

Exploring South African/USA cryptocurrency arbitrage

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Abstract

Crypto arbitrage, the exploitation of currency-exchange arbitrage is a low-risk trading strategy which succeeds by leveraging market inefficiencies. By executing frequent buy and sell transactions on two different (fiat) currency exchanges to accumulate profits, the strategy employs the USA and South African Bitcoin price differential and the accompanying exchange rate between the countries. The approach is found to exhibit remarkable stability over the observation period (June 2021 to August 2023), yielding an arbitrage of a roughly 2% return, even after various fees have been accounted for. Higher returns would have been realised if the approach had been implemented earlier, e.g., in 2016, when the arbitrage gap was closer to 6%. The framework is hampered by South African regulations (which amongst other things impose a ZAR 11mn annual cap on cash leaving the country). This can, however, still be circumvented by definitional loopholes and the establishment of shell companies in the different jurisdictions.

Keywords: *Cryptocurrency, arbitrage, emerging markets, price differentials*

Introduction

Cryptocurrencies (cryptos) represent digital assets or currencies grounded in blockchain technology, allowing payment and transaction verification without the need for centralised custodians. The concept governing the most widely recognised crypto, Bitcoin, set out by Nakamoto (2008) was launched in 2009. The crypto market has subsequently undergone significant transformations. With over 100 exchanges worldwide, more than 50 million active investors traded in Bitcoin and other cryptos in 2023 (Almeida, & Gonçalves, 2023). Crypto assets now (2024) represent a burgeoning sector of the global economy (Figure 1) and show no signs of abating with the market capitalisation in late 2023 standing at US\$1.7tn (Detthamrong, Prabpala, Takhom, *et al*, 2024). Fund managers have begun to incorporate cryptos as significant constituents in investment portfolios (Pele, Wesselhöfft, Härdle, *et al*, 2023), crypto derivatives are emerging (Bouteska & Harasheh, 2023) and regulatory authorities – no longer able to ignore the market – must constantly adapt rules governing their use or misuse (Griffith & Clancey-Shang, 2023 and Bonaparte & Bernile, 2023).

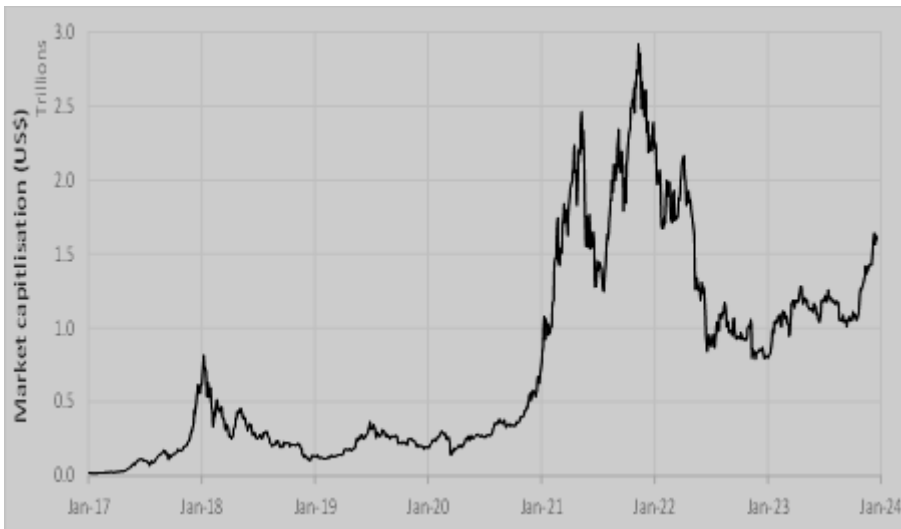


Figure 1: Crypto market capitalization in US\$tn for the seven years between January 2017 and January 2024. (Source: Authors).

Despite the regulatory and investor interest, research on the key factors influencing crypto profitability arbitrage remains scarce even though some detailed studies have started to penetrate the literature (e.g., Malladi, 2023 and Zhang & Li, 2023). Crypto arbitrage (Oanta & Coroiu, 2023) – a strategy which exploits market inefficiencies through the purchase and sale of cryptos on two exchanges in different fiat currencies to accumulate many small profits – has been little explored to date. Using historical price data of the most popular crypto, Bitcoin and the prevailing exchange rate between a developing (South African) and developed (US) nation, this article explores the risks involved with and analyses the potential profits which may arise from crypto arbitrage.

Cryptocurrency arbitrage offers a low-risk trading strategy by exploiting price differences between exchanges. This study focuses on the USA-South Africa Bitcoin price differential, demonstrating roughly 2% returns from June 2021 to August 2023. Despite regulatory hurdles like South Africa's currency restrictions, the strategy remains viable, highlighting the need to navigate these challenges for sustainable arbitrage opportunities in cryptocurrency trading.

There is little existing literature on this niche topic: the field of cryptocurrency arbitrage, especially in Africa, is relatively new and underexplored. Available studies primarily focus on foundational aspects and pragmatic approaches. This scarcity of comprehensive and critical analyses highlights the significance of our study in contributing to an emerging body of knowledge and addressing gaps in the current understanding of global crypto arbitrage markets.

The remainder of this article proceeds as follows: Section 2 presents a literature study governing the opportunities for crypto arbitrage while Section 3 provides the background information on the data used and the methodology applied to determine whether such arbitrage transactions would have been historically profitable after considering transactions costs and other fees. Results are presented and discussed in Section 4, and Section 5 concludes.

Literature review

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A crypto is any form of currency that is digitalised or virtualised, using cryptography to secure a transaction, enabling anyone to receive or make payments from anywhere, safely, and securely, without having dependence on banks. Instead of a regulating authority or a central issuer, cryptos use a decentralised system to record and store transactions, as well as issue new units (coins) (Kavei, 2022) (Arora, 2023).

The blockchain (the distributed public ledger on which cryptos operate) assists with record keeping of all updated transactions by crypto holders (Kaspersky, 2022). Crypto transactions are recorded in a single publicly distributed blockchain ledger, reducing fraud related transactions (Ravikiran, 2023) and providing investors with opportunities to move money offshore, quickly (often only minutes) with low transaction costs compared with traditional financial services.

Traders exploit crypto arbitrage opportunities by purchasing cryptos on a foreign exchange (where the price has not yet been adjusted for the prevailing exchange rate change, so the crypto price on the foreign exchange is undervalued compared with that on a local exchange). Once the crypto has been purchased on an offshore crypto exchange, a simultaneous transaction is conducted on the futures market, where the investor managing the arbitrage will lock in a profitable offer to sell that previously purchased crypto on a domestic crypto exchange. Due to exchange controls, laws, and regulations cryptos sell at a premium in only a limited number of countries (Hub, 2022). Exchange controls cause the prices of the cryptos to be more expensive (coins are purchased and sold at a premium) in comparison with other foreign exchanges that have no such controls installed (Ovex, 2021). Arbitrage traders make small gains from the price differences and because transactions occur almost simultaneously (or at least in very short periods, often minutes), arbitrage is a relatively low risk investment (Bernstein, 2019).

In South Africa, crypto arbitrage represents a considerable investment opportunity because several cryptos trade at a premium compared with other international markets. This is entirely due to South African exchange controls which make it possible for tax compliant individuals to use up to ZAR11mn/annum as capital in tax-free

investment which is used to perform the arbitrage.¹ All required licensing and approvals are derived from the South African Reserve Bank (SARB), the Financial Sector Conduct Authority (FSCA) and the South African Revenue Service (SARS). Investors in the arbitrage opportunity can either supply their own trading capital or finance capital using loans. Investors who use their own capital, for example ZAR250 000 per transaction, could only trade 44 times² before individual allowances were breached (Falkena, 2003).

There are other countries where the crypto arbitrage opportunity is both possible and profitable where the cost of living in comparison to the US dollar is much lower. Profits made through the arbitrage is valued higher in these more underdeveloped countries. Brazil has a strong market for Bitcoin arbitrage as the demand for crypto is far greater than the supply available within the country, which creates a substantial arbitrage opportunity for crypto arbitrage to take place (Coinext, 2021). Bitcoin is classified as a class of 'intangible goods' similarly to shares, so in Brazil crypto is not subject to custom duties or other import taxes. In India, Bitcoin arbitrage is not quite legal: arbitrage may only be undertaken in large capital sums per trade as required payable fees could reduce profits considerably. Colombia also conducts Bitcoin arbitrage, similarly to the South African arbitrage technique, offering discounted crypto prices in relation to other offshore markets. Lastly, Malaysia, one of the most developed Asian countries, enjoys sophisticated local platforms where investors can buy and sell cryptos easily and instantly, allowing Malaysians to benefit and profit through the crypto arbitrage strategy (B2B Pay, 2019).

As this strategy reflects an investment, multiple fees are payable by investors with every transaction. Traders or trading organisations charge fees, usually a sliding scale percentage based on the gross returns of each transaction. Forex fees (per trade) are also payable, based on a sliding scale 0.25%-0.75% depending on the price premium (Clayton, 2023). Other fees include the Society for Worldwide Interbank Financial Telecommunications (SWIFT) foreign exchange fees, applied when the currency of the sender and receiver differ (in South Africa, this fee is

¹ The ZAR11mn comprises two tax allowances: an individual's standard discretionary allowance (SDA) of ZAR1mn, and an individual's foreign investment allowance of ZAR10mn.

² $\text{ZAR11mn} / \text{ZAR250 000} = 44$. The maximum permitted allowances would be breached if the money used in the arbitrage transaction exceeded the sum of the two tax allowances mentioned above. Transactions in excess of the allowance incur punitive taxes, which reduce profits considerably.

ZAR500/trade (Ciaran, 2021)). The process involved for an arbitrage trade is shown schematically in Figure 2.

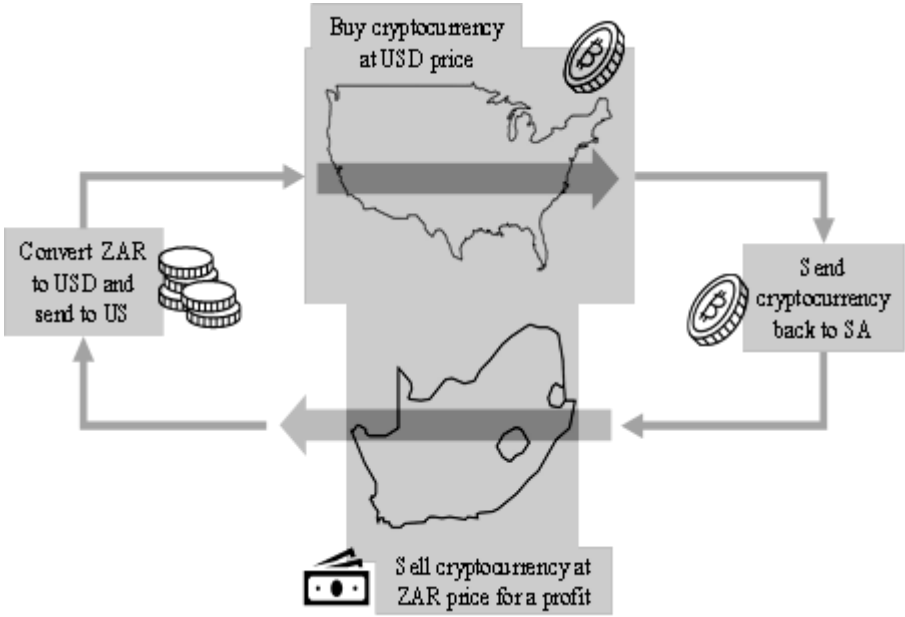


Figure 2: The flow of money during an arbitrage trade (Source: Authors).

Firstly, a client or individual must register with a trading company or trader, requiring positive identification and registration. In South Africa, this is undertaken and governed by Financial Intelligence Centre Act (FICA) documentation (Strand, 2023). Once documents are approved and all background client checks have been completed, a foreign exchange/trading bank account is opened on behalf of the client. The client transfers funds into the trading account to which the trader or trading organisation has access. When premia are profitable, the trader sends the clients' money to the US using the client's funds to either purchase a crypto asset (e.g., Bitcoin) on a foreign exchange (Kraken) or purchase USD on a foreign exchange at a given spot rate. This will be used to buy crypto assets in the US. Simultaneously the trader locks in a futures sell order, to sell the purchased crypto assets offshore on a South African exchange (Luno or VALR), returning the crypto asset back into South African markets and selling for a locked in profit (Bank for International Settlements, 2023). Profits generated from the returns are kept in the client's trading account

and available for withdrawal. The remaining capital portion may be used for future arbitrage trades, and the cycle continues (Stobierski, 2021).

The advantages for an investor or client engaging with various institutions to undertake the arbitrage is that as little as ZAR250 000 may be used as an investment.³ Profits from such a trade would accumulate and the ZAR250 000 could be re-used for the next trade. This cycle would continue until the client's annual allowances were exhausted (amounting to ZAR11 mn according to the SARB's FIA⁴/AIT⁵ and SDA⁶) provisions. Such an investor would need 44 trades of ZAR250 000 to exhaust the maximum annual allowance of ZAR11 mn. Assuming a net of 1% return, the investor would generate a profit of ZAR110 000 off the initial investment of ZAR250 000 (if the initial ZAR250 000 were used repeatedly). The investor would thus generate a 44% net return after all 44 trades have been completed. This process would take about six months, dependent on SARS and how quickly an investor received their tax clearance pin.

The crypto arbitrage premium is never a fixed rate, many factors conspire to provide higher or lower premia. At the end of Q1 2021 the arbitrage premium on Bitcoin was almost zero; at times it can be below zero (at which point it is cheaper to purchase Bitcoin in South Africa rather than use an offshore exchange). This is extremely rare, occurring for only three days over the period January 2017 to January 2024, on South African exchanges (see Figure 3). This substantial decrease in the crypto premium was caused by MTI⁷ liquidating Bitcoin to the value ZAR1.1bn owned by investors. All this Bitcoin was sold through South African exchanges which created a substantial oversupply of the crypto asset, pushing down the local price and therefore removing the arbitrage opportunity (Ciaran, The three main factors influencing crypto arbitrage profits, 2021). Such events, at least on exchanges in the US and South Africa are almost vanishingly rare.

Figure 3 presents the impact that the liquidation of the R1.1 billion worth of Bitcoin sold on South African exchanges had on the crypto arbitrage premia. The premia were negative for three days. This is,

³ The client may also borrow, but because of interest charged, this option would lower returns and profit.

⁴ Foreign Investment Allowance.

⁵ Approval for International Transfer.

⁶ Single Discretionary Allowance.

⁷ MTI was a cryptocurrency trading platform which promised high returns using an AI bot for automated trading. It was eventually declared a pyramid scheme by the South African High Court, after facing intense scrutiny and legal challenges from authorities.

however, usually not the case when it comes to Bitcoin and other crypto prices in South Africa. The arbitrage premium increases when prices fall in US dollars relative to the rand (i.e, the rand strengthens to the dollar) as the premium is correlated to the US dollar price of Bitcoin (Ciaran, The three main factors influencing crypto arbitrage profits, 2021). Another factor that influences the crypto arbitrage premium is the number of companies and crypto arbitrageurs trading at a time or on a certain day. If multiple traders and many firms trade simultaneously, the premium is lower compared to when there are fewer traders operating on a specific day (Businesslive, 2022).

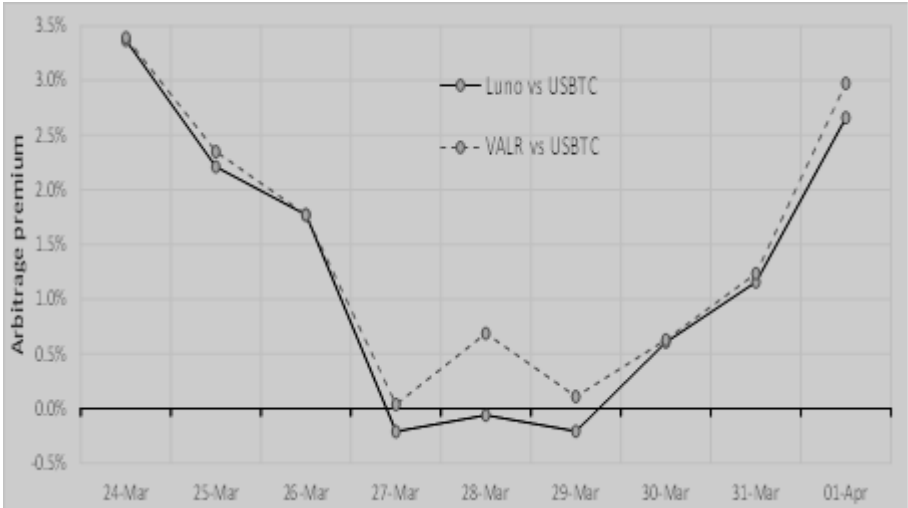


Figure 3: The impact the liquidation of Bitcoin sold on South African exchanges had on the return premia recorded from 24-Mar-21 to 1-Apr-2021.

On the 25 August 2023 a large US based exchange, Kraken, ceased accepting South African deposits as Krakens banking partners Bank Frick blocked deposits from South African-based users (Crypto News, 2023). The reason for the decision was linked to the Financial Action Task Force (FATF) recently adding South Africa to its grey list. This list identifies culprit countries as lacking in strategic anti-money laundering directives and the financing of terrorism deficiencies. South Africa is under increased monitoring and continues to work closely with the FATF to address strategic deficiencies (FATF, 2023). The impact of the grey listing and Kraken ceasing to accept deposits from South Africa saw

the premium on crypto assets such as Bitcoin jump to 3.5% (previously it fluctuated between 0.7% and 1.5%). South African crypto trading and arbitrage companies who relied on Kraken were unable to continue operations (Kodzila, 2023), but those which did not, benefited enormously (Zimwara, 2023) as restricted trading volumes generated correspondingly high returns (Ciaran, 2023).

The South African Financial Sector Conduct Authority (FSCA) declared that financial crypto companies must be registered – through the FSCA – and apply for Category II⁸ license from 1 June 2023 to 20 November 2023 (Savage, 2022). This afforded the opportunity for trading houses to trade on clients' behalf (Moonstone, 2023). Licenses are necessary for various reasons, ranging from regulatory compliance to controlling the ways in which cryptocurrencies are utilized. Additionally, licenses help mitigate potential financial harm to individuals and safeguard the global economy. The decentralised nature of cryptos has led the SARB to investigate their use in South Africa. The SARB unearthed potential non-compliance with existing South African regulations, which could lead to tax evasion, money laundering and terrorist financing activities (Barnett, 2022). Overall, however, the SARB does not intend to regulate cryptos as a *currency*, but rather as a *financial asset*. In doing so it will legitimise the crypto industry and ensure certain controls are in place to combat money laundering, terrorist financing activities and tax evasion, as well as safeguard exchange control regulations and many other regulations remain installed and accepted.

The new regulation and required license for financial crypto companies to operate will have many advantages to crypto arbitrage and potential disadvantages. If companies are unable to obtain their required licensing, there will potentially be fewer companies operating within the crypto arbitrage field thereby increasing premia (and hence returns) for clients and crypto arbitrage companies: higher commissions (performance fees) can be demanded for executing trades. A possible issue relating to the new regulation is new institutional participants entering the crypto arbitrage market that are licensed. This could lead to a substantial decrease in premia as an increased number of companies will exploit the arbitrage opportunity leading to considerably increased volumes of traded crypto assets.

⁸ A Category II license is a sought-after discretionary services license issued by the South African Financial Sector Conduct Authority, obtained only by meeting strict requirements for knowledge, experience, skill, and personal integrity.

Data and methodology

The two main South African crypto exchanges are Luno (Investing.com, 2023) and VALR (VALR, 2023). Historical Bitcoin prices from both exchanges are used to conduct the test and discover potential arbitrage premium returns.⁹ Daily historic Bitcoin prices quoted on a US exchange are obtained from Coincodex (2023).¹⁰ Time zone differences between South Africa and the US affect crypto arbitrage due to variations in market activity, local demand, regulatory environments, and liquidity on different exchanges. Higher trading volumes during US peak hours can create price differences, while local demand and regulations can lead to price disparities. Banking hours and transaction times cause delays in executing arbitrage trades, and local traders may react faster to news, creating temporary opportunities. Despite 24/7 trading, these factors make time zones significant for arbitrage. Average daily prices are thus used to ensure that each exchange overlaps¹¹ during a particular day because of South African/US exchanges time zone differences and the scarcity of data, (Binance, 2023).

Historical exchange rate data of the South African Rand (ZAR) against the US Dollar (USD) were provided by Currency converter (2023) allowing the conversion of the Bitcoin price on a US exchange into ZAR, used to calculate the price difference (Crypto arbitrage premium) by comparing the Bitcoin price in ZAR on the two South African exchanges Luno and VALR with the US dollar exchange Bitcoin price. All fees, transaction costs and performance fees are deducted from the gross premium calculated from the differing return percentages based off the South African exchanges, and the US exchange. Fees charged are an average total fee used by South African

⁹ In the context of cryptocurrencies where regulatory changes are unpredictable, focusing on historical data offers a stable foundation to understand past trends, assess the impact of previous events, validate models, and manage risks. This approach provides essential context and insights, despite the uncertainty of future regulatory environments and real-time market dynamics.

¹⁰ Selecting just one cryptocurrency exchange for analysis allows for a deeper and more thorough examination of its operations, security measures, regulatory compliance, user behaviour, and market dynamics. This approach provides detailed insights and serves as a benchmark for future comparisons. It is also practical due to resource constraints, ensuring the study is manageable and focused. Analysing a single, strategically important exchange offers valuable information that is broadly applicable to the industry.

¹¹ Time differences between the US and South African exchanges make it difficult to accurately ascertain precise transactional efficiency because both exchanges are operational (and their operations overlap) for part of the same day. Using *average* daily bitcoin prices to evaluate the arbitrage opportunities alleviates this problem without diluting the available opportunities.

crypto arbitrage companies (Fivewest, 2023, Currency Hub, 2023 and Futureforex, 2023).

With all prices being in ZAR, a comparison can be made of the price difference of the South African exchange price per Bitcoin to the US exchange price per Bitcoin. This facilitates the calculation of price differences (gross premium) on the South African exchange compared with the US exchange. Price differences are the gross percentage premium that a trader could make if they took advantage of the arbitrage opportunity within South Africa and other nations. Fee values used are those of current South African crypto arbitrage companies, averaged and deducted from the price difference (return premium) to calculate a net premium, thereby providing realistic estimates of profits received from arbitrage trades.

Analysis and Results

Figure 4 shows the daily standard deviation of the returns of the two South African crypto exchanges, Luno and VALR compared to the US exchange. The standard deviation provides valuable insights about the volatility of the market as well as the risk associated with the crypto price fluctuations and movements. It also helps in making informed decisions about arbitrage strategies and risk management.

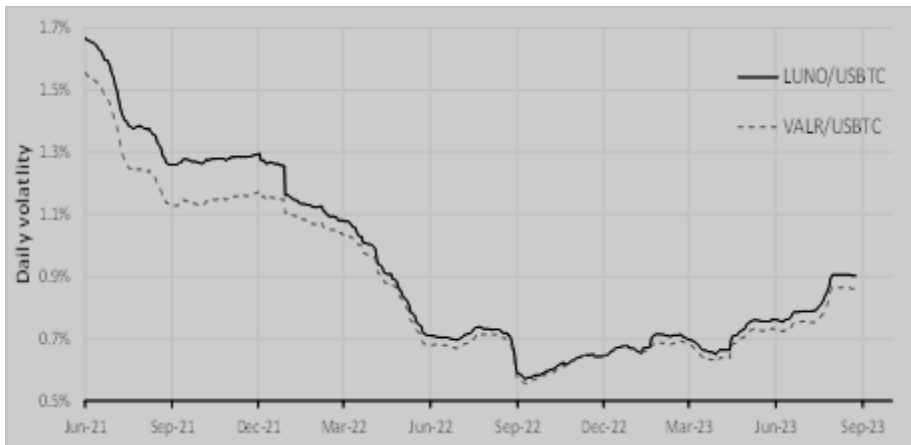


Figure 4: Daily volatility of arbitrage returns compared to the US exchange.

Figure 4 shows the standard deviation over the three years (2021 to 2023) has a downward trend. The downward trend prevalent between 2021 and 2023 is due to more traders and companies becoming involved in crypto arbitrage, increasing liquidity in crypto assets and reducing volatility.

Figures 5 and 6 show the price premium differences in the Luno returns compared to the VALR returns as well as their individual percentage returns on their specific South African exchanges. Figure 5 indicates that in June 2021 Luno had higher premia, offering traders higher returns, but from September 2021 onwards VALR offered better returns and higher premia. More recently, there is no preferred exchange as both exchanges offer very similar return percentages. Figure 6 shows that Luno offers the higher premia in the beginning of 2021, while VALR takes over for most of the time prior.

The arbitrage opportunity arises from the natural consequence of mostly positive premia: traders can buy cheaper Bitcoin offshore (e.g., the USA) and sell it for a premium price in South African markets, making small but consistent margins for each trade.

The skewness shows the asymmetry of the returns (Taylor, 2022) (Figure 7). The returns are negatively skewed (to the left) indicating a potential arbitrage opportunity. Changes in skewness over time suggest a shift in market dynamics or a bitcoin price fluctuation.



Figure 5: Average difference between Luno price premium and VALR price premium, i.e. $Luno_{premia} - VALR_{premia}$. Positive values indicate periods when $Luno_{premia} > VALR_{premia}$ and vice versa. (Source: Authors' calculation).

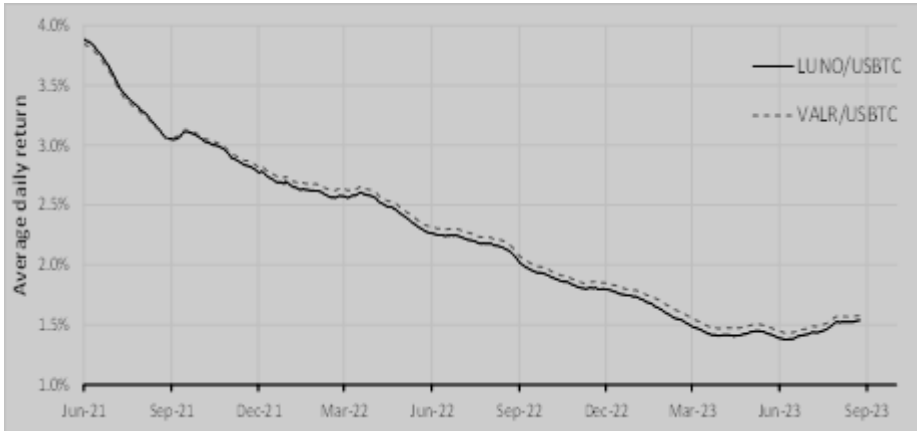


Figure 6: The average daily returns of Luno and VALR. (Source: Authors' calculation).

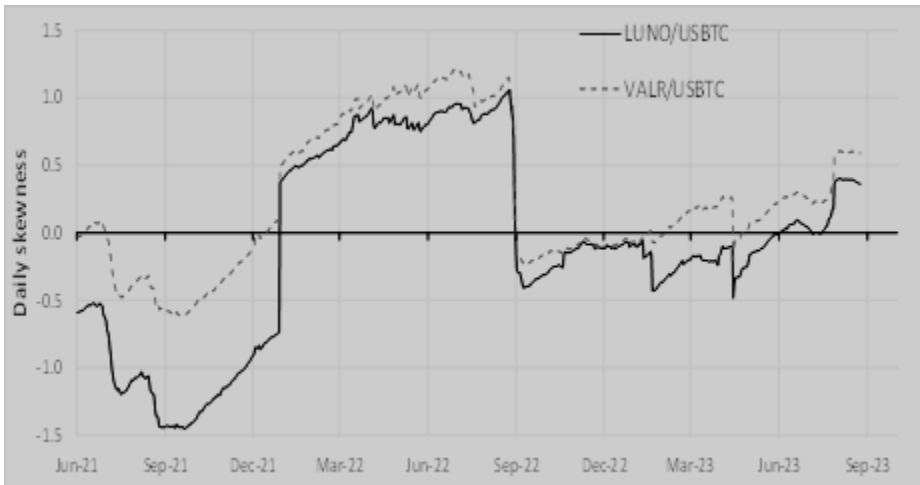


Figure 7: Skewness of Luno and VALR Bitcoin arbitrage return percentages compared to the price on the US exchange. (Source: Authors' calculation).

Return data are characterised by high kurtosis (Figure 8) indicating large price swings and volatile returns. The crypto arbitrage premia fluctuate constantly: the price premium varies throughout the day and from day to day, reflected in the abnormal kurtosis shown in Figure 8.

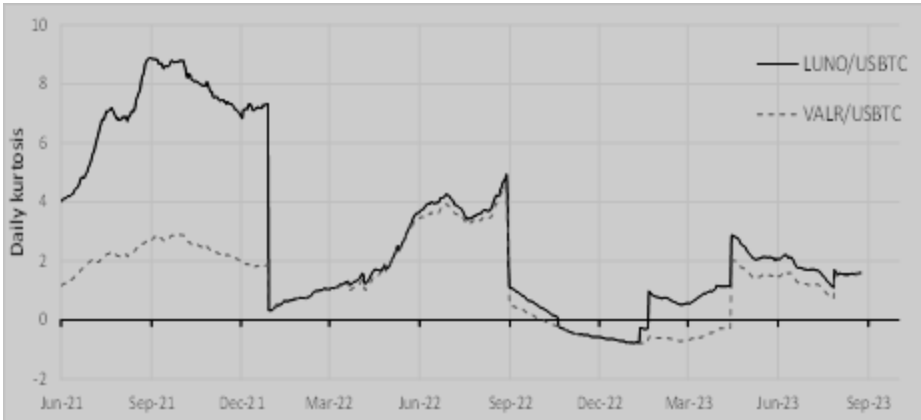


Figure 8: Kurtosis of Luno and VALR Bitcoin arbitrage return percentages, each compared to the price on the US exchange.
(Source: Author's calculations).

Figure 9 shows the daily arbitrage returns available to traders and investors over the investigation period. With most net-of-fee returns positive, daily premia are mostly positive indicating that the arbitrage opportunity is frequently profitable. The price discrepancies between exchanges allow arbitrageurs to exploit crypto arbitrage opportunities. Figure 9 also suggests possible market inefficiencies and opposing market regulatory authority directives: hence the reason for the price premium in South Africa.

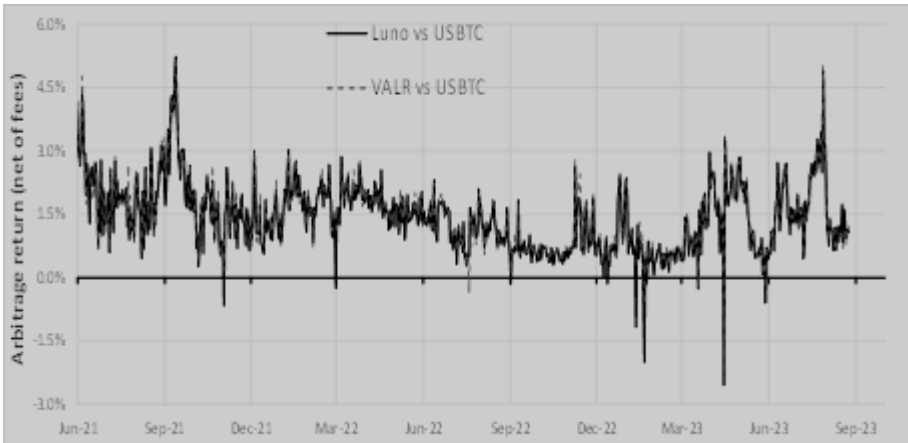


Figure 9: Arbitrage returns (net of fees) on the Luno and VALR exchanges in comparison to the US exchange.
(Source: Authors' calculations).

The existing price premium and the behavior of the premium is influenced by an influx of competition within the crypto arbitrage space. Fees and transaction costs play a considerable role when assessing the price premia. Higher premia may be an opportunity for firms to take higher performance fees impacting the actual profitability of the crypto arbitrage strategy.

Figure 10 shows the relationship and price differences of Luno premia measured on the US exchange. A surplus of positive returns is indicated as well as an existing opportunity for crypto arbitrage within the market alongside the return volatility over time. Deviations and changes in shape on the return distributions reflect changes in market efficiency, new companies and traders onboarding this opportunity and consistent exchange rate and price fluctuations.

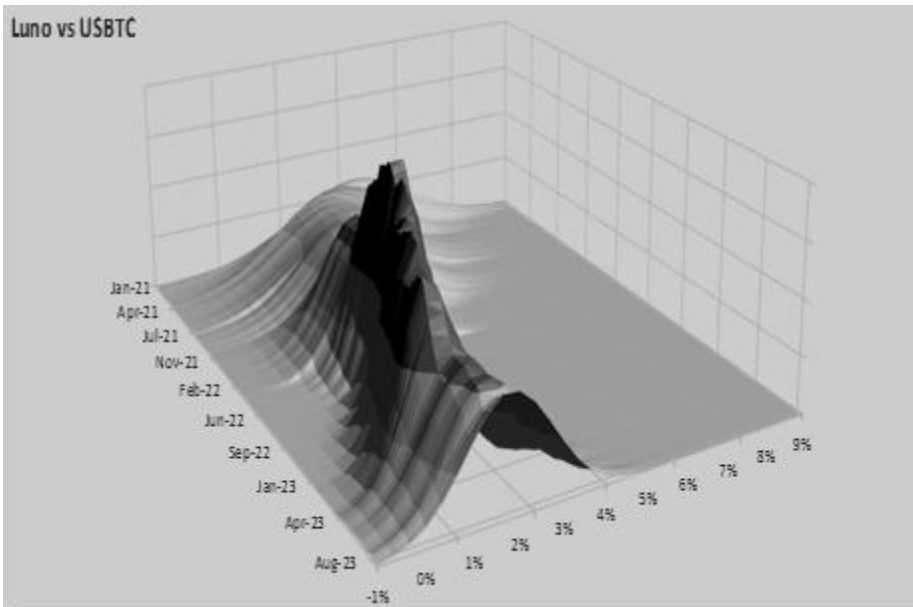


Figure 10: Time series of Luno premium return distribution as measured on the US exchange.

(Source: Authors' calculations).

Conclusion

This article explored risks involved and the profit opportunities offered within the crypto arbitrage space on a global level. Throughout the course of limited research on crypto arbitrage, it was a comprehensive

journey starting with the understanding of the fundamentals of cryptos and the concept of arbitrage. With a profitable arbitrage return price premium, the market is shown to have inefficiencies, regulatory exchange control differences, price and exchange rate disparities and opportunities to be explored.

The premia often shifting with current market conditions, there is a noticeable existence of a volatile but positive arbitrage return premium within South African markets. Risk management will always be a big concern for all involved in the transaction, however with the arbitrage being traded almost simultaneously the risk is almost completely mitigated. The only risks faced are market volatility, transaction costs and fees and lastly, specific exchange risks which will generate reduced trade premia.

This work suggests that crypto arbitrage in South African markets is profitable and large returns can be made. This article provided a comprehensive overview of the opportunities, market dynamics and risks associated with the arbitrage opportunity. This strategy has been shown to be profitable, but all possible risks should be considered as the crypto market remains volatile in a rapidly changing environment.

Several limitations are acknowledged. With different exchanges being used, in this case South African exchanges and US exchanges, times zone differences impacted quantitative data in determining the spot rate arbitrage profits. This was due to crypto and exchange rate prices constantly changing. The fees and costs used in the data when conducting a hypothetical arbitrage trade were a sliding scale of fixed percentages of gross premia calculated.

With the crypto market continuing to mature and regulators adapting to this new financial opportunity, further research could incorporate other cryptos in the research and compare individual arbitrage returns. Using different crypto platforms, exchanges, jurisdictions and currencies to discover the most profitable returns in global markets is another possibility, but staying up to date with new regulations, laws, and exchanges controls is crucial. Regulations are decided by regulatory authorities which may be very different in different jurisdictions, posing threats or opportunities.

Considering the findings on crypto arbitrage opportunities and the associated risks, several policy suggestions can be made to enhance the profitability and manage the risks within the South African markets:

- **Enhanced oversight and transparency:** Implementing stricter oversight on crypto exchanges can help ensure transparency and reduce risks associated with fraudulent activities and market manipulation. This could include mandatory disclosure of transaction fees and costs.
- **Improved financial infrastructure:** Developing a more robust financial infrastructure to support faster and cheaper cross-border transactions can minimise delays and reduce transaction costs, thereby improving arbitrage efficiency.
- **Risk management protocols:** Establishing clear risk management frameworks for crypto arbitrage traders can help mitigate market volatility risks. This might include guidelines on maximum exposure limits, diversification strategies, and the use of hedging tools.
- **Education and awareness:** Increasing education and awareness among traders and investors about the risks and opportunities in crypto arbitrage can help them make informed decisions. This could be achieved through regular publications, seminars, and online resources.
- **Collaboration with global regulators:** South African regulatory bodies should collaborate with their counterparts globally to stay updated on emerging trends, regulations, and technologies in the crypto market. This can help in preemptively addressing issues that could affect arbitrage opportunities.

Implementation of these policies could better leverage the profitable opportunities in crypto arbitrage in South Africa while managing the inherent risks in this volatile and rapidly changing market.

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