Momentum-Based Expert Trading System for the Vietnamese Physical Gold Market

Replication and Extension of Nguyen, Sensoy, Sousa & Uddin (2021)

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1. Overview

This repository provides a self-contained quantitative replication kit examining whether short-term momentum strategies generate positive risk-adjusted returns in the Vietnamese physical gold market over the period January 2015 – December 2025 ($N = 2{,}837$ trading sessions, 13 instruments, 5 lookback windows).

The central methodological contribution relative to the original paper is the **endogenization of transaction costs**: instead of a fixed fee assumption (0.25 %), transaction costs are proxied by the realized bid-ask half-spread c_t of each instrument at every trading date, reflecting the genuine microstructure frictions faced by retail investors in Vietnam's physical gold market.

Key finding. All 65 instrument × lookback-window combinations yield *negative* risk-return ratios under both long-only and long-short strategies once real transaction costs are accounted for. The equally-weighted buy-and-hold portfolio achieves $RR = 1.23$, confirming that passive investment dominates active momentum trading — a result directly attributable to bid-ask spreads ranging from 1.1 % (SJC bullion) to 7.7 % (10K jewellery).

2. Repository Structure

```
vietnam-gold-momentum/
|
|-- config.py                                    # Constants:
   instruments, TD=252, windows
|-- core.py                                      # Engine: prices,
   signals, metrics, HTML
|-- tables.py                                    # Tables 1-6  -->
   output_tables.html
|-- figures.py                                   # Fig. 3-4   -->  PNG
   equity curves
|-- run_all.py                                   # Master runner (single
    command)
|-- make_readme.py                               # Generates README.md
|
```

```
|-- Master_Gold_Dataset_Cleaned_Quant.xlsx  # Input dataset
|-- README.pdf                              # This document
|-- requirements.txt
|-- .gitignore
```

3. Dataset

3.1 Summary

Table 1: Dataset summary

Attribute	**Value**
Frequency	Daily
Period	02 January 2015 – 31 December 2025
Observations	2,837 trading sessions
Domestic instruments	13 (SJC bullion $\times$ 4 regions, PNJ bullion $\times$ 4 regions, PNJ jewellery $\times$ 4 grades + 1 ring)
Benchmark	XAU/VND (international gold converted at the daily USD/VND central rate)
Price unit	Million VND per *chi* (1 *chi* $= 3.75$ g)

3.2 Data Sources

All price series were collected from official retail quotation pages of the respective issuers. The international benchmark was constructed by multiplying the XAU/USD spot price by the daily USD/VND central exchange rate.

Table 2: Data sources by instrument group

Instrument Group	Provider	URL
SJC bullion (4 regions)	Saigon Jewelry Company (SJC)	https://sjc.com.vn
PNJ bullion & jewellery (9 series)	Phu Nhuan Jewelry JSC (PNJ)	https://pnj.com.vn
DOJI bullion (supplementary)	DOJI Gold & Gems Group	https://doji.vn
XAU/USD spot price	TradingView	https://www.tradingview.com
USD/VND central exchange rate	Investing.com	https://www.investing.com

3.3 Instruments

Table 3: Full list of gold instruments in the sample

Label	Type	Brand	Karat	Region
Ring PNJ 24K	Ring	PNJ	24K	National
Jewellery 10K	Jewellery	PNJ	10K	National
Jewellery 14K	Jewellery	PNJ	14K	National
Jewellery 18K	Jewellery	PNJ	18K	National
Jewellery 24K	Jewellery	PNJ	24K	National
PNJ Da Nang	Bullion	PNJ	24K	Da Nang
PNJ Hanoi	Bullion	PNJ	24K	Hanoi
PNJ Mekong Delta	Bullion	PNJ	24K	Mekong Delta
PNJ Ho Chi Minh	Bullion	PNJ	24K	Ho Chi Minh
SJC Da Nang	Bullion	SJC	24K	Da Nang
SJC Hanoi	Bullion	SJC	24K	Hanoi
SJC Mekong Delta	Bullion	SJC	24K	Mekong Delta
SJC Ho Chi Minh	Bullion	SJC	24K	Ho Chi Minh
XAU/VND	Benchmark	—	24K	International

3.4 Missing Data Treatment

Table 4: Missing data imputation strategy

Group	Method	Days Filled
Internal gaps (all series)	Time-based linear interpolation	Varies
SJC / PNJ bullion (trailing)	Last Observation Carried Forward (LOCF)	83
Ring / Jewellery series (trailing)	Last Observation Carried Forward (LOCF)	358 ($\approx$12.6 %)

4. Methodology

4.1 Mid-price and Log Return

$$P_t^{mid} = \frac{P_t^{ask} + P_t^{bid}}{2} \tag{1}$$

$$r_t = \ln\left(\frac{P_t^{mid}}{P_{t-1}^{mid}}\right) \tag{2}$$

4.2 Momentum Signal

The n-day momentum signal is computed over the window strictly preceding day t, precluding any look-ahead bias:

$$a_{t,n} = \frac{1}{n}\sum_{i=1}^{n} r_{t-i} \tag{3}$$

Implemented as `r.shift(1).rolling(n).mean()`, with lookback windows $n \in \{1, 2, 3, 4, 5\}$ trading days.

4.3 Position Rules

Long-Only Strategy (Tables 4 and 5):

$$I_t = \begin{cases} 1 & \text{if } a_{t,n} > 0 \\ 0 & \text{if } a_{t,n} \leq 0 \end{cases} \tag{4}$$

Long-Short Strategy (Table 6):

$$I_t = \begin{cases} 1 & \text{if } a_{t,n} > 0 \\ -1 & \text{if } a_{t,n} < 0 \\ 0 & \text{if } a_{t,n} = 0 \end{cases} \tag{5}$$

Note: Short-selling physical gold is legally prohibited in Vietnam. Long-short results serve as theoretical benchmarks only.

4.4 Dynamic Transaction Cost

$$c_t = \frac{P_t^{ask} - P_t^{bid}}{2\,P_t^{mid}} \tag{6}$$

The cost c_t is charged *only* when the position changes ($|I_t - I_{t-1}| \neq 0$):

$$R_t^{strat} = I_{t-1}\, r_t \;-\; |I_t - I_{t-1}|\, c_t \tag{7}$$

4.5 Annualized Performance Metrics

With $TD = 252$ trading days per year:

$$R_a = \left(1 + \bar{R}^{strat}\right)^{252} - 1 \qquad \sigma_a = \sigma_d \times \sqrt{252} \qquad RR = \frac{R_a}{\sigma_a} \tag{8}$$

5. Output Files

Table 5: Generated output files

File	Contents
`output_tables.html`	Tables 1–6: market microstructure, descriptive statistics, buy-and-hold performance, long-only RR, long-only R_a, long-short RR. Open in any web browser.
`fig3_longonly.png`	Fig. 3: Equity curves, long-only strategy, EW portfolio, $n = 1, \ldots, 5$.
`fig4_longshort.png`	Fig. 4: Equity curves, long-short strategy, EW portfolio, $n = 1, \ldots, 5$.

6. Quickstart

```
git clone https://github.com/<username>/vietnam-gold-momentum.git
cd vietnam-gold-momentum
pip install -r requirements.txt
python run_all.py
```

7. Dependencies

Table 6: Python package requirements (`requirements.txt`)

Package	Minimum Version
`pandas`	2.0
`numpy`	1.24
`scipy`	1.10
`openpyxl`	3.1
`matplotlib`	3.7

8. Core Reference

Nguyen, D. K., Sensoy, A., Sousa, R. M., & Uddin, G. S. (2021). Does short-term technical trading exist in the Vietnamese stock market? *Borsa Istanbul Review*, **21**(1), 23–35. https://doi.org/10.1016/j.bir.2020.05.005

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