MSCI

Factor Analytics
Factors are the building blocks of many portfolios – the elements capable of turning data points into actionable insights.
MSCI is a leader in providing tools to help clients build and manage better portfolios, implement strategies and measure performance. As a leader in the application of factors for more than 40 years, MSCI, beginning with Barra has invented a common language to explain risk and return through the lens of factors.

With the advancement in data and technology, MSCI has simplified complex data into actionable insights to be used by a broader audience. MSCI has developed Factor Models in consultation with the world’s largest investors and has research backed by four decades of factor data. Our Factor Models have evolved in tandem with the industry and have their roots in academic literature.
Evolution of MSCI's Factor Models with Industry and Academia

1972
Haugen & Heins refining CAPM to create low volatility factor investing, demonstrated that stock portfolios with lower volatility tend to produce higher returns on average

1975
Barra launch Creation of the multi-factor Barra risk models

1976
Stephen Ross introduced the Arbitrage Pricing Theory (APT) Rosenberg & Marathe Academic Asset Pricing Literature and Practitioner risk factor modeling research

1979
GEM model 1st gen First generation MSCI Global Equity Model (GEM) launched

1986
Chen, Ross, Roll suggested that macroeconomic factors can systematically affect stock market returns

1989
Fama & French expanded on the Rational Market Theory to demonstrate that company size and valuation factors are drivers of stock price

1992
Jegadeesh & Titman published first research on momentum factor

1993
Mid 1990s First true integrated multi-asset class factor model

1997
Carhart expanded on Fama-French three-factor model to include momentum factor, creating the Carhart four-factor model

1998
Launched MSCI Global Minimum Volatility Indices, global benchmark offering managed volatility investment strategies

2000-2010
Multiple next generation models

2008
MSCI FactorLab was developed to provide the latest factor innovations outside of MSCI standard models

2013
New Systematic Equity Strategy factors across 50+ models

2018
MSCI Launches FaCS and Factor Box An industry standard and factor classification for consistent implementation and measurement for Factor Investing

2018
Launched MSCI Multi-Asset Class Factor Model (MSCI MAC Factor Model), a multi-tiered model that helps analyze key portfolio exposures across asset classes

2018
MSCI FactorLab was developed to provide the latest factor innovations outside of MSCI standard models

2018
MSCI Launches FaCS and Factor Box An industry standard and factor classification for consistent implementation and measurement for Factor Investing
MSCI Factor Analytics is a leader that helps clients throughout the investment process.

Asset Managers
We provide leading research, data and tools to help asset managers build and manage their portfolios. Our models help asset managers understand factor exposures which enables them to position their fund more effectively and build a differentiated portfolio.

Need / Challenges
To better educate financial advisors about factor exposures, our client, one of the largest mutual fund organizations in the U.S., required a robust infrastructure to power an easy-to-understand advisor tool. They were looking for a solution that seamlessly integrated into its external Financial Advisory Services website.

MSCI solution
MSCI developed a custom application for this large mutual fund organization comprised of client defined factor exposures and optimized for the client’s advisor-facing factor investing tool.

Asset Owners
The complexity in fund selection makes it very difficult for Asset Owners to make informed decisions. We offer solutions to help Asset Owners understand investment portfolios in a very simple way, assess fund performance and compensate managers.

Need / Challenges
One of the leading U.S. institutional Asset Owners wanted to further enhance their due diligence and manager selection.

MSCI solution
MSCI factor tools provided insights into the drivers of risk and return. With MSCI Factor Indexes, the client was able to measure investment exposures in a systematic and transparent manner.

Outcome
» More informed manager selection and performance while controlling for risk.

Banks
As our banking clients need much faster moving metrics to stay ahead of the key drivers of risk and return, MSCI continuously innovates to offer our banking clients the latest factor models with new content and research.

Need / Challenges
Leading sell-side bank wanted to incorporate market standard factor baskets for the bank’s hedge fund clients to take directional bets on hedge portfolios through basket swaps. They specifically wanted a long-short construct with neutrality to all other factors and the ability to rebalance frequently enough to account for market movement.

MSCI solution
Our Managed Services helped client implement tools to allow them to create factor replicating portfolios with auto-rebalance on a monthly basis. MSCI, helped client implement optimization inputs for a pre-specified number of custom factor baskets (Momentum, Value, etc.).

Outcome
» This joint effort allowed the client to create a new product for a key growth client segment that allows their clients to gain more precise hedge exposure to MSCI factors.
» Ability to serve additional client segments with this new capability.

Hedge Funds
Our factor models help hedge funds seeking to create alpha by employing different strategies. Our ground-breaking factor research and indexes help fund managers seeking to maintain optimal exposure to a diverse set of factors.

Need / Challenges
Our hedge fund client was looking for a factor provider that stays at the forefront of research and innovation in factors. Specifically, they sought to drive performance, access insight into risk and return, and understand exposures better.

MSCI solution
We successfully demonstrated MSCI’s continuous innovation in factors that give the client full access to our factor research and development.

Outcome
» The client creates their own models, generates alpha signals, and communicates to investors their competitive advantage using MSCI factor data and solutions.
MSCI Equity Models provide institutional investors with tools for investigating sources of factor alpha, understanding returns, and measuring risk due to factors. MSCI offers more than 70 models across 75,000+ securities, 45 Industry factors and 87 countries.

MSCI Barra Equity Models leverage MSCI’s experience in developing and maintaining global equity multi-factor models and indexes, which are utilized by institutional fund managers worldwide.

### MSCI Barra Equity Factor Models

MSCI Barra Equity Factor Models leverage MSCI’s experience in developing and maintaining global equity multi-factor models and indexes, which are utilized by institutional fund managers worldwide.

### Single Country, Regional, and Global Models

MSCI Equity Models provide a foundation for investment decision support tools via a broad range of insightful analytics for Single country, Regional and Global Models. These models are built on decades of experience in constructing equity models and market-leading benchmarks.

### Models for Multiple Investment Horizons

MSCI Equity Models are available in different factor structures designed to align to individual investment horizons and goals. Long-term models are designed with a focus on portfolio construction & reporting and Trading models are constructed for short-term trading, hedging, and daily risk monitoring.

### Features of MSCI Equity Models

- **Enhanced style factors based on Systematic Equity Strategies (SES)** include multiple new Quality factors
- **Factors based on MSCI data such as ESG or Economic Exposure**
- **Multi-industry and country exposures** for deeper insight into a firm’s business segments
- **Point-in-Time fundamental data address look-ahead bias in back-tests and enable more timely updates**
- **Daily history back to at least the mid-1990s for most markets and back to the 1970s for the U.S.**
- **Latest modeling methodologies aimed at improving risk forecasting accuracy, portfolio construction, asset beta estimation and more precise attribution of stock returns**

### Barra® global model

<table>
<thead>
<tr>
<th>Global Equity Model</th>
<th>Barra® Integrated Model</th>
</tr>
</thead>
</table>

### Barra® regional models

<table>
<thead>
<tr>
<th>Europe Equity Models</th>
<th>Europe Stochastic Factor Model</th>
<th>Asia Pacific Equity Models</th>
<th>Emerging Markets Equity Model</th>
<th>North America Stochastic Factor Model</th>
</tr>
</thead>
</table>

### Barra® single country equity models

#### Americas

- US Total Market Equity Model Suite
- US Sector Equity Models
- US Small Cap Equity Model
- US Trading Equities Model
- Canada Equity Model
- Brazil Equity Model
- Mexico Equity Model

#### Europe, Middle East & Africa

- Europe Equity Model
- South Africa Equity Model
- United Kingdom Equity Model
- United Kingdom Trading Equity Model

#### Asia Pacific

- Australia Equity Model
- China Equity Model
- China International Equity Model
- Hong Kong Equity Model
- India Equity Model
- Indonesia Equity Model
- Korea Equity Model

#### Malaysia Equity Model

- New Zealand Equity Model
- Singapore Equity Model
- Taiwan Equity Model
- Thailand Equity Model
MSCI Equity models

Multi-Asset Class Factor Models

Factors have brought disruptive change to the asset management industry. First established to define common characteristics among stock, factors now take many forms and span many asset classes. The MSCI MAC Factor Model:

Supports factor-based asset allocation

Traditional asset allocation has viewed the markets in terms of asset-class buckets: equity, fixed income, and alternatives. Factor-based asset allocation moves the strategic allocation decisions away from asset-class buckets to factors that both cut across and split apart traditional asset class. As portfolios transition from traditional asset class allocation to a factor-based allocation process, MSCI’s MAC Factor Model can help investors focus on factor exposures across asset classes in a consistent manner.

» Provides high-to-low granularity in looking at Systematic Strategy Factors through an integrated and consistent framework
» Provides further insight and control into multi or single asset class investing

Captures systematic characteristics across asset classes

Many investors recognize a spectrum between traditional alpha and beta, with a variety of systematic strategies in the middle. Systematic strategy factors like Value and Momentum have been common in equities for decades. More recently, many investors have recognized the importance of systematic strategies in a wide range of asset classes. Many strategies that originated in equities have counterparts in other asset classes.

» Introduce systematic strategy factors beyond equities
» Multi-asset class systematic strategy
Factors distinguish factor betas from alpha and traditional beta

The MSCI Multi-Asset Class (MAC) Factor Model

The MSCI Multi-Asset Class Factor Model provides further insight and control into multi or single asset class investing. The integration between tiers helps bridge the gap from construction to communication between the board, CIO, and portfolio managers using a common language.

<table>
<thead>
<tr>
<th>Tier</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>6 factors</td>
</tr>
<tr>
<td>02</td>
<td>25 factors</td>
</tr>
<tr>
<td>03</td>
<td>70+ factors</td>
</tr>
<tr>
<td>04</td>
<td>~3,000 factors</td>
</tr>
</tbody>
</table>

Board reporting

Asset allocation and total plan budgeting

Portfolio management

Risk reporting

Systematic Strategies

Evaluate systematic strategies

Allocate with systematic strategies

Construct portfolios and analyze specific exposures

Strategic asset allocation

Tactical asset allocation

Equities
Commodities
Fixed Income
Derivatives
Private assets

Strategic asset allocation

Systematic strategies

Tactical asset allocation
MSCI FaCS™ and Factor Box

MSCI FaCS™ creates a common language and definitions around factors to be used by a broader audience including asset owners, managers, advisors, consultants, and investors. Investment managers can use the framework to analyze and report factor characteristics, while investors and consultants can use the data to compare funds using common factor standard definitions.

This standard comes to life through an innovative way of looking at factors-MSCI Factor Box. The Factor Box provides a visualization designed to easily compare factor exposures between funds and benchmarks. It includes factors which have historically demonstrated excess market returns over the long run. The Factor Box helps clients evaluate and implement factors, while easily comparing funds with a simple visualization.
MSCI FactorLab

MSCI believes in staying ahead of the curve and researches factors to help clients gain a competitive edge. MSCI continues this factor innovation to identify underutilized and alternative data and algorithms to provide unique information not contained in classic factors. MSCI FactorLab provides the latest factor innovation outside of MSCI’s standard models that can be integrated quickly. MSCI FactorLab provides further transparency and access to our curated factor research. It provides access to new, research-enhanced data sets for use cases ranging from alpha research to building custom-risk factors.

Key benefits of FactorLab include:

- Faster Access to New Research and Datasets
- Alternative factor research gives more insight into factor performance that can be translated into alpha generation
- Facilitate creation of custom models and internal analytics
- The format of FactorLab is the same as other MSCI products and therefore can be integrated at a low cost

Features of FactorLab:

- Daily financial metrics on over 77,000 equities covering 87 countries
- Asset-level signals include raw and standardized exposures
- Same data used to build models and updated as markets evolve

MSCI empowers our clients to make better investment decisions.
Factor Framework
by Key MSCI Equity model

Leverage
Debt to Assets
Book Leverage
Mkt Leverage
Profitability
Asset Turnover
Profitability
Profit Margin
Return on Assets
Return on Equity
Earnings Variability
Variation in Sales
Variation in Earnings
Variation in Cash Flow
Variation in Fwd EPS
Earnings Quality
Cash Earnings/Earnings
Accruals - I/S Statement
Accruals - C/F Statement
Variability in Sales
Variability in Earnings
Variability in Cash Flows
Standard Deviation of Analyst Prediction to Price
Investment Quality
Asset Growth
Capex Growth
Issuance Growth
Capital Expenditure
Management forecast bias
Composite Issuance

Momentum
Real Strength
Historical Alpha
1-Day Reversal
1-Day Reversal
Industry Momentum
Industry Momentum
Prospect
Skewness
Maximum Drawdown
Lottery
Regional Momentum
Regional Momentum
Short-Term Reversal
Short-Term Reversal
Structural Valuation
Seasonality
Quarterly Seasonality
Annual Seasonality

Book-to-Price
Book-to-Price
Earnings Yield
Reported E/P
Forecasted E/P
Cash E/P
EBITDA E/P
Long-Term Reversal
LT Real Strength
LT Hist Alpha
Other
Sales-to-Price
Cash-Flow-to-Price
Structural Valuation

Analyst Sentiment
Revision Ratio
Change in Analyst-Predicted E/P
Change in Analyst-Predicted EPS
Net Profit Forecast Revisions
Analyst Rating Change
News Sentiment
Positive Composite Sentiment
Positive Event Sentiment
Composite Sentiment
Dispersion
At-the-money Skew
Net profit forecasts revisions
Analyst rating change
Market Sentiment
At-the-Money Skew
Short Interest

Dividend Yield
Reported D/P
Forecast D/P

Size
Log of Market Cap
Mid Cap
Cube of Size

Growth
Sales Growth
Earnings Growth
Forecast LTO

Liquidity
1m Turnover
3m Turnover
12m Turnover
12m ATVR
Modified Amihud Measure
Pastor-Stambaugh Measure

Foreign sensitivity
Foreign Sales to Total Sales
US market sensitivity
Developed market sensitivity
Currency Sensitivity
Long-Term Reversal
Interest Rate
Oil Sensitivity
Gold Sensitivity

Beta
Historical Beta
Residual Volatility
Historical Sigma
Daily Std Dev
Cumulative Range
Implied volatility
1 month Call
Implied Volatility
3 month Call
Implied volatility
1 month Put
Implied Volatility
3 month Put

Downside Risk
Lower Partial Moment
Idiosyncratic Hybrid Tail Coverage Risk
Hybrid Tail Coverage Risk
Mean Lower Partial Moment
CAPM Beta
Idiosyncratic Lower Partial Moment

Downside Beta
Lower Partial Moment

Value
VOLATILITY
QUALITY
MOMENTUM
VALUE
SENTIMENT
QUALITY
YIELD
SIZE
GROWTH
LIQUIDITY
MACRO
MSCI is a leading provider of critical decision support tools and services for the global investment community. With over 45 years of expertise in research, data and technology, we power better investment decisions by enabling clients to understand and analyze key drivers of risk and return and confidently build more effective portfolios. We create industry-leading research-enhanced solutions that clients use to gain insight into and improve transparency across the investment process.

To learn more, please visit www.msci.com.

Learn more about Factor Investing at www.msci.com/factor-investing

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