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Top-10 South African Fine Wines: To Drink or to Invest?

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NITheCS–Colloquium

Agenda

1. Fine wine
2. The world Consumption and production of Wine
3. Motivation
4. Model Framework
    - Growth Optimal Portfolio
5. Data
6. Methodology and Empirical Results
7. Implication of Results
8. Economic Significance in SA

Collaborators

- This talk is based on joint work with my FRM honours students **Anton Blignaut, Jean-Pierre Viljoen** and **Roland Peens**, the CEO of Wine Business Advisors and a wine specialist at Strauss & Co
- Papers:
  - Peens, R., Alfeus, M. (2023). SA Fine Wine Enhances Portfolio Growth. *Personal Finance Magazin*e, 515(2023), 15-16
  - Alfeus, M., Blignaut, A., Viljoen, J.-P. Cheers to Enhanced Portfolio Performance: Wine as a Unique Asset Class, under review at *International Journal of Theoretical and Applied Finance*
  - Peens, R., Alfeus, M. (2024). Introduction to SA Fine Wine Derivatives. *Work in progress*


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FINE WINE

Fine Wine

- Fine wine is wine that gets better with time and appreciates in value.
- What are the characteristics of this market?
- Could it be considered as an asset class and which are the tools that can possibly help insiders and investors to manage the associated risk?
- Could it be considered as a safe asset like gold in times of financial crises or at times when investing in the financial market risks being too dangerous as it is at this time where the indices are at their maximum values?

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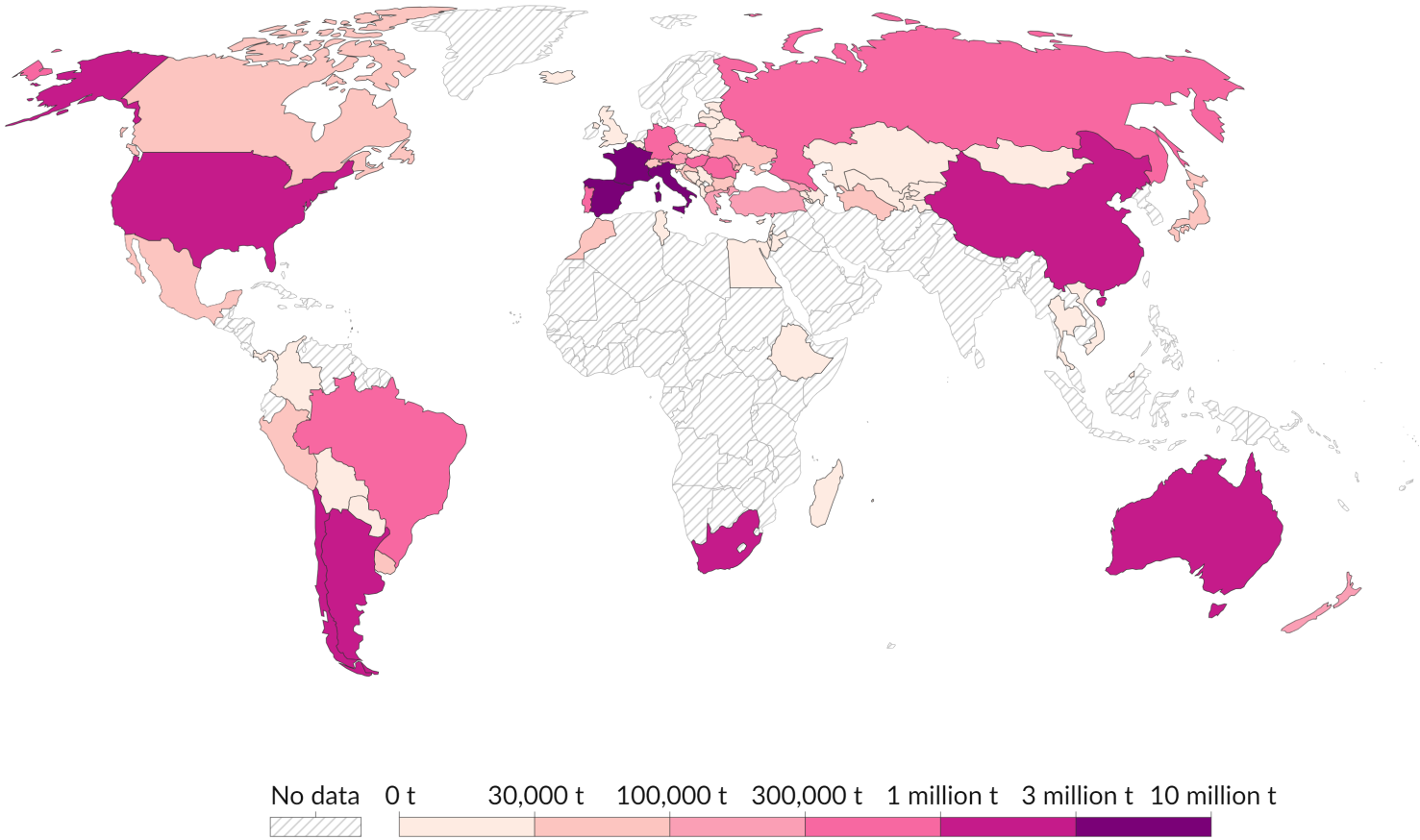
GLOBAL WINE PRODUCTION

Wine production, 2021

Wine production, measured in tonnes per year.

Our World in Data



Data source: Food and Agriculture Organization of the United Nations (2023)

OurWorldInData.org/agricultural-production | CC BY

The Liv-ex 100 Benchmark FWI

- London International Vintage Exchange Fine Wine Index
  - Introduced in London in 1999
  - Represents a fine wine price tracking index of the top 100 wines in the world
  - Dominated by the French, with their Burgundians, the Bordoeax and Cote du Rhone.
- Liv-Ex100 constituents
  - 1 Australian (Penfolds, Grange 2008)
  - 3 US (Opus One 2014, Screaming Eagle 2015, Dominus 2014)
  - 1 Spanish (Vena Sicilia, Unico 2006)
  - 7 Italian (Masseto, Ornella, Tignanello, Sassicaia, Conterno)
  - 88 French (6 Rhones, 7 Champagne, 8 Burgundy, 67 Bordeaux)

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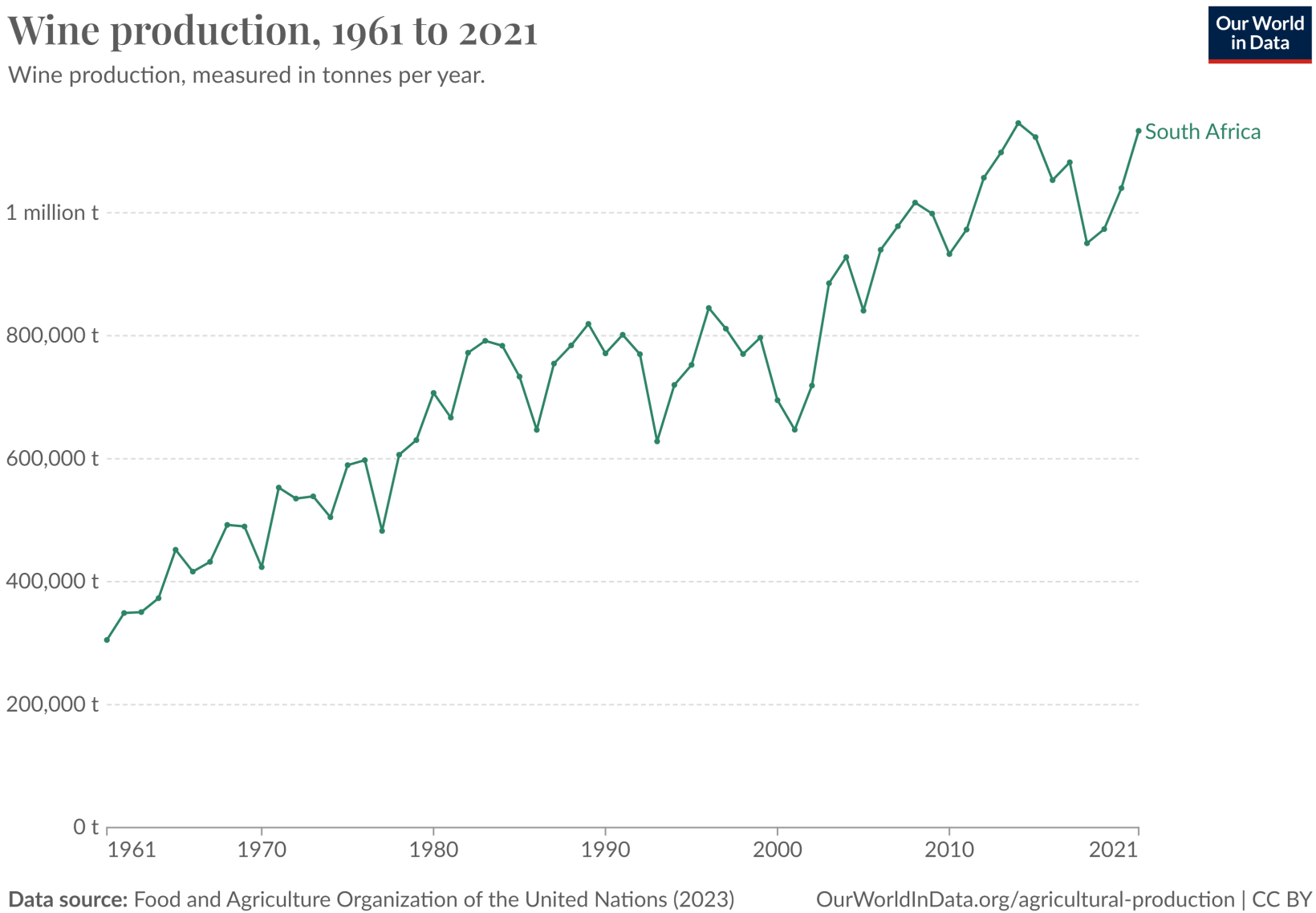
SA WINE PRODUCTION

Local Overview I

- “Today, Praise be to God, Wine was pressed for the time from Cape Grapes.“- Jan Van Riebeek, February 2nd, 1659.


Wine production, 1961 to 2021
Wine production, measured in tonnes per year.
Our World in Data
South Africa
1 million t
800,000 t
600,000 t
400,000 t
200,000 t
0 t
1961
1970
1980
1990
2000
2010
2021
Data source: Food and Agriculture Organization of the United Nations (2023)
OurWorldInData.org/agricultural-production | CC BY

Local Overview III

- South Africa
  - The eighth largest wine producer in the world
  - The world's sixth largest exporter of wine
  - Exports R10.3 billion worth of wine annually
  - In 2022 a total of 90 512 hectares of land used for wine grape cultivation by 2 613 wine grape producers for 536 cellars
  - Remarkably, the industry employed 269 096 people
  - The country produces 1.13 billion liters of wine annually with 81% being consumed domestically.
  - In 2019 the wine industry's contribution to the national economy was R55 billion
- Both demand and supply of South African fine wine are increasing, particularly demand for and supply for older and rare vintages
- A weak rand is adding cost pressure and demand, and prices are set to increase further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MOTIVATION

Why this research?

- According to the 2023 Knight Frank Luxury Index
  - An annual report that details the performance of collectable luxury assets such as art, classic cars and wine,
  - Fine wine assets have grown in value by 147% over the past decade, and wine is outperforming many other luxury assets
- Fine Wine has provided a stability not found in other investments
- Buffet said, "...wine offers a safe yet profitable haven for your capital, with very low correlation to the stock market."
- Wine is also a popular treasure asset. But is wine a good investment or just a good drink?

RESEARCH CONTRIBUTION

Key Contributions

- Develop the first SA fine wine (SAFW10) index
- Empirically verifies that SAFW10 represents a well diversified index?
- Employs principles of Growth Optimal Portfolio (GOP) introduced by Platen (2006)
- We demonstrate that the SAFW10 is more diversified than the Liv–Ex100, with a higher growth rate and higher Sharpe ratio
- Our study underscores that if one wants to grow and diversify an investment portfolio, look no further than the SAFW10 index

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MODEL FRAMEWORK

Model Framework: GOP I

- A general financial market model where uncertainties are driven by a multidimensional Brownian motion denoted as $\mathbf{W}$, with $\mathbf{W}(t) = \{(W(t)^1, \cdots, W(t)^d)^\top\}, t \in [0, T]$
- This model is defined on a filtered probability space $(\Omega, \mathcal{F}, \mathbb{F}, \mathbb{P})$, where T represents a fixed time horizon, and the filtration $\mathbb{F} = \{F_t, t \in [0, T]\}$ adheres to standard conditions of right continuity and completeness

Model Framework (GOP) II

- We assume the existence of m non-negative risky primary security accounts $\mathbf{S}(t) = (S^1(t), \cdots, S^m(t))^\top$, satisfying the following vector stochastic differential equation (SDE):

$$d\mathbf{S}(t) = \mathbf{S}(t)(a(t)dt + b(t)^\top d\mathbf{W}),\ t \in [0, T], \tag{1}$$

  where, $a(t)$ is the instantaneous drift vector, and $b(t)$ is the instantaneous volatility matrix.
- All dividends and interests are reinvested.
- The covariance process is a matrix-valued function given by:

$$\mathbf{\Sigma}(t) = b(t) \cdot b(t)^\top. \tag{2}$$

Model Framework: GOP III

- We denote $S^{\boldsymbol{\pi}} = \{S^{\boldsymbol{\pi}}(t)\}_{t\geq 0}$ as the value process of a strictly positive, self-financing portfolio with portfolio weights $\boldsymbol{\pi}(t) = (\pi(t)^1, \cdots, \pi(t)^d)^\top, t \in [0,T]$. The value process follows the SDE:

$$\frac{dS^{\boldsymbol{\pi}}(t)}{S^{\boldsymbol{\pi}}(t)} = \boldsymbol{\pi}(t)^\top (a(t)dt + b(t)^\top d\mathbf{W}(t)),\ t \in [0,T]. \tag{3}$$

- Using Ito's formula, we can express the SDE for the log-price as:

$$d\log S^{\boldsymbol{\pi}}(t) = a^{\boldsymbol{\pi}}(t)dt + b^{\boldsymbol{\pi}}(t)^\top d\mathbf{W}(t),\ t \in [0,T] \tag{4}$$

$$a^{\boldsymbol{\pi}}(t) = \boldsymbol{\pi}(t)^\top a(t) + \frac{1}{2}\left[\boldsymbol{\pi}(t)^\top \mathrm{diag}(\boldsymbol{\Sigma}(t)) - \boldsymbol{\pi}(t)^\top \boldsymbol{\Sigma}\boldsymbol{\pi}(t)\right] \tag{5}$$

$$b^{\boldsymbol{\pi}}(t) = b^\top(t) \cdot \boldsymbol{\pi}(t). \tag{6}$$

- A growth-optimal portfolio (GOP) is a positive self-financing portfolio $S^{\boldsymbol{\pi}}$ which maximises the growth rate in Equation (5). We now focus on the growth-optimal portfolio $S^{\boldsymbol{\pi}^*}$ in this investment universe, where the instantaneous expected growth rate is maximised for all t. This is achieved by setting the optimal portfolio weights $\boldsymbol{\pi}^*(t)$ as follows:

$$\boldsymbol{\pi}^*(t) = \arg\max_{\boldsymbol{\pi}} \mathbb{E}\left[\log\left(\frac{S^{\boldsymbol{\pi}}(T)}{S^{\boldsymbol{\pi}}(0)}\right)\right],\ \boldsymbol{\pi}^\top \cdot \mathbf{1} = 1,\ t \in [0, T]. \tag{7}$$

- The Lagrange function is formulated as:

$$L(\boldsymbol{\pi}, \lambda) = \boldsymbol{\pi}(t)^\top a(t) + \frac{1}{2}\left[\boldsymbol{\pi}(t)^\top \mathrm{diag}(\boldsymbol{\Sigma}(t)) - \boldsymbol{\pi}(t)^\top \boldsymbol{\Sigma}\boldsymbol{\pi}(t)\right] - \lambda(1 - \boldsymbol{\pi}^\top \mathbf{1}).$$

- The first-order condition:

$$\frac{\partial L}{\partial \boldsymbol{\pi}} = a(t) + \frac{1}{2}\text{diag}(\boldsymbol{\Sigma}) - \boldsymbol{\Sigma}\boldsymbol{\pi} + \lambda \mathbf{1} = 0.$$

- To ensure the solution is a maximum, the second-order condition is checked:

$$\frac{\partial^2 L}{\partial \boldsymbol{\pi}^2} = -\boldsymbol{\Sigma} < 0.$$

- Since the Hessian of the objective function is still the covariance matrix, which is positive definite, the optimal weight vector $\boldsymbol{\pi}^*$ is reached:

$$\boldsymbol{\pi}^* = \boldsymbol{\Sigma}^{-1}(\boldsymbol{\alpha}(t) + \lambda \mathbf{1}),$$

where

$$\boldsymbol{\alpha}(t) = a(t) + \frac{1}{2}\text{diag}(\boldsymbol{\Sigma}(t)).$$

- Substituting this value into the constraint, we can solve for λ:

$$\lambda = \frac{1 - \boldsymbol{\alpha}(t)^\top \boldsymbol{\Sigma}^{-1}\mathbf{1}}{\mathbf{1}^\top \boldsymbol{\Sigma}^{-1}\mathbf{1}}.$$

- Finally, the optimal portfolio weights $\boldsymbol{\pi}^*$ are obtained as:

$$\boldsymbol{\pi}^* = \boldsymbol{\Sigma}^{-1}(\boldsymbol{\alpha}(t) + \lambda \mathbf{1}) \tag{8}$$

$$= \frac{(1 - \mathbf{1}^\top \boldsymbol{\Sigma}^{-1}\boldsymbol{\alpha}(t)) \cdot \boldsymbol{\Sigma}^{-1}\mathbf{1}}{\mathbf{1}^\top \boldsymbol{\Sigma}^{-1}\mathbf{1}} + \boldsymbol{\Sigma}^{-1}\boldsymbol{\alpha}(t),\ t \in [0, T]. \tag{9}$$


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DATA

Data

- Gathered data from two primary sources:
  - Wine Cellars, which provided comprehensive information on both the quantities and prices of wines transacted through their brokerage
  - Strauss & Co Fine Wine Auctions provided all their past auction data on lots of South African fine wine
- The dataset used in our study covers the period from 2018 to 2023 and serves as the exclusive repository of empirical records related to secondary market fine wine transactions within the South African context during this specific time frame
- Noteworthy that the majority of transactions within this dataset involve red wines, constituting approximately 67% of total sales, while white wines and fortified wines represent 29% and 4% of the transactions, respectively

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METHODOLOGY

Index Construction

- We employed the repeat sales regression (RSR) method by Bailey et al (1963)
- RSR tracks the repeated sales of the same wine across different vintages sold at auction
- Given the limited data from the secondary market in South Africa, RSR ensures enough repeated sales to build a robust and representative index
- Constructing the wine index requires careful consideration of biases such as salience bias and selection neglect (Van Tillo and Verdickt, 2023).
- We noted that employing a repeat-sales methodology may not account for the effect of external influences, such as changing consumer preferences and economic conditions on fine wine markets (Fernandez- Perez et al, 2019)

The repeat sales Methodology I

- First, we divide the set of wines W into two subsets
  - wines that sell only once ($i \in J = 1, \cdots, I \subset W$)
  - wines that sell more than once ($j \in J = 1, \cdots, J \subset W$)
- Second, let $t \in J = \{0, 1, \cdots, T\}$ be the set of time periods
- For wines sold more than once, let the first sale of wine j occur at time t and the second sale at time $t + s$
- Define P_{jt+s} as the logarithm price of the wine j at time $t + s$
- The price difference between the sales of the wine j can be written as:

$$\Delta P_{j\tau} = P_{jt+s} - P_{jt} = \boldsymbol{\delta}^{\top} \Delta Z_{j\tau} + \Delta \epsilon_{j\tau}, \tag{10}$$

- where $\Delta \epsilon_{j\tau} = \Delta \epsilon_{jt+s} - \Delta \epsilon_{jt}$, and

$$\Delta Z_{j\tau} = \begin{cases} -1 & \text{if} \quad \tau = t \\ 1 & \text{if} \quad \tau = t + s \\ 0 & \text{otherwise,} \end{cases} \tag{11}$$

The repeat sales Methodology II

- $\boldsymbol{\delta}$ s a vector of log price index numbers
- The error term $\Delta\epsilon_{j\tau}$ is random and uncorrelated with $\Delta Z_{j\tau}$ and $\boldsymbol{\delta}$
- Reflecting the notion that individual wine price variations unrelated to the Winery-vintage variations are due to idiosyncratic value changes
- Then the estimated log price index for time j is the jth element of the ordinary least-squares regression coefficient vector

Top-10 SA Fine Wines

SAFW10	**Volume**	**TA Rating**
Sadie Family Columella	504	98,40
Kanonkop Paul Sauer	944	97,60
Porseleinberg	325	98,20
Klein Constantia Vin de Constance	328	97,40
Sadie Family Palladius	486	96,20
Meerlust Rubicon	701	95,50
Boekenhoutskloof Syrah	264	96,40
Vilafonte Series C	264	95,60
Sadie Family Skurfberg	179	98,60
Alheit Family Makstok	158	98,75

EMPIRICAL RESULTS

- Historical returns information for seven exchange-traded funds and LIV fine wine indices obtained from Bloomberg.

Table: **Investment Indices and Their Full Names**

Index	**Full name**
LXFW100 Index	Liv Ex Fine Wine 100
STX40 SJ Equity	Satrix Top 40 ETF
ETF500 SJ Equity	1nvest S&P 500 Index ETF
STXEMG SJ Equity	Satrix MSCI Emerging Markets ETF
STXWDM SJ Equity	Satrix MSCI World ETF
ETFGLD SJ Equity	1nvest Gold ETF
ETFBND SJ Equity	1nvest SA Bond ETF
STXPRO SJ Equity	Satrix Property Portfolio ETF
SAFW10	South Africa Top 10 Fine Wine index

Table: **Statistical Summary of Asset Returns and Wine**

	LXFW100	STX40	ETF500	STXEMG	STXWDM	ETFGLD	ETFBND	STXPRO	SAFW10
Mean	0.0091	0.0267	0.0417	0.0178	0.0368	0.0439	0.0101	-0.0208	0.0537
Standard Deviation	0.0275	0.1062	0.0743	0.0641	0.0681	0.1072	0.0450	0.1646	0.1454
Detrended S,D,	0.0263	0.1056	0.0738	0.0636	0.0678	0.1064	0.0440	0.1619	0.1441
Nonlinear Detrended S,D,	0.0230	0.1053	0.0738	0.0636	0.0677	0.1001	0.0416	0.1587	0.1339
Kurtosis	0.5903	0.3955	0.1111	2.5544	0.7374	3.2489	0.6830	4.1843	-0.9563
Skewness	-0.1551	-0.1527	-0.4780	-0.6114	-0.6056	1.0714	0.1379	-1.3964	0.0904

Table: **Log price index estimation**

Repeat sales model		
Year	Estimates	std Errors
2019Q1	2	-
2019Q2	2.0078	(0.0023)
2019Q3	2.0105	(0.0026)
2019Q4	2.0928	(0.0029)
2020Q1	2.1556	(0.0024)
2020Q2	2.1202	(0.0021)
2020Q3	2.1202	(0.0023)
2020Q4	2.1624	(0.0027)
2021Q1	2.1727	(0.0029)
2021Q2	2.1091	(0.0029)
2021Q3	2.1606	(0.0028)
2021Q4	2.1388	(0.0027)
2022Q1	2.2157	(0.0021)
2022Q2	2.1233	(0.0024)
2022Q3	2.0849	(0.0025)
2022Q4	2.1906	(0.0021)
2023Q1	2.3011	(0.0024)

Empirical Results: SAFW10 vs. LXFW100

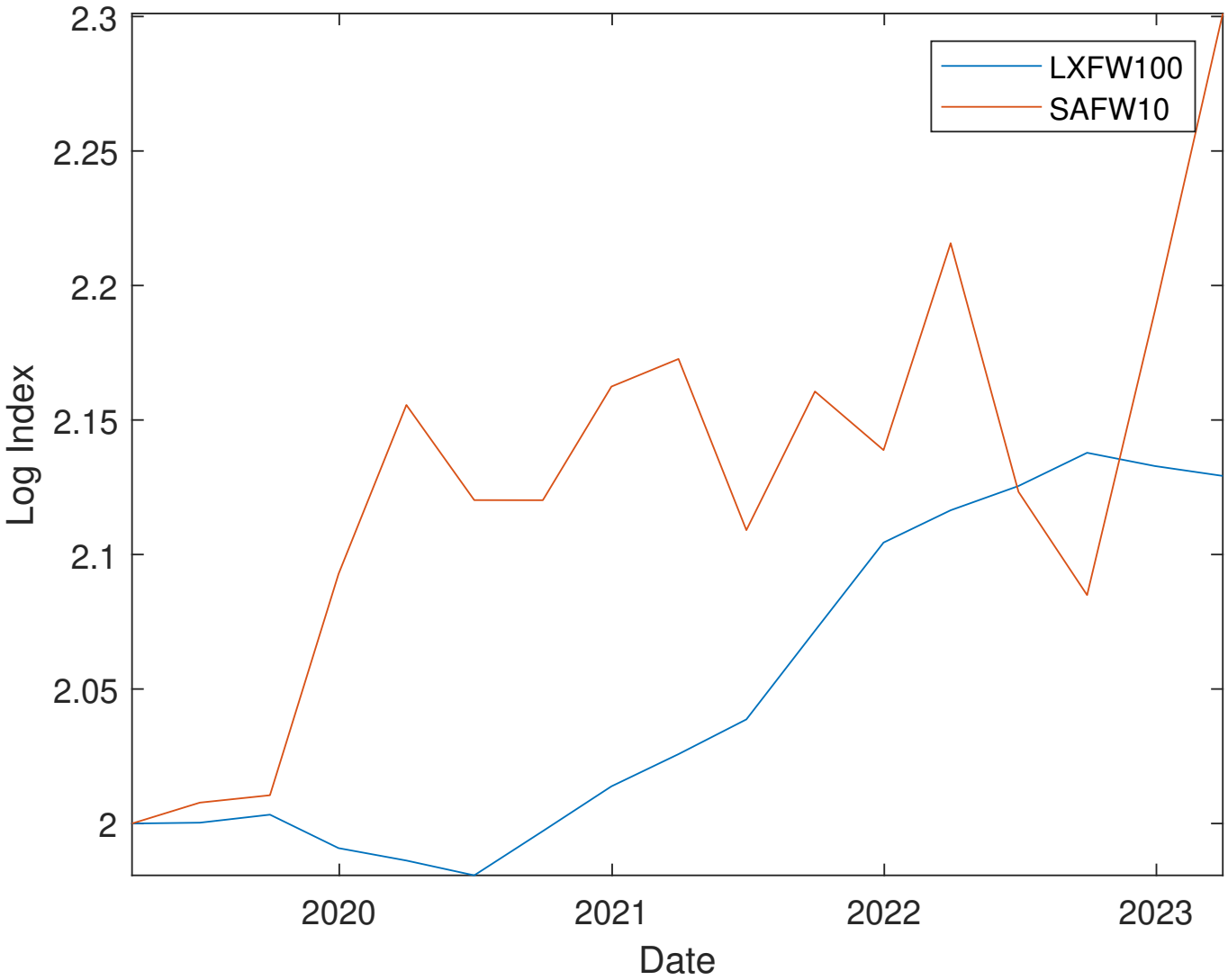

Figure: Price Evolution of SAFW10 and LXFW100 index

Empirical Results: SAFW10 vs. SA Overall Market

- We show the correlation of the SAFW10 Index to indices representing the South African market, namely STX40 , BND, and PRO

Table: **Correlation Matrix for SA Assets and SAFW10**

	STX40	BND	PRO	SAFW10
STX40	1	-0.2166	0.7531	0.2569
BND	-0.2166	1	-0.4236	-0.2036
PRO	0.7531	-0.4236	1	0.0605
SAFW10	0.2569	-0.2036	0.0605	1

Empirical Results: Portfolio Performance I

- The table on the following slide provides a comparative analysis of equity portfolios, including the inclusion of LIV EX100 and SAFW10
- Key performance metrics, such as portfolio volatility, portfolio growth rate, and the Sharpe Ratio, are utilised for assessment
- Notably, the inclusion of SAFW10 generally contributes positively to portfolio growth and risk-adjusted returns, as evidenced by the growth rate

Table: **Comparative Analysis of Equity Portfolios with LIV EX100 and SAFW10**

	Equity Portfolio		Incl. LIV EX100		Incl. SAFW10		Entire Portfolio	
Asset Class	**MVP**	**GOP**	**MVP**	**GOP**	**MVP**	**GOP**	**MVP**	**GOP**
LXFW100 Index			67%	170%			53%	-522%
STX40 SJ Equity	-3%	687%	5%	608%	-15%	380%	-3%	253%
ETF500 SJ Equity	105%	-1946%	-18%	1317%	198%	3203%	50%	4669%
STXEMG SJ Equity	46%	-1173%	16%	-572%	64%	-193%	30%	143%
STXWDM SJ Equity	-164%	3700%	4%	-780%	-271%	-3025%	-80%	-4918%
ETFGLD SJ Equity	39%	-377%	18%	355%	35%	340%	21%	482%
ETFBND SJ Equity	45%	-105%	6%	-783%	40%	-781%	12%	-504%
STXPRO SJ Equity	30%	-686%	3%	-214%	35%	-63%	11%	180%
SAFW10					14%	240%	6%	317%
Portfolio volatility	**0.054**	**1.498**	**0.033**	**1.373**	**0.042**	**1.482**	**0.031**	**1.513**
Portfolio growth rate	**0.052**	**0.566**	**0.056**	**0.997**	**0.073**	**1.170**	**0.064**	**1.208**
Sharpe ratio	**-0.978**	**0.614**	**-0.930**	**0.670**	**-0.959**	**0.621**	**-0.966**	**0.608**

Empirical Results: Portfolio Performance III

- In this context, the comparison aims to highlight the impact of including fine wines as an asset class in the investment portfolio
- This underscores the diversification benefits and risk reduction potential associated with integrating fine wines into investment portfolios, thereby illustrating the potential advantages of considering wine as an alternative asset class in the context of portfolio management

Implication of our Results

- Provides important insights into the potential benefits of integrating South African wines into investment portfolios
- We have found that the inclusion of wines effectively contributes to risk reduction and portfolio diversification.
- These favourable outcomes suggest that South African wines could serve as a valuable addition to a broader investment strategy
- Paves the way for future explorations in this exciting domain, potentially stimulating further research and investment in the South African wine market
- Beyond the financial implications, this study holds cultural significance as it underscores the importance of wine in South African history and heritage

Economic Significance in SA

- The fine wine index provides a benchmark for investors interested in wine as an alternative asset class
- The hope is to attract local and international investors looking to diversify their portfolios
- It could also lead to the development of financial products such as wine investment funds or futures contracts, boosting capital flow into the wine industry
- As wines included in the index are typically of high quality, producers may strive to improve their offerings to gain entry into the index
- This emphasis on quality can elevate the reputation of South African wines globally, leading to increased demand and potentially higher prices for premium products

Possible Future Research Directions I

- Develop a classification model leveraging machine learning techniques to predict the investment potential of individual wines, facilitating their inclusion within the fine wine index
- Investigate the depth and liquidity of the secondary market for fine wine in South Africa, exploring factors such as trading volume, frequency, and market participants' behaviour
- Enhance index construction methodologies beyond Repeat-Sales Regression, incorporating advanced techniques such as hedonic regression or machine learning algorithms. Additionally, explore alternative weighting schemes to improve the accuracy and representatives of the index

Possible Future Research Directions II

- Implement a systematic approach for regular updates and maintenance of the fine wine index, ensuring it reflects current market dynamics and provides reliable performance indicators for investors
- Is it possible to outperform this index using a proxy for the GOP?
- Pricing procedures for wine derivatives under the Risk-Neutral measure


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Thank You For Your Attention!