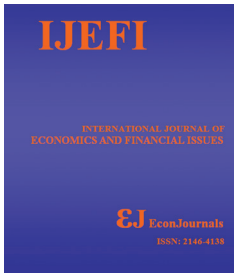

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Estimation of the Relationship Between Exchange Rate and Domestic Consumption: Evidence from South African Red Meat Industry

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ABSTRACT

The average individual experiences the value of currency as constant from day to day. The fact that the value of currency is constantly fluctuating in relation to other currencies only seems to matter for most people when planning for consumption. The purpose of the study is to examine the nexus between exchange rate changes and consumption of the South African red meat industry from 1995 until 2020, employing a time-series analysis. The paper used the secondary time series data for exchange rate volatility and red meat consumption. Descriptive statistics and Unit root test were performed for statistics and integration, respectively. Ordinal least square estimation was employed to determine the relationship. Furthermore, Granger causality test for directional causality effect. The overall conclusion from the results is that there is 1% change in total consumption that resulted from 0.04 percent change in exchange rate, so it can be conclude that exchange rate volatility has negative effects on domestic consumption. Exchange rate changes impact on consumption per capital, production, the volume of exports and industry's employment. The study recommends that increasing local red meat production can help reduce dependence on imports, thereby insulating the industry from exchange rate volatility.

Keywords: Exchange Rate Changes, South African Red Meat Industry, Total Consumption, Consumption Per Capital, Ordinal Lest Square and Granger Causality Test
JEL Classifications: F31, Q13, D12, C32

1. INTRODUCTION

Globalisation and the integration of economies into the international market have accelerated, bringing benefits to both developing and developed countries. In this era of globalisation, exchange rates have a significant impact on the prices of imported products and inputs. The South African economy's integration into the international market has opened significant opportunities for various sectors, including agriculture and the red meat industry (Ke-Chyn and Mui-Yin 2021). These opportunities include participating in global trade through exports and imports, gaining access to advanced technological innovations, and impacting domestic consumption, production, and the labor market (Mashinini et al., 2019). However, these benefits come with certain costs, such as high volatility in South Africa's currency, which disproportionately affects developing economies (Sekantsi, 2011).

Dahir et al. (2018) highlight that currency volatility exerts substantial pressure on economic policymakers when selecting exchange rate regimes. The choice of exchange rate regimes and their influence on economic variables remains one of the most debated issues in macroeconomic policy. Although the effects of exchange rate regimes on inflation and policy credibility have been extensively studied, their influence on economic growth has surprisingly received limited attention. This may stem from the

perception that nominal variables generally have little connection to long-term growth outcomes.

According to Mohammadi et al. (2011), the exchange rate impacts the real economy primarily by influencing the demand for exports and imports. A real depreciation of the domestic currency enhances the competitiveness of exports in international markets while reducing the competitiveness of imports in the local market, thereby boosting the demand for domestically produced goods (Aye et al. 2015). As with other sectors of the South African economy, prices in the red meat industry are determined by supply and demand forces, making the industry highly competitive in the international market. This also makes it particularly vulnerable to global market shocks and fluctuations in the exchange rate.

The indirect impact of exchange rates and their fluctuations extends much more broadly and deeper in ways that affect several of the most important economic activities. According to Metsileng et al (2018) exchange rates have a tremendous influence on the economy both in the near term and over prolonged periods of time. The shift to a floating exchange rate system has sparked a vigorous theoretical debate on how exchange rate unpredictability affects output-driven foreign trade (Kihangire, 2004). Research by Munyama and Todani (2005) shows that increased exchange rate volatility generates uncertainty, heightening the risks associated with trading activities, which ultimately discourages trade.

It is argued that a free-floating exchange rate system can yield both positive and negative outcomes. While it allows for unrestricted foreign exchange and balance of payment stability, the adverse effects of exchange rate fluctuations on exports, output, and employment often outweigh these benefits (Ngondo and Khobai, 2018). Therefore, studying the impact of exchange rates on consumption, exports, output, and employment in South Africa's red meat industry has become crucial.

2. LITERATURE REVIEW

This study acknowledges the South African Reserve Bank's shift in 2000 from a fixed exchange rate regime to a floating exchange rate system. It is therefore essential to understand how the red meat industry benefits from global market integration and changes in exchange rate regimes. Over 50 years ago, Friedman (1953) argued that flexible exchange rates could shield an economy from external shocks. However, experience has shown that floating exchange rates can also be highly volatile. Theories and empirical studies on international trade, exports, and the labor market are needed to assess how South Africa's labor market and output in the red meat industry are impacted by a floating exchange rate, particularly with key trading partners like Vietnam, the United Arab Emirates, and Jordan.

Empirical studies on the impact of exchange rates on Nigeria's agricultural sector output reveal mixed results. Many findings indicate a significant effect from exchange rates, particularly through the moderating influence of the nominal exchange rate (Sonaglio et al., 2016; Mashinini et al., 2019; Obidike et al., 2022). Although these studies agree that agricultural output is responsive to exchange rates, they differ on the direction of this effect. For instance, Ozei et al. (2013) found that all exchange rate variables used in their study negatively affected agricultural output in both the long and short term, suggesting that exchange rate fluctuations hinder agricultural output in Nigeria. This contrasts with studies such as Onuorah and Osuji (2014), which argue that exchange rates positively influence agricultural output in Nigeria.

Ngondo and Khobai (2018) conducted an empirical study on the impact of exchange rate volatility on South African exports, utilizing the ARDL bounds testing approach and monthly data from 2000 to 2013. The study measures real exchange rate volatility and assesses the stability of long-run coefficients alongside short-run dynamics. The findings indicate that exchange rate volatility has an insignificant negative impact on South African exports in the long run. Additionally, the real exchange rate shows an insignificant negative long-term effect on exports (Alam et al. 2012). The positive but statistically insignificant error correction term for the exports model does not support a valid long-run equilibrium relationship among the variables.

Nyahokwe and Ncwadi (2013) examined the effect of exchange rate volatility on South Africa's total export flows to the global market from 2000 to 2009. The study employed the Vector Autoregressive (VAR) and Vector Error Correction Model (VECM) to analyze both long- and short-run relationships between exports and exchange rates. The findings indicate that there is no statistically significant relationship, suggesting an unclear connection between South African export flows and exchange rate fluctuations which agrees with findings of Chamalwa and Bakari (2016) study.

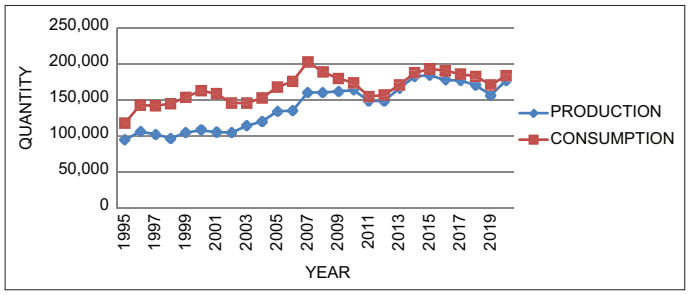
Filiztekin (2004) investigated the impact of exchange rate fluctuations on employment and wages in Turkey's manufacturing sector using data from a panel of manufacturing industries between 1981 and 1999. His findings differ from those of many other studies on this topic. He concluded that depreciation has a net negative effect on both employment and wages, with the impact on wages being more pronounced. The heavy reliance of Turkish manufacturing industries on foreign inputs diminishes the positive effect depreciation might have on competitiveness (Dincer & Kandil 2011). However, there was significant variation across industries, with the clothing sector the one that experienced the most employment growth during the 1980s being the most negatively affected by devaluations.

2.1. Sheep and Goat Production Trends

Figure 1 shows sheep and goat production compared to consumption from 1995 to 2020. As per DALRRD (2022), production and consumption of sheep and goat gradually rose from 1995 to 2007, reaching a peak consumption of 203,000 tons. From 2010 onward, both production and consumption increased in tandem, then declined together between 2018 and 2019, before rising again in 2020 to 184,000 tons for both. Over the past two decades, production has generally kept pace with consumption. However, the data indicate that sheep and goat consumption in South Africa consistently exceeds production levels.

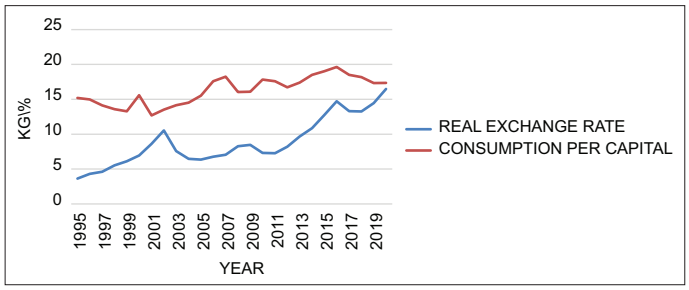
Figure 2 illustrates per capita consumption and the exchange rate from 1995 to 2020. This figure highlights structural breaks in the

Figure 1: Sheep and goat production versus consumption in South Africa



Data source: STAT SA, DALRRD (1995-2020)

Figure 2: Exchange rate versus consumption per capital in South Africa



Data source: DALRRD (1995-2020)

exchange rate that influence the pattern of per capita consumption. Significant structural breaks in the real exchange rate occurred in 2002, 2008, and 2016, driven by both internal and external shocks. Although the exchange rate has generally increased over the review period, this trend has impacted beef production and pricing. It is evident that rising exchange rates have constrained the growth of per capita consumption. This effect is attributed to the devaluation of the rand, which reduces consumer income levels.

3. METHODOLOGY

This section provides information about the dataset sources, descriptive statistics and unit root test using the Augmented Dickey-Fuller (ADF) test. The study further employed Ordinal Least Square estimation to determine the relationship between exchange rate changes and consumption in the red meat industry of South Africa. Lastly, Granger causality test was employed to determine the causality reversible relation between consumption and exchange rate in the south African red meat industry.

3.1. Data Sources

The study employed annual data observations for the period between 1995 and 2020 to estimate the response of the South African red meat industry particularly sheep and goat towards exchange rate changes. Data on South Africa's exchange rate against the US dollar was provided by the South African Reserve Bank (SARB). Export and import data were obtained from Quantic Easy Data, while information on consumption, production, and employment was sourced from the Department of Agriculture, Land Reform and Rural Development (DALRRD) and Statistics South Africa. Additionally, the Bureau for Food and Agricultural Policy (BFAP) supplied data on red meat consumption in South Africa. The variables are denoted as follows: total consumption ($TOCONS_t$), production ($PROTP_t$), export volume ($VOLEXPT_t$), total employment ($TOEMP_t$), and exchange rate ($REXRT_t$).

3.2. Descriptive Statistics

The study deploys descriptive statistics to detail the features of the data quantitatively by providing a simplified summaries concerning the observations included in the study. The study uses the following descriptive statistics to evaluate the properties of the data: minimum, maximum, mean, median and standard deviations. The minimum represents the smallest value of the series, while the maximum is the biggest value of the series. The mean is the commonly applied method of describing average tendency. Finally, the median is the score occurring in the middle of the series values.

3.3. Model Specification

The aim of the study is to estimation of the relationship between exchange rate and domestic consumption in South Africa. Getting an appropriate model for the estimation of the relationship between exchange rate and domestic consumption requires an insight drawing from works such as Iyke and Ho, (2020) and Bahmani-Oskooee and Xi (2012) by adapting their model with the elimination of variables that do not have relevance with this study. Therefore, the functional form of the model could be presented as follows;

$$\Delta lnTOCONS_t = \beta_0 + \beta_1 \Delta REXRT_{1t} + \beta_2 \Delta CONSPC + + \beta_5 lnVOLEXPT_{5t} + \beta_6 \Delta lnTOEMP_{6t} + \beta_9 \Delta lnPROTP_{t-1} + \varepsilon_t \quad (1)$$

Where $\Delta lnTOCONS_t$ denote the dependent variable, while X_1 until X_k ($REXRT$, $CONSPC$, $VOLEXPT$, $TOEMP$, and $PROTP_{t-1}$) represent the explanatory variables which are various factors that affect consumption as the dependent variable. The t subscript represents a period or dimension. Where Δ represent differencing notation, while ln (log) represent natural logarithm, and Disturbance term is represented by ε_t, which captures effects of variables which were not included in the regression.

4. EMPIRICAL RESULTS AND DISCUSSION

The section presents and discuss the empirical results. It commences with the descriptive statistics, followed by the unit root test. After that, Ordinal least square estimation, furthermore Granger causality test.

4.1. Descriptive Statistics

Table 1 shows that the minimum estimated production of sheep and goats is 94,000 tonnes, with a maximum of 184,000 tonnes, an average of 141,000 tonnes, and a standard deviation of 31,081.90. The minimum estimated consumption is 118,000 tonnes, reaching a maximum of 203,000 tonnes, with an average of 116,000 tonnes and a standard deviation of 20,364.07. Export volume ranges from a minimum of R 773,000 to a maximum of R 146 million, with an average of R 27 million and a standard deviation of R 32,856,569.72. Total employment estimates range from a minimum of 25,000 to a maximum of 37,000, averaging around 32,000 with a standard deviation of 3,405.69. The real

Table 1: Summary statistics for the sheep and goat industry

Properties/ Variable	Descriptive statistics			
	Minimum	Maximum	Mean	Standard deviation
PROTP	94800	184600	141050.00	31081.895
TOCONS	118000	203000	166846.15	20364.071
VOLEXPT	773690	146965454	27914094.15	32856569.718
TOEMP	25430	37090	32250.12	3405.688
REXRT	3.6271	16.4719	8.824742	3.4693039
CONSPC	3.000000	4.300000	3.500000	0.309764

Source: Author's calculations

exchange rate varies from R 3.63 to a maximum of R 16.47, with a mean of R 8.82 and a standard deviation of R 3.47. Per capita consumption ranges from 3.0 kg/year to a maximum of 4.3 kg/year, with an average of 3.5 kg/year and a standard deviation of 0.31.

4.2. Unit Root Test

To assess the stationarity properties of the data, the study used the ADF unit root test (Dickey and Fuller, 1979). The null hypothesis of a unit root was rejected if the P-value of the ADF statistic was at or below the 5% significance level. As shown in Table 2, the analysis of the sheep and goat industry included eight variables. One variable was stationary at levels [(0)], while the other seven were stationary after first differencing [(1)]. The variable stationary at level was total consumption, while the seven variables stationary at first difference included total sheep and goat numbers, export volume, imports, total production output, total slaughtered, per capita consumption, and the real exchange rate.

Following the unit root tests, statistical analyses were conducted to assess the effects of the exchange rate on total production output, export volume, and total employment in South Africa's red meat industry. Economic theory emphasizes that stationarity tests are essential when using secondary data to prevent spurious results (Gujarati and Porter, 2009; Gujarati, 2015; Wooldridge, 2013). The next section presents detailed results and interpretations from three economic analyses. The study employs ordinary least squares and Granger causality tests, with findings intended for international publication and to support policymaking.

4.3. OLS Estimation Results for the Sheep and Goat Industry

The Ordinary Least Squares (OLS) method was applied to examine the impact of the exchange rate on three dependent variables: total production output, export volume, and total employment in South Africa's sheep and goat sector within the red meat industry. OLS estimates the coefficients in linear regression models, showing the relationship between one or more independent variables and a dependent variable. Table 3 presents the regression model results, summarizing the model's robustness or goodness of fit. With an R^2 coefficient of 0.51 when total consumption is the dependent variable, this indicates that 51% of the variation in sheep and goat employment numbers is explained by the independent variables (exchange rate, total employment, total slaughtered, sheep and goat count, per capita consumption, export volume, and total production output). The Probability (F-statistics) is significant at 5% (0.040594), and the Durbin-Watson statistic is 1.86, close to 2,

Table 2: Unit root test for sheep and goat variables using ADF test

Variables	Order of integration				Conclusion
	Level		1st difference		
	C	C&T	C	C&T	
$TOSGNU_t$	0.9108	0.8299	0.0023	0.0120	Stationary at $I(1)$
$PROTP_t$	0.7073	0.5492	0.0021	0.0146	Stationary at $I(1)$
$IMPO_t$	0.4113	0.9030	0.0013	0.0046	Stationary at $I(1)$
$TOCONS_t$	0.0345	0.0289	--------	------	Stationary at $I(0)$
$VOLEXPT_t$	0.9999	0.8957	0.0225	0.0336	Stationary at $I(1)$
$TOSLAU_t$	0.2065	0.1116	0.0020	0.0043	Stationary at $I(1)$
$TOEMP_t$	0.1225	0.3365	0.0000	0.0000	Stationary at $I(1)$
$REXRT_t$	0.9440	0.8487	0.0145	0.0434	Stationary at $I(1)$
$CONSPC_t$	0.0580	0.1382	0.0047	0.0079	Stationary at $I(1)$

The presence of a unit root is tested by comparing the calculated t-statistic with the critical value at the 5% significance level. Rejection of the unit root hypothesis at the 1% level (P≤0.01) and 5% level (P≤0.05) were used

Table 3: Ordinal least square estimation for sheep and goat industry

Dependent variable		*D (lnTOCONS)*	
Independent variable		**Coeficient**	**Prob.(5%)**
$CONSPC_t$		0.125	0.6671
$REXRT_t$		−0.039	0.0076
$lnTOEMP_t$		0.116	0.9168
$lnTOSGNU_t$		0.401	0.7195
$lnTOSLAU_t$		−0.415	0.4406
$lnPROTP_t$		−0.117	0.7797
$lnVOLEXPT_t$		−0.011	0.7700
$LNTOCONS_t$		0.014	0.0410
Goodness of fit	R-squared	0.51	
	Prob (f-statistic)	0.040594	
	Durbin-watson	1.86	

Source: Author's own computation

suggesting that the model does not suffer from serial correlation or multicollinearity. Table 3 highlights one independent variable with a significant positive impact on total sheep and goat consumption. The regression coefficient shows that the real exchange rate ($LNREXRT_t$) has a positive relationship with total consumption, with a coefficient of 0.03, significant at the 5% level. This means a 1% change in total consumption is associated with a 0.03% change in the exchange rate. The finding aligns with Bahmani-Oskooee (2015), showing that exchange rate volatility negatively impacts domestic consumption.

4.4. Granger Causality Test

The Granger causality test was used to examine the causal relationships among the variables in the regression, including the volume of exports ($LNVOEXPT_t$), real exchange rate ($REXRT_t$), total employment ($LNTOEMP_t$), and total production output ($LNPROTP_t$) in the sheep and goat industry. As shown in Table 4, there is a bi-directional causality effect between total production output and export volume, as both have P-values below the 5% significance level. The statistical hypothesis test assesses whether one time series can help predict another (Gilmore and McManus, 2002, based on Granger, 1969). This relationship indicates that as the sheep and goat industry increase production output, it boosts the likelihood of exporting more products to other countries. The

expansion of production capacity creates long-term causality effects between these two variables. Additionally, Table 4 shows no significant long-run causality effects for the other variables tested in the Granger causality analysis for the sheep and goat industry.

4.5. Diagnostic Test for the Sheep and Goat Regression

Various diagnostic evaluations were undertaken to validate the sheep and goat model, specifically employing the Breusch-Godfrey Lagrange Multiplier (LM) test for identifying serial correlation, the Breusch-Pagan-Godfrey test for Heteroscedasticity, and an assessment of model stability using the cumulative sum of recursive residuals (CUSUM). The outcomes of the Breusch-Godfrey LM test for serial correlation resulted in the rejection of the null hypothesis associated with serial correlation. Consequently, it was deduced that the model is devoid of serial correlation (Gujarati, 2015; Wooldridge, 2013).

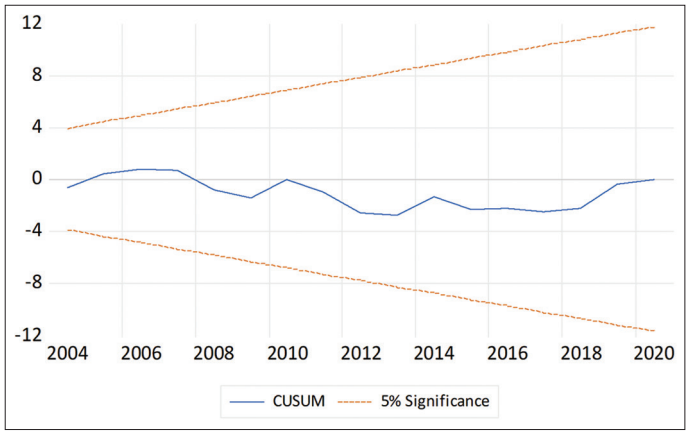
Results from the Breusch-Pagan-Godfrey test indicate that the sheep and goat model is unaffected by heteroscedasticity. These results suggest that the error term is uniformly distributed across all regressors. These findings substantiate the credibility of the regression, ensuring that the results are trustworthy and not misleading. Therefore, the influence of regressors on the South African red meat industry is accurately delineated by the sheep and goat regression.

Table 4: Granger causality test for the sheep and goat industry

Null hypothesis	F-statistics	Prob.
$LNVOEXPT_t$ does not granger cause $REXRT_t$	0.52745	0.4753
$REXRT_t$ does not granger cause $LNVOEXPT_t$	2.44648	0.1321
$LNTOEMP_t$ does not granger cause $REXRT_t$	0.00899	0.9253
$REXRT_t$ does not granger cause $LNTOEMP_t$	1.42974	0.2445
$LNPROTP_t$ does not granger cause $REXRT_t$	0.93490	0.3441
$REXRT_t$ does not granger cause $LNPROTP_t$	0.10125	0.7533
$LNTOEMP_t$ does not granger cause $LNVOEXPT_t$	0.14793	0.7042
$LNVOEXPT_t$ does not granger cause $LNTOEMP_t$	0.04556	0.8330
$LNPROTP_t$ does not granger cause $LNVOEXPT_t$	5.49651	0.0285
$LNVOEXPT_t$ does not granger cause $LNPROTP_t$	1.66633	0.0212
$LNPROTP_t$ does not granger cause $LNTOEMP_t$	0.00319	0.9555
$LNTOEMP_t$ does not granger cause $LNPROTP_t$	0.12657	0.7254

Source: Author's own computation The relationship with P values below 0.05% signifies the causality effects between the variables, while the relationship with P value over 0.05% denotes no causality between the variables

Figure 3: The model stability test for the sheep and goat industry



Source: Author's computation

The CUSUM test results for stability, depicted in Figure 3, indicate that the residuals derived from the sheep and goat regression conform to a normal distribution. Moreover, all requisite variables have been properly incorporated into the regression. The use of recursive residuals as a method for testing model stability is evident in Figure 3, where these residuals exhibit linearity due to their identical and independently dispersed nature. Consequently, the sheep and goat regression is appropriately specified, satisfying all diagnostic criteria. In conclusion, the Ordinary Least Squares (OLS) model emerges as the most fitting model for scrutinizing the impact of regressors on the South African red meat industry, covering aspects such as consumption, exchange rate, production output, exports volume, and employment.

5. CONCLUSIONS

This study is one of the very few studies, which have empirically analysed the effects of exchange rate on total consumption in the sheep and goat industry of South Africa. Due to the importance of consumption decisions in policy, earlier research has focused on identifying the main factors influencing consumption. Traditionally, income level and interest rates have been identified as key determinants. More recent studies, however, have highlighted the impact of exchange rate changes on consumption, suggesting that currency depreciation may reduce consumption by causing inflation that shifts income from individuals with a high marginal propensity to consume (MPC) to those with a low MPC. Other research points to exchange rate volatility rather than average changes as having a significant impact on consumption, as such volatility can lead to inflation fluctuations, which may either hinder or boost consumption.

The empirical analysis is based on the annual time series dataset during the period between 1995 and 2020. The unit root test of the series was employed using the ADF before executing the inferential estimation. The ADF test highlighted that all variables were found to be stationary either at level or at the first differences. The descriptive statistics, ordinal least square and Granger causality test were applied to analyse the effect of exchange rate on total consumption domestically. The results for sheep and goat regression show that, there is 1% change in total consumption that resulted from 0.04% change in exchange rate, so it can be conclude that exchange rate volatility has negative effects on domestic consumption. Causal relation or effect results for sheep and goat industry shows that single directional causality effect exist between, or which runs from exchange rate to total consumption. Other pairs for sheep and goat estimation do show causal relationship or effect because their P-values are greater that 5% significant level.

Policy makers together with government should develop a robust system for tracking exchange rate trends, red meat prices, and consumption patterns which can help anticipate shifts in demand. Increasing local red meat production can help reduce dependence on imports, thereby insulating the industry from exchange rate volatility. This could be achieved through government subsidies, improved access to financing for local farmers, and investing in modern farming technologies.

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