dollars using the spot exchange rate at that time.

The current value method is relatively straightforward to apply and is easily replicable, and this is the method used for the Index.

Exchange rate source WM Company closing mid values are used for both spot and forward rates at 4pm London time.

The hedging calculation

The index uses the current value method to execute a one-month hedge at the beginning of each calendar month. One-month forward rates are purchased to cover the full market value of the index at the beginning of the month. Any subsequent appreciation or depreciation in the value of the index is un-hedged until the next hedge is taken out.

- Single currencyThe hedged return on a single currency index or portfolio can be viewed as consistingindex hedgeof three parts:
 - Local return;
 - Currency return on the un-hedged portion of the fund;
 - Profit or loss on the hedge itself.

Multi-currency
index hedgeIn an index, income is reinvested across all the bonds in proportion to their weight. This
takes place as soon as income is received and hence the weight will depend on the local
market price and, in the case of a multi-currency basket, on the currency cross rates.
Because of this reinvestment strategy we cannot observe the local currency return in
the same way as described above. Instead we use a simpler breakdown:

- Index return (in the desired currency); and
- Profit or less on the hedge itself (or in this case on a series of currency hedges).

Calculating a daily
hedged indexIn order to provide a daily estimate of the performance of the monthly-hedged index
we do a daily mark-to-market of the currency hedge. This is done by unwinding the
forward position and adjusting the return on the hedge. The hedge return is then
combined with the month-to-date local currency return and the un-hedged currency

return to give an overall month-to-date hedged index return and hence the hedged index value.

Note that, as stated above, this is a daily estimation of the monthly-hedged index and not a true daily-hedged index. In this way we provide continuity between the monthly and daily series hedged total return series.

Pricing theTo mark the initial one-month forward position we use an offsetting forward to the endoffsetting forwardof the month. This is more precise than using the spot rate as it takes into accountexpected interest rate differentials for the remaining part of the month.

The easiest way to explain this is to look at an example. Suppose we are 10 days into the month and that the last business day of this month is the 28th. Here we need to offset the starting one-month forward with an 18-day forward (ie, 28 - 10 = 18 days). In theory we could obtain an 18-day rate directly for the forward market, but in practice only certain periods (tenors) are quoted, and we need to use interpolation to arrive at a rate for the desired period.

For the sake of simplicity we use a linear interpolation based on the current one-month forward rate and spot rate. In our example we would calculate the 18-day forward rate as the current spot rate plus the premium or discount between spot and 1-mth forward pro-rated for 18 days.

Formulae for monthly calculation – single currency index

Local Return =
$$LR = \frac{TRI_{L,e}}{TRI_{L,s}} - 1;$$

Currency Return =
$$CR = \frac{S_{LF,e}}{S_{LF,s}} - 1$$

Forward Return =
$$FR = \frac{F_{LF,s,1M}}{S_{LF,s}} - 1$$

Currency Return on Un-hedged Portion = (1 + LR) x CR

Hedge Return = FR – CR

Hedged Index Return = LR + Currency Return on Un-hedged Portion + Hedge Return

Hedged Index Value = Start Hedged Index Value * (1+Hedged Index Return)

Where:

s – Start date

e-End date

*TRI*_L – Local Currency Total Return Index

 S_{LF} – Spot foreign exchange rate between local currency and the hedge currency

 $F_{LF, IM}$ – One-month forward foreign exchange rate between local currency and the hedge currency.

MTD Local Return = MTD
$$LR = \frac{TRI_{L,e}}{TRI_{L,s}} - 1$$

Formulae for daily calculation – single currency index

MTD Currency Return = MTD $CR = \frac{S_{LF,e}}{S_{LF,s}} - 1$

Forward Return = $FR = \frac{F_{LF,s,1M}}{S_{LF,s}} - 1$

MTD Currency Return on un-hedged portion = (1 + MTD LR) x MTD CR

Hedge Reversal Return =
$$\frac{S_{LF,i}}{F_{LF,i,R}} - 1$$

MTD Hedge Return = FR + Hedge Reversal Return – MTD CR

MTD Hedged Index Return = MTD LR + (1+MTD LR) * MTD CR + MTD Hedge Return

Hedged Index Value = Start of Month Hedged Index Value * (1 + MTD Hedged Index Return)

Where:

i – Intra-month date;

R – *R*emaining days in hedge;

 $F_{LF, i, R}$ – Forward FX rate local currency into hedge currency on day *i* for forward period *R*. This is calculated by linear interpolation between the spot rate $S_{LF, s}$ and the one-month forward rate $F_{LF, s, 1M}$ where 1 < R < 1M.

Barclays Capital Inflation-Linked indices on Bloomberg

The Bloomberg page 'BCIN' is the landing page for the full set of legacy Barclays Capital Indices. From this page it is possible to navigate to an extensive set of attributes belonging to the Barclays Capital World and Euro Government Inflation-Linked Indices, 'BCIN' and 'BCIX' respectively. In addition, a full set of Breakeven indices are also accessible from this page. The Barclays Capital/ABSA South African Government Inflation-Linked Index is navigable from the Barclays Capital Emerging Markets Government Inflation-Linked page (BBEM), which is also located on the BCIX landing page. Note that it is possible to link directly to the requisite page by typing the four-character mnemonic followed by (GO), ie, BBEM (GO).



Accessing Barclays Capital Inflation-Linked indices

Index levels and a comprehensive set of analytics are available on the Barclays Capital Index Products website. http://ecommerce.barcap.com/indices/ and the indices page on Barclays Capital Live http://live.barcap.com.







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For complete information, Investors are requested to consult both sources listed below.

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