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

Replication and Extension of **?**

Borsa Istanbul Review, Vol. 21(1), pp. 23–35 • *DOI: 10.1016/j.bir.2020.05.005*

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).

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 derived from the realized bid-ask half-spread c_t of each instrument at every trading date.

Key finding. All 65 instrument $\times$ lookback-window combinations (13 instruments $\times$ 5 windows) 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 in the Vietnamese physical gold market.

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
|-- robustness.py                            # Robustness tests -->
   robustness_output.html
|-- run_all.py                               # Master runner (single
   command)
|-- make_readme.py                           # Generates README.md
|
|-- Master_Gold_Dataset_Cleaned_Quant.xlsx # Input dataset
```

```
|-- references.bib                          # BibTeX bibliography
|-- README.tex                              # This document
|-- requirements.txt
|-- .gitignore
```

3. Dataset

Table 1: Dataset summary

Attribute	**Value**
Frequency	Daily
Period	02 January 2015 – 31 December 2025
Observations	2,837 trading sessions
Instruments	13 Vietnamese gold instruments + 1 international benchmark
Source	https://giavang.org
Price unit	Million VND per *chi* (1 chi $=$ 3.75 g)

3.1 Instruments

Table 2: 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

3.2 Missing Data Treatment

Table 3: Missing data imputation strategy

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

4. Methodology

4.1 Mid-price and Log Return (Section 3.2)

The mid-price is defined as the arithmetic mean of the quoted bid and ask:

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

Daily log returns are computed as:

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

4.2 Momentum Signal (Section 3.3)

The momentum signal is the n-day average return 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 in Python as `r.shift(1).rolling(n).mean()`.

4.3 Position Rules (Section 3.4)

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) — theoretical benchmark only; short-selling physical gold is

legally prohibited in Vietnam:

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

4.4 Dynamic Transaction Cost (Section 3.5)

Transaction costs are proxied by the bid-ask half-spread:

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

The net strategy return charges c_t *only* on position changes:

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

4.5 Annualized Performance Metrics (Section 3.6)

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 4: Generated output

File	Contents
`output_tables.html`	Tables 1–6 (market microstructure, descriptive statistics, buy-and-hold, long-only RR, long-only R_a, long-short RR). Open in any web browser.
`robustness_output.html`	Tables R1–R4 (sub-period analysis, alternative transaction costs, extended lookback windows, exclusion of anomalous instruments). Open in any web browser.
`fig3_longonly.png`	Fig. 3: Equity curves (EW portfolio, long-only strategy, lookback windows $n = 1, \ldots, 5$).
`fig4_longshort.png`	Fig. 4: Equity curves (EW portfolio, long-short strategy, lookback windows $n = 1, \ldots, 5$).

6. Robustness Checks

Four robustness tests validate the primary finding that momentum strategies fail to generate positive risk-adjusted returns in the Vietnamese physical gold market:

6.1 Table R1 — Sub-period Analysis

The full sample is partitioned into three structural sub-periods:

- **Pre-COVID (2015–2019)**: baseline market conditions
- **COVID (2020–2022)**: extreme volatility and policy interventions
- **Post-COVID (2023–2025)**: SJC premium spike and regulatory changes

Negative risk-return ratios are observed consistently across all three sub-periods, ruling out the possibility that a single episode drives the aggregate result.

6.2 Table R2 — Alternative Transaction Cost Scenarios

Three cost assumptions are compared:

1. **Dynamic half-spread** $c_t = (P_t^{ask} - P_t^{bid})/(2P_t^{mid})$ (baseline)
2. **Zero cost** ($c_t = 0$): tests whether momentum signal has intrinsic value
3. **Fixed cost** ($c_t = 0.25\%$): replicates **?** assumption

Under zero cost, $RR > 1.0$ across all lookback windows, confirming that the momentum signal is statistically valid. Under both dynamic and fixed cost scenarios, $RR < 0$, demonstrating that transaction costs — not signal weakness — are the decisive barrier to profitability.

The average realized half-spread in the Vietnamese physical gold market is $\approx 3.5\%$, an order of magnitude higher than the fixed 0.25% assumption in prior literature.

6.3 Table R3 — Extended Lookback Windows

Lookback windows are extended to $n \in \{1, 2, 3, 4, 5, 10, 20\}$ trading days for both long-only and long-short strategies. Negative RR persists at $n = 10$ and $n = 20$, ruling out the possibility that the finding is an artefact of short-window parameterization.

Long-short strategies underperform long-only strategies at all horizons due to higher turnover and cumulative transaction costs.

6.4 Table R4 — Exclusion of Anomalous Instruments

PNJ Mekong Delta and SJC Mekong Delta exhibit anomalous returns of $\pm 39\%$ due to data gaps in the source (https://giavang.org). Table R4 compares:

- **EW Full**: 13-instrument equally-weighted portfolio (baseline)

- **EW ex-Mekong**: 11-instrument portfolio excluding Mekong Delta instruments

Risk-return ratios are statistically indistinguishable between the two portfolios ($\Delta RR < 0.1$ across all windows), confirming that the result is not driven by outliers.

7. Quickstart

```
# 1. Clone the repository
git clone https://github.com/<your-username>/vietnam-gold-momentum.
   git
cd vietnam-gold-momentum

# 2. Install Python dependencies
pip install -r requirements.txt

# 3. Place the dataset in the project root (if not already present)
#    Master_Gold_Dataset_Cleaned_Quant.xlsx

# 4. Run primary analyses (Tables 1-6, Figures 3-4)
python run_all.py

# 5. Run robustness checks (Tables R1-R4)
python robustness.py

# 6. Compile this document (requires TeX Live / MacTeX)
pdflatex README.tex
bibtex   README
pdflatex README.tex
pdflatex README.tex
```

8. Dependencies

Table 5: Python package requirements

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

9. License

This project is released under the MIT License.