Trend: Catch me if you can!

A Business Case for
MNTO: A Quantitative Proprietary Trading Model
Long Only Trend Following Strategy

21st of February, 2011

Abstract

MNTO is an actively-managed investment vehicle based on a statistically validated proprietary trading model. Its combined approach integrates financial engineering, trading psychology, market adaptability and money management, and aims to generate superior returns with excellent risk-reward properties and a low correlation to directional market movements.
The results of 4 years of research on this long-only trend-following strategy are based on the ASX50 stocks and the historical ex-post examination spans over 11 years [2000-2010] incorporating 10 years of backtesting and 1 year of paper trading. Transaction costs (inclusive of slippage, commission, and market impact), overnight gaps and liquidity were accounted for, and tests for survivorship bias were also conducted.
The empirical results strongly suggest that the Quantitative Proprietary Trading Model – Long-Only Trend-Following Strategy – has a competitive advantage in being a profitable trading system and earning sound risk adjusted excess returns.

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"… as long as financial markets demand instant liquidity there will always be a profitable niche for quantitative trading…" or a self-fulfilling prophecy…

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1 Performance Analytics @ a Glance

ALL FIGURES ARE BASED ON BACKTESTING RESULTS[1]

1.1 1$ Investment Return: The Model vs. ASX200

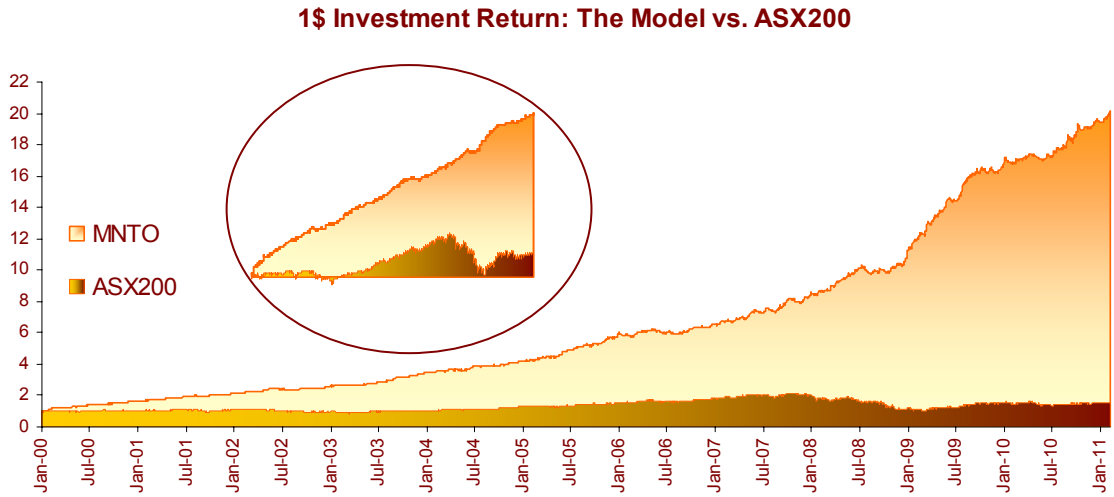


Figure 1: The above chart shows the hypothetical performance of MNTO compared to the ASX200 index. Returns are excluding dividends received and interest earned from the cash positions. The chart in the circle is expressed in log scale to uniformly illustrate percentage changes.

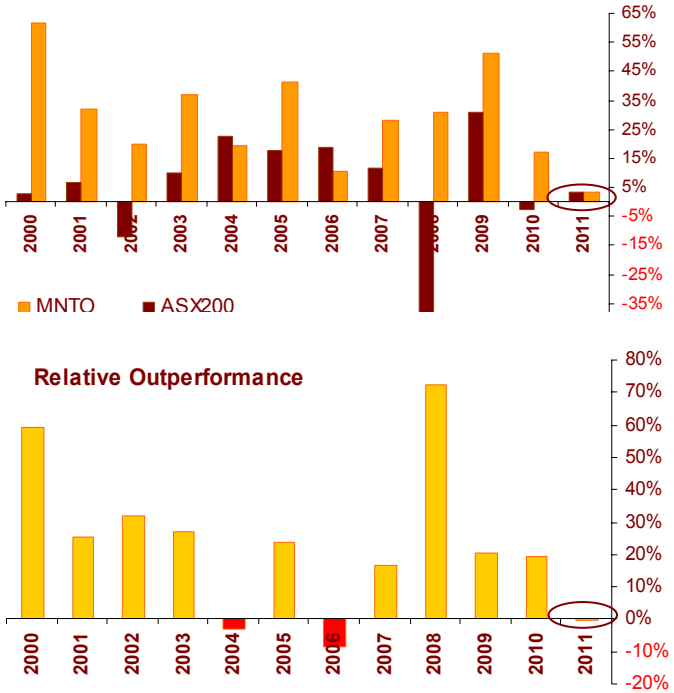


Figure 2: This chart shows the hypothetical model returns compared to ASX200 returns on a calendar year basis (1 Jan – 31 Dec). Annual performance ranges from 10.56% to 61.94% with an average of 31.75% (excl. 2011). $1 invested 11 years ago would have grown to $20.06 (ASX200 - $1.58). Performance marked in circles for 2011 are to 10-Feb.

[1] See full disclosure statement at the end of the paper.

1.2 Monthly Returns Performance Analysis

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MNTO	ASX200
2011	1.52%	1.70%											3.25%	3.57%
2010	1.03%	1.23%	1.25%	0.27%	-1.33%	1.24%	2.74%	3.35%	1.34%	2.06%	0.37%	2.25%	16.91%	-2.57%
2009	8.15%	3.65%	5.20%	4.90%	5.65%	0.56%	6.44%	3.89%	1.99%	-0.86%	0.26%	2.59%	51.14%	30.85%
2008	3.23%	0.90%	2.64%	4.79%	3.80%	3.30%	-1.42%	0.53%	0.30%	1.37%	2.34%	5.75%	30.99%	-41.29%
2007	2.97%	0.66%	1.68%	0.59%	5.87%	-0.62%	2.69%	1.15%	5.03%	1.70%	-0.24%	3.96%	28.35%	11.82%
2006	0.33%	-1.98%	4.26%	1.64%	-0.27%	-1.55%	-1.59%	0.34%	5.31%	0.05%	1.24%	2.58%	10.56%	19.03%
2005	1.88%	1.49%	3.11%	-0.33%	4.01%	6.07%	2.79%	3.20%	2.57%	0.81%	5.93%	3.74%	41.34%	17.60%
2004	-1.00%	2.76%	2.55%	-0.45%	0.26%	6.00%	0.04%	0.97%	0.22%	1.46%	3.08%	2.27%	19.53%	22.75%
2003	2.88%	-0.39%	0.13%	2.50%	1.23%	4.18%	2.43%	5.07%	2.95%	3.37%	1.53%	5.97%	36.69%	9.73%
2002	2.08%	3.23%	1.09%	3.32%	4.45%	-2.20%	-0.96%	0.30%	1.01%	0.25%	2.11%	3.63%	19.68%	-12.13%
2001	3.91%	2.24%	1.60%	4.96%	0.79%	4.00%	1.46%	0.77%	2.54%	1.18%	2.22%	2.61%	32.12%	6.74%
2000	9.86%	8.65%	4.18%	4.49%	1.81%	8.62%	-0.44%	1.73%	3.94%	0.97%	4.58%	1.39%	61.94%	2.84%

Table 1: Illustrates the monthly performance of MNTO over 10 years of backtesting [2000-2009] and 1 year of paper trading [2010] compared to the ASX200 index returns. Returns for February are to 10-Feb-2011.

1.3 Performance Analytics Characteristics[2]

Performance Analysis		
3-Jan-2000 through 10-Feb-2011	**MNTO**	**ASX200**
Total returns	1906%	58%
1$ Invested	$20.06	$1.58
Compounded Annualised Returns	30.97%	4.18%
Volatility - 11.1 years	7.90%	16.64%
Drawdown (Loss in %)		
Maximum Drawdown (94 Trading Days)	-5.78%	-53.94%
	15-Aug-08	06-Mar-09
Start Date	14-Jul-08	02-Nov-07
End Date	21-Nov-08	10-Feb-11
Drawdown (Number of Trading Days)		
Maximum Drawdown (-4.86%)	125	855
Start Date	30-May-02	02-Nov-07
End Date	21-Nov-02	10-Feb-11
Sharpe Ratio (average)	2.99	0.30
Sortino Ratio (average)	7.13	0.55
Min/Max Returns (min/max)		
Rolling 12 months	9.68% 67.78%	-47.32% 51.13%
Rolling 3 months	-4.91% 28.18%	-32.01% 27.17%
Correlation (11 yrs)		**0.193**
Maximum Monthly Consec. Loss	-3.41%	
N Months	3	
Start Date	May-06	
End Date	Jul-06	
Average Monthly Return	2.29%	
% Months with Gains	88.06%	

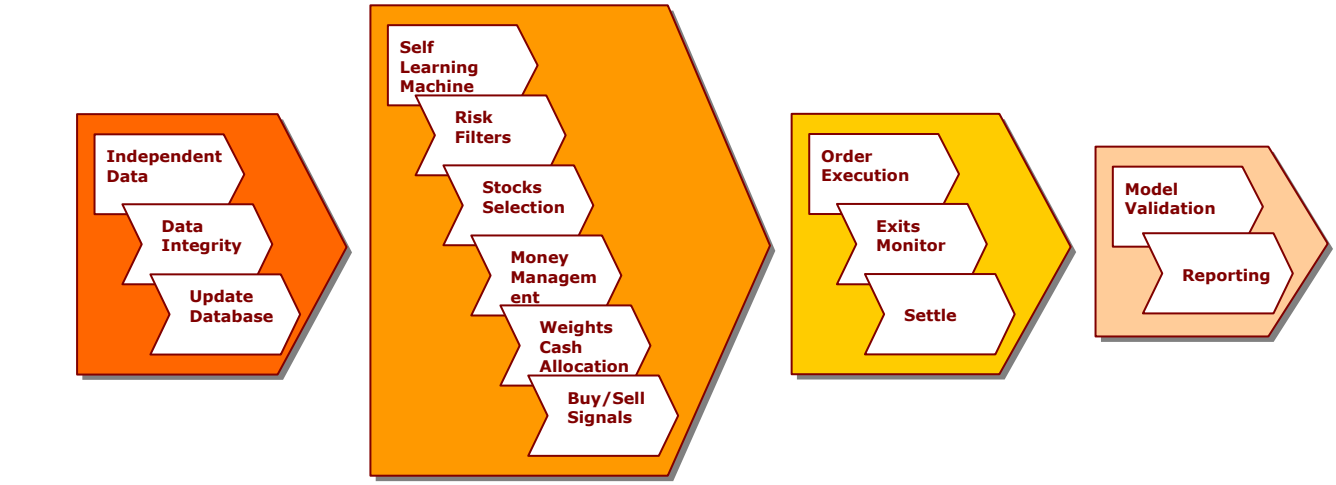
[2] Note on DD: The drawdown is the peak-to-trough decline during a specific record period.
Note on Sharpe and Sortino Ratio: The Sortino ratio is a modification of the Sharpe ratio. It is identical to the Sharpe ratio for the time series of negative returns.

2 The Model @ a Glance

The Model is quantitative active management style strategy / Investment fund vehicle utilising a systematic absolute return, algorithm-based, statistically validated proprietary trading model. Its combined approach integrates financial engineering, trading psychology, market adaptability and money management, and aims to generate superior returns with excellent risk-reward properties and a low correlation to directional market movements.

The Model's key characteristics:

- Long only: Takes advantage of upward trends
- Self learning: Auto-adapting to changing market conditions
- Leverage free: Free of the use of any derivatives
- Purely based on technical analysis: Does not have any fundamental bias
- Systematic rules based: No discretion or ad hoc decision making
- Trends dependent: Captures non-ranging market opportunities
- Risk adjusted: Positions reflect the model's risk appetite and money management constraints
- Low capacity and arbitrage free: Low capacity proprietary model (~$600 Mio)
- Capital readily available: Investing in exchanged-traded and highly liquid securities offering full transparency



	Input Data	Model Calculation Engine	Execution	Reporting
Process Type	Automated	Automated	Semi-Automated Electronic Trading	Manual
System	IRESS* EXCEL MATLAB	MATLAB	EXCEL* IRESS Broker	EXCEL IRESS*
Timing	After market Close (10 min)	Overnight (1/2 hr)	@ open (1/2 hr) During market (continuous)	@ Close (1/2 hr)

Figure 3: Synopsis of The Model processes including required systems and daily operation schedule. IRESS is the trading/execution platform.

3 Performance Analytics – Details of MNTO

3.1 Monthly Returns

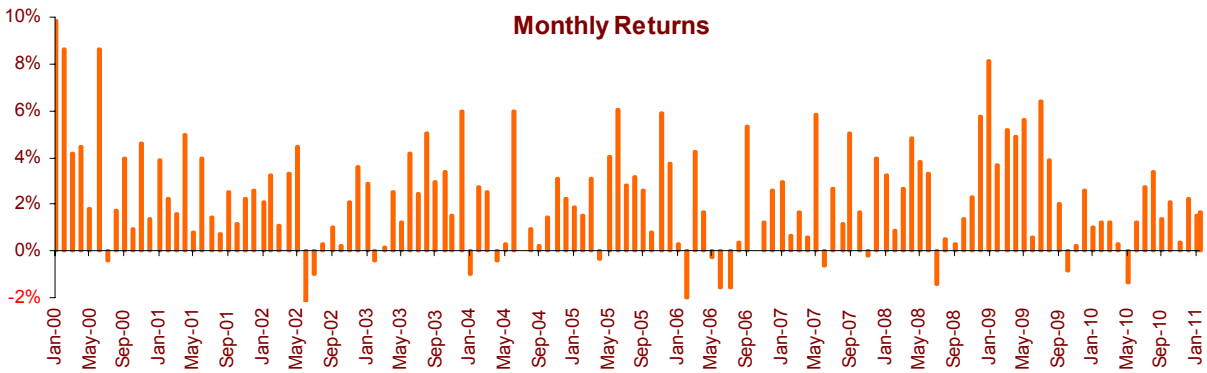


Figure 4: Monthly returns with a Hit Ratio of 88.06%. Average monthly returns of 2.30% (excl. 2011).

3.2 Returns & Volatility

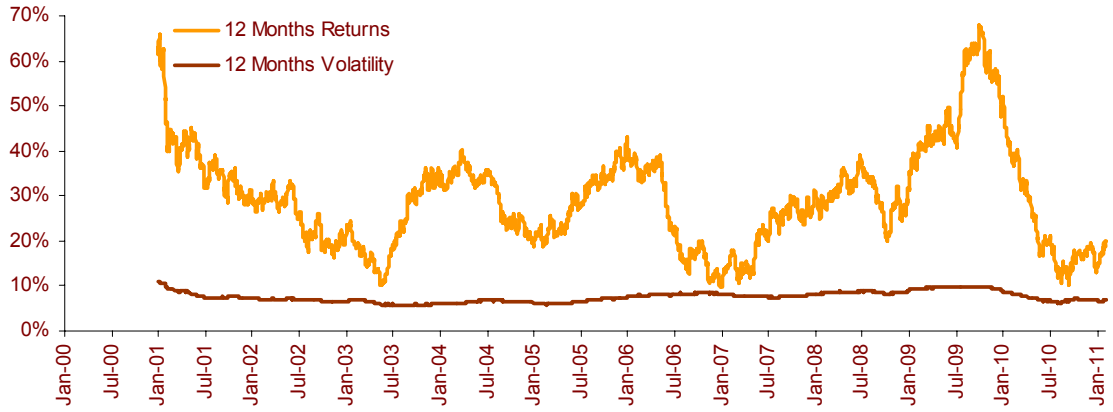


Figure 5: Rolling 12 months volatility average of 7.55% (min 5.62% - max 10.94%). Rolling 12 months returns average of 29.44% (min 9.68% - max 67.78%).

3.3 Correlation to the ASX200

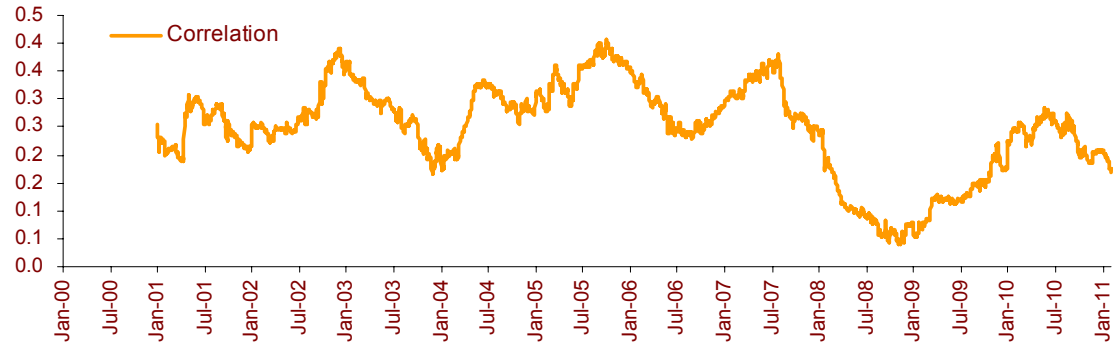


Figure 6: Rolling 12 months correlation average of 0.25 (min 0.04 - max 0.41). Diversification to the ASX200 is more so in bearish markets.

3.4 Sharpe / Sortino Ratios

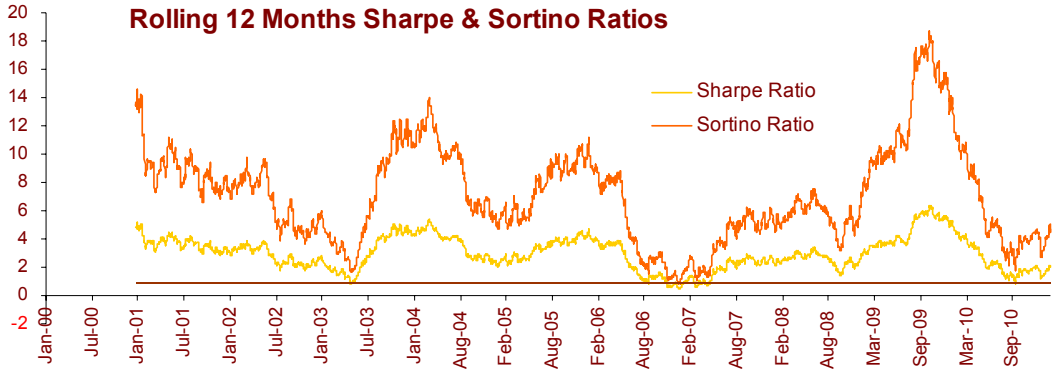


Figure 7: Rolling 12 months Sharpe Ratio average of 2.99 (min 0.43 - max 6.33). Rolling 12 months Sortino Ratio average of 7.13 (min 0.80 - max 18.65).

3.5 Historical Allocation Graph

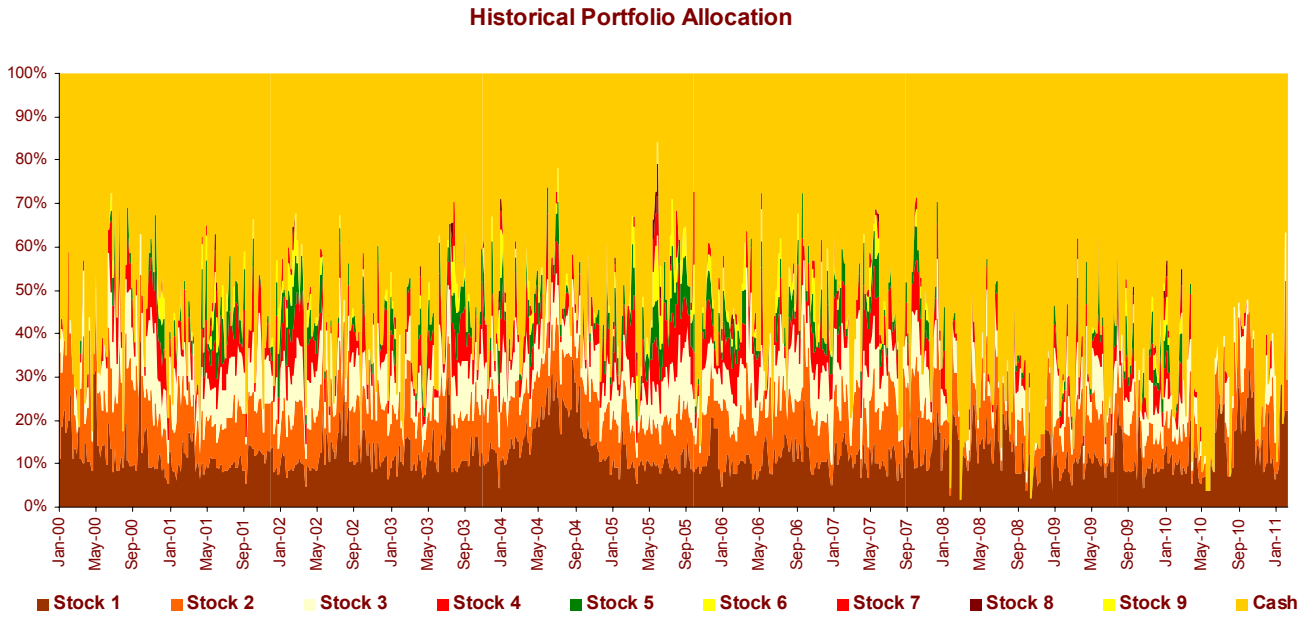
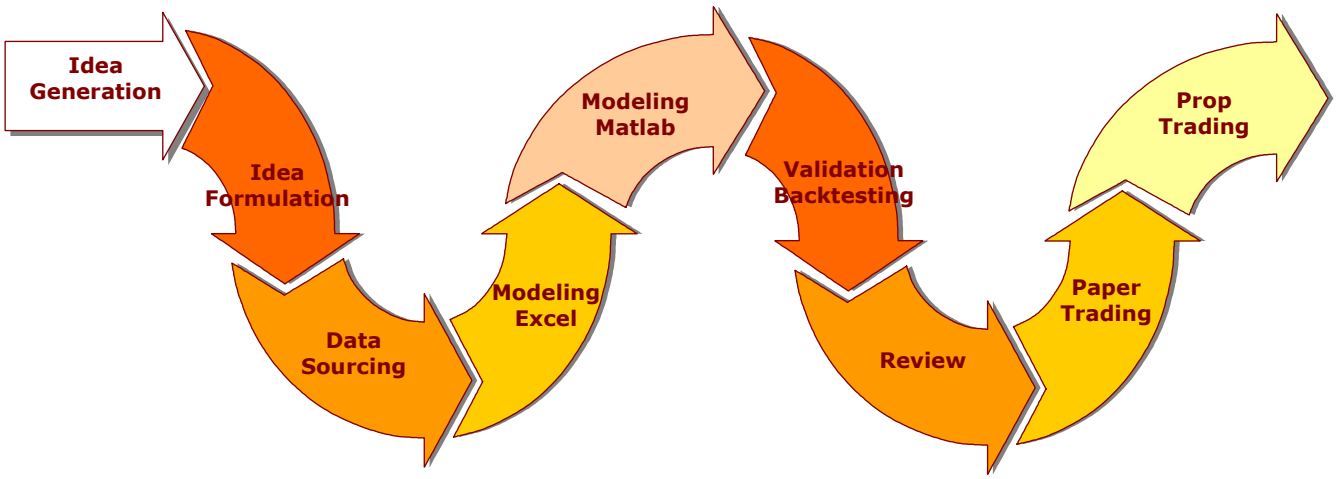


Figure 8: 5 days average of portfolio allocation between stocks and cash. The average number of stocks for a given day – without 5 days averaging - is 3 (min 0 - max 9).

4 The Model - Details

4.1 The Idea

The vision behind the model dated from May 2003 whilst listening to a lecture on "Investment Management". It has evolved since then and its roots lie in physical engineering, finance and behavioural market psychology.
Since then, the author has worked in various financial market environments to accumulate skills, knowledge and experience that have been central to creating this algorithmic proprietary trading model[3].



The main driver of the strategy resides in financial markets' persistent inefficiencies, especially with respect to price trends. The unique goal of MNTO is to trade those inefficiencies in a profitable manner without taking undue risks, learning from the markets and adapting to non event-driven market changes.

The research and implementation of the idea started in May 2007 and has been conducted outside of working hours.

The model has been built from the ground up since there was neither literature nor off the shelf algorithmic modelling available on the idea forming the base of the model. This resulted in a model with the following characteristics: flexible, look through, proprietary, arbitrage free, customisable, predictable, understandable, scalable, simple, dynamic, verifiable and reusable.

[3] See appendix: About The Author

4.2 Data Integrity

Data coverage
The database used includes the constituents of the ASX50 as at 4-Jan-2010.

Survivorship bias
The database used for this research includes historical data for all stocks including those.

- It mostly affects mean reverting strategies
- It has been tested with no substantial variation of results
- It is negligible for regime-switching models

Data snooping bias
All optimisations occur in a lookback moving window, involving no future unseen data eliminating any possibility of data snooping.

Corporate actions
Given the nature of the long-only strategy at the portfolio level - with most of the trade durations of less than a week, no adjustments have been made for corporate actions including but not limited to cash dividends, splits, mergers, spin-offs, stock dividends and reverse splits.
It is understood that returns on dividend-paying stocks are underestimated when dividends are not accounted for (long only strategy).

Universe of tradable assets
To mimic a realistic trade execution environment, the algorithm estimates liquidity based on previous trading days and assigns weights accordingly. This filtering is used in the portfolio construction phase to adjust for stocks that would not have been liquid enough at the time of the trade.

Unsustainable returns
Within the portfolio construction phase, there is a mechanism whereby unsustainable returns, often event-driven, are truncated before the portfolio stocks allocation.

4.3 The Model Methodology

A complete discussion on the model methodology is beyond the scope of this paper.

Self-Learning Machine
A key driver of the methodology of the model can be viewed as a form of artificial intelligence: neural networks. Indeed, it is a machine-learning tool to profit from regime-switching. It aims at continuously adapting to the ever-changing market conditions with the following characteristics:

- Sound rational basis and not random discovery of patterns
- Self-made trading model based on momentum effects
- Conceptually simple with few parameters and simple utility functions

Competitive advantages to institutional money managers

- Very low capacity in comparison
- Trade few stocks (if any) on a daily basis
- Potentially not arbitrage-able by the big hedge funds
- Infrequent positions and rebalancing
- Believed to have its own unique novel approach to trading the market

Entry & exit or Buy & Sell signals
The Model is run and Buy/Sell signals are generated after the previous day's Close. Orders are executed the following trading day at the Open

Exit (stops)
Besides sell signals from a long positions and stock dis-allocation, dynamic exits are monitored and generated by The Model on a continuous basis:

- Stop loss
- Trailing stop loss

4.4 BackTesting and Paper Trading

The strategy was first implemented in an Excel spreadsheet, then in an Excel macro before being migrated to Matlab for the following reasons:

- WYSIWYG: Nothing is hidden and data and macros are all in one place
- One of the main pitfalls in backtesting was easier to avoid: "look ahead" bias
- Excel was not able to accommodate some of the model's cutting edge features

Transaction costs

The below costs have been taken into account to mimic the profitability of the backtesting

- Commission fees (broker)
- Liquidity costs (bid-ask)
- Market impact costs (moving price on low liquidity stocks)
- Slippage costs (difference between the bid and the executed price)

Note, commission fees are: 2 bps

Paper Trading

- Added an additional layer in validating the trading model for bugs.
- Ensured there is no glaring "look ahead" bias
- Provided further intuitive understanding of the strategy
- Exposed the operational requirement of the trading model

Conclusions

- Risk-return profile as per expectations
- Maximum drawdown dollar amounts and maximum drawdown durations sustainable and in line with expectations
- Times of market stress/crisis are manageable
- Confidence in managing real money with the strategy
- Better feeling of model behaviour and limits

4.5 Risk Control and Money Management

Daily risk management is at the core of the performance of the model. MNTO portfolio is constructed to target pre-defined levels of risk. Returns are just a consequence of such an approach. Risks are mitigated via the following:

- **Investment style:** Long-only strategy (no leverage) i.e., one of the most risk-averse trading strategies. Note that long-only strategies are historically more profitable. If traded in small volumes and frequently, which is the case here, they are no riskier than market neutral strategies.
- **Universe of assets:** ASX50 stocks which are liquid enough for the purpose of this investment vehicle.
- **Dynamic Portfolio allocation** (stock screening and stock allocation)**:** Positions frequently adjusted to market changes and to increase portfolio diversification. The optimal allocation is driven by the portfolio CV@R (tail-risk). CV@R is used as the key measure of risk to circumvent the assumptions around the standard deviation of normal distributions.
- **Dynamic stop loss or trailing stop loss:** The essence of the stop-loss rule is precisely to minimise the risk of losing large bets and to require limited access to capital.
- **Risk Management approach:** Combining risk management and money management.
- **Infrastructure:** Simple and robust infrastructure with strong operational controls.
- **BCP plan:** Back-up trading model, systems and execution.

Systems

- Internal risk management system
- Middle/Back office reconciliation
- Proprietary statistical tools
- Quarterly test of the BCP

Diversification of trades

- Statistically driven position size allocation (market driven)
- Concentration limits per underlying stock and per individual trade

Daily reporting (to management and stakeholders)

- V@R
- CV@R
- Stress testing scenarios
- Risk/Return reports

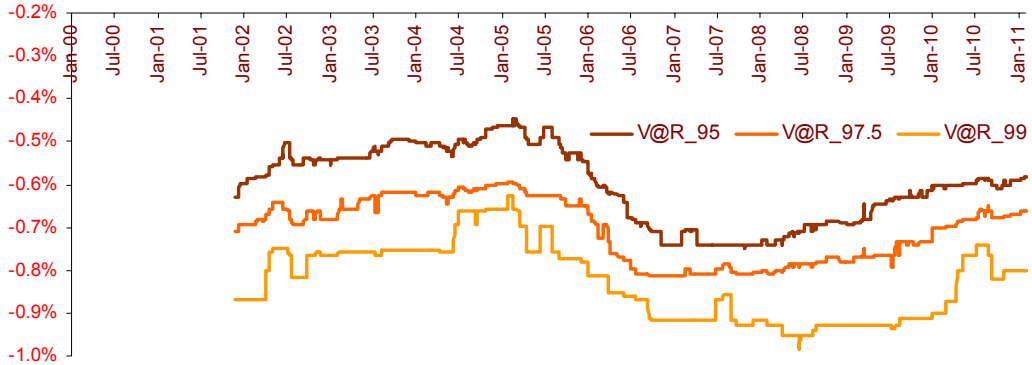


Figure 9: Rolling 1 day – 99% V@R average of 0.83% (min 0.63% - max 0.98%).

4.6 Platform and Systems

Excel (Excel and VBA)

- Database
- Trade execution
- Report generation

Matlab & Matlab Toolboxes

- Signal generation
- Portfolio allocation
- Report computation

Matlab (MATLAB (MLALL)) is the most common backtesting platform used for quantitative analysis. Toolboxes required to start operating the model are:

- Financial Toolbox (FIALL)
- Optimization Toolbox (OPALL)
- Statistics Toolbox (STALL)
- Spreadsheet Link EX (ELALL)

IRESS[4]

- Market data
- Direct Market Access (DMA) via the selected broker
- Trade execution
- Execution reporting and confirmation

[4] IRESS is the execution/trading platform

4.7 Operations

Brokers
- As per existing (if any) arrangements; including
- A backup broker

Staffing
- Using current middle/back office resources
- One trader with back-up on the desk

Trade reconciliation
- Daily booking reconciliation
- Daily PnL checks
- Daily cash account reconciliation
- Daily tracking of settlement

Confirmations
- Checked first by trading
- Checked by back office
- Unsigned confirmations are tracked

Others
- Review of corporate actions
- Review of dividends payments

Compliance and other enablers
- As per existing (if any) arrangements

4.8 Limits of The Model

Model capacity:
Circa AUD $600 Mio driven by current market liquidity for ASX50 constituents

Market liquidity
Stock allocation subject to observable liquidity

Constraints
Model invests as per pre-defined constraints

Expect Losses
The willingness to assume risk for appropriate reward is inherent in realising some risk i.e. losses.

Purely Technical
Any event negatively impacting the price of a security cannot be assumed by the model. This is likely to result in some losses in line with the model's risk controls and risk management.

Long only
The model will not benefit from downtrend markets. In saying that, the model would be invested in cash in the case that the constituents of the portfolio i.e. all sectors, are on a downward trend consistently and for a long enough time period. Note, in short selling a security, the maximum gain that can be realised is 100%.
MNTO will incur small losses when the market is ranging and invest in cash during downwards trending markets.

Tax inefficiency
Owing to the short-term nature of the positions, it is unlikely that the strategy profits would qualify for long-term capital gains treatment. This should not have material impact if the model is not used for external investors.

Universe of investable Assets
The universe of assets is at this stage limited for mathematical and computational tractability.

5 MNTO: A Perfect Fit

Additional earnings could potentially be sourced from either improving the current operational efficiencies, or from developing new capabilities that could enhance long-term performance. MNTO would be an additional capability to assist the business in responding to a relentlessly changing marketplace. MNTO would enhance revenues in times where flows are drying up, such as has been the case in recent times.

Further to diversifying the source of revenues, the following apply:

- **Negligible risk limits:** No additional risk limit required given the all time 99% 1 day V@R of the strategy is less than 1% (e.g. $20K on $2Mio capital invested).
- **Limited downside:** Maximum Drawdown of 5.78% (e.g. $116K on $2Mio capital invested). There is little to lose and a lot to gain in pursuing this opportunity.
- **Look through**: The strategy's verifiability provides confidence to manage real money and to clearly understand the limits of the strategy.
- **Negligible set up costs:** Leveraging of existing (if any) infrastructure may be utilised.
- **Scalability of the investment approach:** From capital to be managed.
- **Low maintenance business:** No external marketing required, no external business development / external client relationships or external queries to handle.
- **Multipurpose:** MNTO could be adapted to other different type of assets.

Furthermore MNTO would create an intellectual dynamic/stimulus and set the basis for further non-discretionary trading capabilities – including high-frequency trading.

6 Where To From Here

1. **Management buy-In**: Management reviews, considers and potentially agrees to cover the set up costs of the system(s), and to provide capital for MNTO to start trading within 2 months or as soon as practical.

2. **Set up of the operations – Enablers/Stakeholders**: Liaising with all enablers/stakeholders (if any - Finance, Legal, Credit, Market Risk, Compliance, Operations) and brokers: 2 months.

3. **Set up of the fund – Proprietary Model**: Purchase and installation of required architecture and systems. Transferring of files.

4. **Testing of operations:** One week of dummy trading to ensure smooth operational activity once trading resumes.

7 Take Home

- ✓ Long-only, leverage free, ASX50 Equities.
- ✓ Systematic rules based on technical analysis.
- ✓ Invested capital at call.
- ✓ Adaptive and aims to dynamically optimize risk-adjusted returns.
- ✓ Downside risks historically low.
- ✓ Negligible set-up and implementation costs.
- ✓ Auxiliary benefits apart from the potential for material revenue.
- ✓ Historical backtesting results are compelling.

8 Disclosures

The information contained in this paper and the hypothetical results are shown for research purposes only. It is not a solicitation to sell or buy any security and does constitute neither an offer nor a solicitation.

Speculative trading in equities can result in significant loss of capital.
Past performance is not indicative of future performance.
Model performance may not be indicative of future performance.
All figures are hypothetical.

It should not be relied upon as the sole basis for making an investment decision, nor should a decision be made until the investments are fully understood. The paper does not take into account individual objectives, financial situations or needs.

This paper has been prepared with all reasonable care. All information was based on information obtained from sources believed to be accurate, but the accuracy of such information cannot be guaranteed. The information is provided without warranty of any kind. The results contained within have not been audited. The author assumes no responsibility for errors, inaccuracies or emissions in this paper that is subject to change without notice.

Different types of investments involve varying degrees of risk, and there cannot be assurance that any specific investment will be profitable.

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9 Appendix: About the Author

The Author graduated in 1998 from a French engineering school as an Engineer in Optronics (equivalent to a Master in Engineering) after following the French pre-engineering elitist educational system of Math-Sup / Math-Spé.

After working as an Optronics engineer for Alcatel for four years (fibre optic telecommunication systems design and implementation), he migrated to Australia and studied at the MGSM (Macquarie Graduate School of Management) where he received the equivalent of a Master of Financial Management before validating his MBA. During his MBA, the author received a Certificate of Merit Award in recognition of his outstanding performance in Information and Decision Analysis.

Thierry then started working with Macquarie Bank where he participated in writing a research paper[5] in Equity Derivatives Portfolio Optimisation. He then worked at PWC in Financial Risk Management mainly focusing on Equity Derivatives pricing and Value at Risk. After being approached, he joined IAG-Asset Management to set up and head their Market Risk division with ~$13 billion under management.

The author joined ANZ in May 2007 after being approached to join the "Product Structuring and Innovation" team as an Associate Director within the Debt Capital Markets Group (DCM). In January 2008, after expressing his interest in partaking in the establishment of an Equity Derivatives desk at ANZ, he was approached by the Head of Global Markets to assist in the building of ANZ's Equity Derivatives Desk (EQD).

Thierry is currently an Associate Director at ANZ on the Equity Derivatives Desk. His core activities include trading, structuring and managing a book. He is often involved in Client-Facing / Sales types of activities where he recently conducted research on the optimal hedge for an Australian Equities Portfolio.

Thierry's background experience in Engineering, Risk management, Model building and coding, Derivatives valuation, Structuring and trading, backed up by his academic credentials in Engineering, Finance and Business Administration have given him the necessary tools and skills to address challenges inherent to algorithmic trading i.e. to be able to develop, build and test robust trading algorithms which require data gathering, preparation and standardisation, model development and prototyping, backtesting, calibration, systems integration and deployment.

[5] https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=QMF2006&paper_id=6