Intelligent Dynamic Portfolio Theory (IDPT)

- Unification of
  Modern Portfolio Theory, Financial Market Prediction,
  Relative Strength Investing and Technical Trend Trading

Prof Dr PAN Heping, Director
◆ Chinese Institute of Intelligent Finance
◆ Prediction Research Centre
  University of Electronic Science & Technology of China (UESTC)
  Room 340, Yifu Building, UESTC, North Jianshe Road
  Chengdu 610054, China
◆ Finance Research Center of China
  Southwestern University of Finance & Economics (SWUFE)
◆ Swingtum Prediction, Australia
Email: panhp@swingtum.com
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1. Introduction

◆ Our Aim: A Minimal Complete Theory of financial investment
  which is not only scientifically sound but also practically effective

◆ Modern Portfolio Theories
  (Academic)

◆ Successful Investment Methodologies
  (Professional)

◆ Intelligent Dynamic Portfolio Theory (IDPT)
  (Fundamental Science + Operational Framework)
  (Framework begets Methodologies + Systems)
Modern Portfolio Theories

① Single-Period Static Portfolio Theory
   - Markowitz Mean-Variance Analysis
   - Tobin Market Portfolio

② Passive Dynamic Portfolio Theory
   - Sharp-L-M-T Capital Asset Pricing Model (CAPM)
   - Ross Arbitrage Pricing Theory
   - Index Tracking Funds

③ Active Dynamic Portfolio Theory
   - Grinold-Kahn Active Portfolio Management
   - Multiperiod Dynamic Portfolio Management
   - Direct Dynamic Portfolio Management
Successful Investment Methodologies

①  Value Investing

②  Strength Investing

③  Macro Investing

④  Dynamic Arbitrage
IDPT in the historical background of Modern Portfolio Theories and Investment Methodologies

Our Aim:

- **Intelligent Dynamic Portfolio Theory (IDPT)**
  is meant to be a minimal complete theory of financial investment in stock market

- **The theory must be not only scientifically sound but also practically effective**

- **Scientifically Sound:**
  1) provide a coherent understanding to stock market
  2) generalize the modern portfolio theories
  3) integrate successful investment methodologies

- **Practically Effective:**
  1) outperform the market index during bull market
  2) protect the total capital during bear market,
     avoid severe draw-downs (e.g. < 20%)
Until the advent of modern financial theory, studies on Financial Investment were limited to practical insights and skills, including accounting, tax, regulations and financial form analysis as well as technical analysis. During that period, there were two dominant empirical approaches:

1) **Benjamin Graham & David Dodd (1934):**
   “Security Analysis”
   proposed the “margin of safety” as the central principle of value investing.

2) **John Burr Williams (1938):**
   “The Theory of Investment Value”
   formulated the dividend discount model, which is still central to modern valuation models.
1950-2008: Great Investors and Speculators
[Value, Growth, Strength, Macro, Arbitrage]

- **Value Investing**: Warren Buffett after Benjamin Graham
- **Growth Investing**: Peter Lynch after Philip Fisher
- **Strength Investing**: William O’Neil
- **Macro Investing**: George Soros
- **Dynamic Arbitrage**: Jim Simons

In reality, Growth Investing is either absorbed into Value or Strength Investing.

**Commonalities:**

1. Belief in Inefficient Market
2. Confidence in Outperforming Market Index
3. First Priority on Protection of Capital
   (by Margin of Safety, Hedge or Stop Loss)
4. **Concentration of Capital without Deliberate Diversification**
Buffett on Concentration:

- Diversification may preserve wealth, but concentration builds wealth.
- Wide diversification is only required when investors do not understand what they are doing.
Wisdom of George Soros on Reflexivity

- We human must accept our own **fallibility** in any rational constructions
- **Misconceptions** play a significant role in the making of history
- Market participants act on the basis of **imperfect understanding**, so the outcomes are liable to diverge from expectation.
- Markets move **away from a theoretical equilibrium** almost as often as they move towards it, and they can get caught up in initially self-reinforcing but eventually self-defeating process, i.e. **bubbles**
- Bubbles often leads to financial **crises**
- Crises, in turn, lead to the **regulation** of financial markets.
- Changes in the regulatory environment place every crisis into a **unique historical context**.
- Therefore, Financial markets are best interpreted as a **historical process**.
- A historical process is unpredictable. **How about financial markets ???**
Portfolio Theory: from Qualitative to Quantitative

• Old sayings: Do not put all the eggs in one basket. When the nest is overturned, no egg stays unbroken.

• Empirical Wisdom from Investment Industry: When multiple assets are not completely correlated, a portfolio of them will reduce the risk.

• Harry Markowitz (1952) as the first expressed such an old investment principle in quantitative form through the Central Limit Theorem in Statistics.
Harry Markowitz on Mean-Variance Portfolio

• Use variance of portfolio returns as measure of risk
• Tradeoff between portfolio returns and portfolio risk

• Factors affecting returns: asset mean returns, weights
• Factors affecting risks: asset variance, weights, covariance

• More assets help to reduce portfolio risk which will stabilize after a certain size
• However, the management cost of portfolio will increase along with the portfolio size
Obvious Problems of Portfolio Optimization

- Objective Functions: Max Portfolio Returns, Min Portfolio Risks, Tradeoff leads to Efficient Frontier.
- Parameters of Optimization: Portfolio Weights
- Implications: Asset Selection and Size of Portfolio
- Obvious Problems:
  1) Starting Portfolio: All Assets or Initial Selection?
  2) Factors affecting Asset Returns: Causation or Correlation?
  3) Factors affecting Asset Risks?
  4) Asset Valuation or Price Volatility?
  5) Expectation or Prediction of Asset Returns and Risks?
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Portfolio Theory: from Static to Dynamic

- **Objective Functions**: Max Portfolio Returns, Min Portfolio Risks, Tradeoff leads to Efficient Frontier.
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  4) Asset Valuation or Price Volatility?
  5) Expectation or Prediction of Asset Returns and Risks?
Portfolio Theory: from Static to Dynamic

• Markowitz Mean-Variance Analysis is a static portfolio theory, and variance is an inadequate measure of risk as it penalizes both higher returns and lower ones.

• Sharpe Capital Asset Pricing Model (CAPM) and Ross Arbitrage Pricing Theory (APT) lead to one-step expectation model of asset returns involving multiple risk factors under the Efficient Market Hypothesis (EMH).

• Multi-Factor Asset Return Forecasting Models, Future Cash Flow Forecasting Models, and Future Income Discount Models

Lift the Portfolio Theory from Static to Dynamic
**Some Hidden Limitations of EMH-Compliant Dynamic Portfolio Theories**

a) EMH excludes the possible existence of inherent dynamism of the markets, such as Bull or Bear Market, Trends, Waves, Periodicity, and very importantly, Sector Rotation.

b) Multifactor return forecasting models are mainly based on macroeconomic indices, in practice, which are observed once a month at best; this limits the timeliness of portfolio management.

c) The EMH-compliant Portfolio Theories are unable to integrate various passive, active and reactive trading strategies, such as Passive Index Tracking, Active Return Forecasting, and Reactive Trend Following.
2. Structure of Intelligent Dynamic Portfolio Theory

1. Risk Measure: Maximum Draw-Down of the Portfolio Value
2. Investment Strategy: Concentration on Minimal Diversification (Strength Investing)
3. Scale-Space of Price-Time Exploration:
   Multi-Time-Frame Portfolios (Long-Interm-Short Terms)
4. Strength Concentration:
   Multi-Market-Level Portfolios (Nations – Sectors – Stocks)
5. 3 Assumptions:
   Long-Run Up Trend, Bull-Bear Market Cycle, Sector Rotation
7. Impulse-Retracting Market Wave Analysis (Log-Periodic Power Laws)
8. Sector Rotation Analysis (Cross-Sections of Trend-Waves)
9. Stock Selection (Portfolio Construction)
10. Price Trend Forecasting
11. Portfolio Weights Optimization
12. Technical Trading
I. Market Models
   - what we understand about the market

II. Trading Rules
   - how we trade for profit according to the market models

III. Risk Models and Management Rules
   - what we do not understand or misunderstand
   - the possible adverse outcomes from our trading actions
An Example: Swingtum Trading System

Market Analysis
- Market Models
  - Historical
  - Ecological
  - Fundamental
  - Technical
  - Strategic
- Market Signals
  - Long-Term
  - Interm-Term
  - Short-Term
  - Intraday

Technical Trading
- Trading Rules
- Trading Plans
  - Market Selection
  - Market Timing
  - Capital Allocation
- Entry
  - Correct?
    - yes: Add
    - no: Liquidate
    - stop

Risk Management
- Risk Models
- Risk Analysis
  - Market Risk
  - Credit Risk
  - Operational Risk
  - Liquidity Risk
- Risk Assessment
  - Value at Risk
  - Portfolio Risk
  - Scenario Test
- Risk Control

www.swingtum.com
panhp@swingtum.com
Minimizing Downside Risk - Objective Functions

Relative to a target value $T_t$ the rate of return of the portfolio $R_t$ during one time period can be distinguished between two classes: a positive value $V_t$ above the target and a negative value $Z_t$ below the target.

$$R_t - T = \begin{cases} V_t & \text{if } R_t \geq T \\ Z_t & \text{if } R_t < T \end{cases}$$

To minimize the downside risk, the first four simplest objective functions are:

I - MinMDD1: to minimize the maximum draw-down

II - MinMDD2: to minimize the maximum downside deviation

III - MinSDD: to minimize the sum of downside deviations

IV - MinSDDS: to minimize the sum of downside deviation squares
Minimizing Downside Risk - Objective Functions

Four simplest objective functions:

I - MinMDD1: to minimize the maximum draw-down

\[
\min \left\{ \frac{(HH_t - RR_t)}{HH_t}, \; t = 1, 2, \ldots, N \right\}
\]

(HH - highest high, RR - relative return to the start)

II - MinMDD2: to minimize the maximum downside deviations

\[
\min \{ \max \{Z_t, \; t = 1, 2, \ldots, N \} \}
\]

III - MinSDD: to minimize the sum of downside deviations

\[
\min \frac{1}{N} \sum_{t=1}^{N} Z_t
\]

IV - MinSDDS: to minimize the sum of downside deviation squares

\[
\min \frac{1}{N} \sum_{t=1}^{N} Z_t^2
\]
Semi-Minimum Absolute Deviations (SMAD)

Based on the concepts and approaches of Minimum Absolute Deviations (MAD) and Downside Risk Modeling of Konno & Yamazaki (1991), Feinstein & Thepa (1993), and Zenios and Kang (1993), Oberuc (2004) provides an integrated formulation of the objective function of Semi-MAD, which he termed DynaPorte Model: (Direct Dynamic Portfolio Theory)

$$\min \frac{1}{N} \sum_{t=1}^{N} Z_t, \quad AA_{jt} = A_j + \sum_{k=1}^{K} B_{kj} F_{kt}$$

($AA$ – asset allocation, $F$ – influential factors)

The complete formulation can include constraints on
1) lower and upper bounds of asset allocation
2) lower and upper bounds of leverage
3) Cost of borrowing
4) Buy and sell transaction costs.

The solution is a Linear Programming for minimizing the Semi-MAD subject to all the constraints.
3. Three Assumptions
– Factual Understanding of the Stock Market

Assumption 1: Long-Run Up-Trend (LRUT)

For the stock market of the world leading economy or one of the mainstream economies, there is an up trend in the stock market index in the long run over 10 years.

Assumption 2: Bull-Bear Market Cycle (BBMC)

For a stock market which has a LRUT, the market as a whole goes through a cyclic switching between bull market and bear one intermittently.

Assumption 3: Sector Rotation

During a BBMC, over different stages, the relative strength of the sector indices will rotate over different stages (waves) of the bull market and of the bear one.
- the gate to Dynamic Modeling of Stock Market

The single most reliable dynamic process pattern of the stock index is the Bull-Bear Market Cycle (BBMC). A whole cycle most likely lasts for 3-5 years, but a bull market can last over 10 years, such as 1990-2000 IT bubble.

Four different perspectives confirm this phenomenon:

① Macroeconomics: Business Cycles in the West last 5 years on average, corresponding to the BBMC with a phase shift;
② Technical Analysis: The theory of Charles Dow (1880s) as the cornerstone of TA starts with the primary trends of bull-bear markets;
③ Master Traders: The lifetime experience of George Soros was summarized in his so-called “Boom-Bust Cycle”, a synonym of BBMC;
④ Econophysics: Didier Sornette (1996-2006) stock market crash model - log-periodic power law, LPPL, contains a financial bubbling process (bull market) and its busting process (anti-bubble, bear market). LPPL is a dualism as an econophysical expression of BBMC.
Dow Theory - the Primary Trend of Dow
Dow Theory - Secondary Trends of Dow
Dow Theory - Minor Trends of Dow
Waves 1, 3, and 5 are impulsive waves. Waves 2 and 4 are corrective waves. Waves A, B, C correct the main trend from wave 1 to wave 5.
The Elliott Wave Fractal Patterns

Waves 1, 3, and 5 are impulsive waves. Waves 2 and 4 are corrective waves. Waves a, b, c correct the main trend from wave 1 to wave 5.
The Elliott Wave Rules and Retracement Ratios

- 38.2%
- 50%
- 61.8%
Log-Periodic Power Laws (LPPL)
(Sornette et al 1996 – 2006)

\[ \ln x(t) = A + B(t-t_c)^\beta + C(t-t_c)^\beta \cos[\omega \ln(t-t_c) + \phi] + \xi(t) \]

More complicated form (Zhou & Sornette 2003)

\[ \ln x(t) = A + B t^m + \Re \left( \sum_{n=1}^{N} C_n e^{i \psi_n} x^{-s_n} \right) \]

\[ C_n = \frac{C}{n^{m+0.5}}, \quad s_n = -m + i \frac{2\pi}{\ln \gamma}, \]

\[ \gamma = e^{-2\pi/\omega}, \quad \psi_n = \omega n \ln(\omega n) \]
Log-Periodic Power Laws as a kind of Trend and Cycle for Intelligent Dynamic Portfolio Management

Discontinuation of LPPL
Multi-Level Log-Periodic Power Laws
6. Sector Rotation and Money Flows

Stock Market Sectors
1 – Transportation
2 – Technology
3 – Capital Goods
4 – Basic Industries and Materials
5 – Energy
6 – Food, Drugs, Health Care
7 – Utilities
8 – Financials
9 – Autos, Housing, Consumer Cyclicals

(Ref: Navarro 2004)
Sector Comovement vs Sector Rotation (Monthly Charts)  
(Chinese Stock Sector Indices, June 2005 to April 2008)
Sector Comovement vs Sector Rotation (Weekly Charts)
(Chinese Stock Sector Indices, June 2005 to April 2008)
Sector Comovement vs Sector Rotation (Daily Charts) (Chinese Stock Sector Indices, June 2005 to April 2008)
The scale-space of price-time (time scale, time horizon, time frame, time resolution) is the foremost dimension for considering an investment strategy involving portfolios.

- **Super Long-Term (5-20 years)**
  - buy-&-hold

- **Long-Term (1-3 years)**
  - stay a whole bull market

- **Intermediate-Term (1-6 months)**
  - ride a whole impulsive wave on the first level

- **Short-Term (1 day – 1 month)**
  - ride a whole impulsive wave on the second level

- **Super Short-Term (shorter than 1 day)**
  - high-frequency
8. Multi-Market Level Equity Portfolios (time scale) – Countries, Sectors, Stocks

The aggregation level is another important dimension to consider where to invest and what to trade

◆ **Country Level** (Long-run trend and BBMC)
  - World Leading Economy
  - Developed Economies
  - Leading Developing Economies

◆ **Sector Level** (Life cycle and BBMC)
  - Financials
  - Resource and Energy
  - Real Estate
  - Medical

◆ **Stock Level** (Life cycle and BBMC)
  - Sector Leaders
  - Strong Followers
  - Good Lagers
Go with the trend is the first principle of trading!!!

In the history, there are too many people, many way smarter than us, have lost millions and billions, far more money than most of us dare to think, because they were violating this principle, either fighting against the trend, or not being aware of the trend but without a strict risk control.

What we can do:
(1) Trend Prediction for Portfolio Optimization and Trading
(2) Trend Following for Portfolio Management and Trading
(3) Do Both: Enter with Trend Prediction or Trend Following
    Exit with Trend Prediction or Trend Following
Market Analysis, Active and Reactive Trading

◆ Market Analysis
  - Long-run Trend
  - BBMC - Cycle
  - IRMW – Waves
  - Sector Rotation – Cross Section of Trend-Cycle-Waves

◆ Trend Prediction
  - Phase of BBMC
  - Wave of IRMW
  - Monthly Returns of an Asset Price (market index or stock price)
  - 1-5 Days Short-term Trends of an Asset Price

◆ Trend Following
  - Follow the BBMC
  - Follow the IRMW
  - Follow the Monthly Trend for Portfolio Management
  - Follow the Daily Trend for Day Trading
  - Follow the Intraday Trend for Intraday Trading
    (not necessarily high-frequency)
The Structure of a Trend
- Scenario Analysis of Stock Index e.g. S&P 500
New Orders of Durable Goods is a leading indicator to S&P 500.
Sales in transport of Durable Goods leads S&P 500 too
Unemployment Rate leads S&P 500 too, with negative correlation
Fusion of Multiple Market Dynamics (US leads Australia)
Predicting Daily High-Low-Close Price of Stock Index with Probability Distribution
\[
\begin{pmatrix}
X(t), X(t-1), X(t-2), \ldots, X(t-k), \\
\phi_1(t), \phi_1(t-a), \phi_1(t-2a), \ldots, \phi_1(t-ka), \\
\phi_2(t), \phi_2(t-2a), \phi_2(t-4a), \ldots, \phi_2(t-2ka), \\
\phi_4(t), \phi_4(t-4a), \phi_8(t-8a), \ldots, \phi_4(t-4ka), \\
\vdots & \vdots & \vdots & \vdots & \vdots \\
\phi_b(t), \phi_b(t-ba), \phi_b(t-2ba), \ldots, \phi_b(t-bka) \\
Y_1(t), Y_2(t), Y_3(t), \ldots, Y_q(t), DoW(t+1)
\end{pmatrix} \rightarrow X(t+1)
\]
(a) unconditional
Fig. 18. Probability distribution of predictions for Case A (from left: High, Low and Close)
Fig. 19. Probability distribution of predictions for Case B (from left: High, Low and Close)
Hit Rate of H-L-C(t+1) (2004)

18-year data (1985-2003) used for training
first 100-day data of 2004 used for testing

Hit Rate:

High: 78%
Low: 82%
Close: 70%
Hit Rate of H-L-C(t+1) (2008)

We now have new nonlinear prediction models implementing multilevel process analysis of stock index time series, which are far more accurate and reliable.

Hit Rate:

High: 80-90%
Low: 80-90%
Close: 70-80%

We can also predict H-L-C at t+2, t+3, t+4, t+5.
Here shows a Sector Portfolio only. A Stock Portfolio after this Sector one should produce even better performance.
Chinese Index HS300 vs Strong Sector Portfolio (June 2005 to April 2008): 250% vs 800%

Here shows a Sector Portfolio only. A Stock Portfolio after this Sector one should produce even better performance.

Portfolio Return: 800%
Market Return: 250%
11. A Complete Invest-in-Trading System

1. World Leading Markets Analysis
2. Developed Markets Analysis
3. Developing Markets Analysis
4. Country Portfolio
5. Sector Portfolios (Index Funds)
6. Stock Portfolios
7. Long-Term Portfolios (BBMC)
8. Interm-Term Portfolios (IRMW)
9. Short-Term Portfolios (Chart Patterns)
10. Asset Selection with Value and Strength
11. Portfolio Optimization with Nonlinear Prediction
   (of asset returns or direct portfolio weights)
12. Trading with Active and Reactive Techniques
   (multi-time frame trend prediction and trend following)
Unification of Four Most Successful Methodologies together with Portfolio Theory and Computational Intelligence

- Value Investing
- Macro Investing
- Dynamic Arbitrage
- Strength Investing
Thanks for your attention!