Axioma Worldwide Macroeconomic Projection Equity Factor Risk Model

Equity Factor Risk Models

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Model Overview

The Macroeconomic Projection model is a transformation of the WW4 fundamental model combined with an additional set of market-traded macroeconomic factors. It is constructed from all the features and deliverables from the WW4 model, including asset coverage, estimation universe, factor exposures, factor returns, specific returns, specific risks. Currency risks are modeled separately which is the same as WW4.

Asset Coverage	The model covers roughly 48,100 securities (over 84,900 historically), primarily from the following 68 markets:

Argentina	Denmark	Ireland	New Zealand	Spain
Australia	Egypt	Israel	Norway	Sweden
Austria	Finland	Italy	Pakistan	Switzerland
Belgium	France	Japan	Peru	Taiwan
Brazil	Germany	Korea	Philippines	Thailand
Canada	Greece	Luxembourg	Poland	Turkey
Chile	Hong Kong	Malaysia	Portugal	UK
China	Hungary	Mexico	Russia	USA
Colombia	India	Morocco	Singapore	
Czech Rep.	Indonesia	Netherlands	South Africa	
Bahrain	Cyprus	Kuwait	Oman	Slovenia
Botswana	Estonia	Latvia	Qatar	Sri Lanka
Bulgaria	Iceland	Lithuania	Romania	UAE
Croatia	Jordan	Mauritius	Slovakia	Venezuela

In addition, the following 26 emerging markets are included; the following were introduced in 2009:

Bangladesh	Kazakhstan	Namibia	Tunisia	Trinidad & Tobago
Ecuador	Kenya	Nigeria	Ukraine	
Ghana	Lebanon	Saudi Arabia	Vietnam	
Jamaica	Malta	Serbia	Zambia	

and this second group added in 2015:

Ivory Coast	Montenegro	Macedonia	Bosnia & Herzegovina
Tanzania	Uganda	Zimbabwe	Palestinian Territory
Malawi			

Estimation Universe	Includes assets with sufficient size and liquidity, using selection criteria similar to those employed by major index providers. More granular, localized rules are also applied on a per-market basis to filter certain exchanges, asset types, etc. The estimation universe comprised 12,800 securities on average.
Forecast Horizon	Medium-horizon model: 3-6 months.
Estimation Frequency	Factor exposures, returns, and covariances estimated daily.

Macroeconomic Projection Model

Macro Factors (14)

Interest Rate Factors

US Term Spread: 10Y6M	Daily changes in US Treasury term spread between 10Y yield and 6M yield
GB Term Spread: 10Y6M	Daily changes in UK zero-coupon government bond term spread between 10Y yield and 6M yield
EU Term Spread: 10Y6M	Daily changes in Germany zero-coupon government bond spread between 10Y yield and 6M yield
JP Term Spread: 10Y6M	Daily changes in Japan zero-coupon government bond term spread between 10Y yield and 6M yield

Inflation Factors[1]

US Inflation	Daily changes in US 5Y break-even inflation rate
GB Inflation	Daily changes in UK 5Y break-even inflation rate
EU Inflation	Daily changes in Germany 5Y break-even inflation rate

Corporate Credit Factors

USD BBB Corp Spread	Daily log returns of the 5 year node of USD BBB credit spread curve
GBP BBB Corp Spread	Daily log returns of the 5 year node of GBP BBB credit spread curve
EUR BBB Corp Spread	Daily log returns of the 5 year node of EUR BBB credit spread curve
JPY BBB Corp Spread	Daily log returns of the 5 year node of JPY BBB credit spread curve

Commodity Factors

Commodity	Daily returns of GSCI non-energy commodity spot index
Gold	Daily returns of the GSCI gold spot index
Oil	Daily returns of NYMEX:CL 1 month oil futures

Currency Factors   0/1 assignments to the primary currency of an asset's country.

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[1]GB Inflation and EU Inflation are available in the model starting from 2011-01-01

The following factor definitions are used to construct factor returns for the WW4 model. All the following factors have been projected onto the set of macro factors defined previously. Therefore, the factor returns are the residuals after the projections.

Style Factors	AXWWMP4-MH (12)

Market-Based Factors

Market Sensitivity	2-year weekly beta versus the global market
Volatility	6-month average of absolute returns over cross-sectional standard deviation, fully orthogonalized to Market Sensitivity
Liquidity	Natural logarithm of the ratio of 3-month average daily volume and 1-month average market capitalization, inverse of 6-month Amihud illiquidity ratio, and proportion of returns-traded over last calendar year
Exchange Rate Sensitivity	2-year weekly beta to returns of currency basket containing USD, EUR, GBP, JPY, CNY
Medium-Term Momentum	Cumulative return over past year excluding the most recent month
Size	Natural logarithm of market capitalization

Fundamental Factors

Value	Book-to-price
Earnings Yield	Earnings-to-price and estimated earnings-to-price
Leverage	Total debt (current and long-term liabilities) to total assets and total debt to equity
Growth	Sales growth, estimated sales growth, earnings growth, estimated earnings growth
Profitability	Return-on-equity, return-on-assets, cash flow to assets, cash flow to income, gross margin, and sales-to-assets
Dividend Yield	Ratio of sum of the dividends paid (excluding non-recurring, special dividends) over the most recent year to average market capitalization

Industry Factors (68)	GICS®-based, corresponding to GICS® 2016 Industries with 0/1 assignments. Assets with no official GICS® are given industry membership based on internal research and are explicitly labeled as such in product deliverables.
Global Market Factor	Regression intercept term; all assets have unit exposure. Allows the model to better distinguish between country and industry risk contribution effects.
Country Factors	0/1 assignments based on an asset's country of quotation, business activities or domicile. In most cases this is equivalent to the market where an asset trades; the issuer's home country is used for foreign listings, depository receipts, and similar instruments.
Local Factors	Meant to capture strong residual structure in certain markets not captured by others factors. The model currently has one such factor: Domestic China.

Returns Model	Models WW4 factors using 4 sets of macro factors: interest rate factors, credit spread factors, commodity factors, and inflation factors. Currency factors are not projected by macro factors.
Returns History	4 years of weekly overlapping returns for factor correlations, 2 years of weekly overlapping returns for factor volatilities.
Estimation	Estimate regression coefficient beta between WW4 model factors and macro factors by constructing a covariance matrix using WW4 factor return time series and macro factor return time series. Estimate asset macro exposure by multiplying WW4 factor exposures with estimated betas. Currency factor returns are kept the same as WW4 model's currency returns.
Numeraire Currency	Currency risk is expressed from a U.S. Dollar (USD) perspective, but advanced features in Axioma Portfolio Optimizer™ enable users to dynamically re-base the model into various other currencies.

Factor Volatilities / Correlations

Estimation	Covariance of exponentially-weighted weekly overlapping factor returns.
Half-life Parameters	Medium-horizon model: 26 weeks for variances, 52 weeks for correlations.
Adjustments	Axioma's proprietary *Dynamic Volatility Adjustment* (DVA) procedure is used to analyze trends in factor returns dispersion and adjust risk estimation accordingly to allow for heightened responsiveness in risk forecasts and adaptability to the prevailing volatility regime.

Currency Risk

Miscellaneous	Currency risks in all models are taken from the Axioma Global Currency Risk Model, ensuring that all regional/global risk models share consistent estimates of currency risks and covariances.
Estimation	Principal components analysis using 1 year of exchange rate returns and 12 statistical factors, estimated from a pool of core currencies: USD, EUR, GBP, JPY, CHF, CAD, AUD, BRL, MXN, SGD, KRW, ZAR and PLN.

Specific Risks

Estimation	Variance of exponentially-weighted daily specific returns.
Half-life Parameters	125 days.
History	500 days.
Autocorrelation	Newey-West adjustment accounting for 1 day of autocorrelation.
Other Adjustments	Issuer Specific Covariance (ISC) captures covariances between security lines of the same issuer, using a cointegration model of price behavior. Applies only to portfolios containing two or more securities from the same issuer.

Data Deliverables

Availability	Updated daily and downloadable via FTP, SFTP, and HTTPS.
Historical Coverage	Daily history from Jan. 2004 onwards.
Data Format	Delimited text file ("flat files") or proprietary database format for seamless integration into Axioma Portfolio Optimizer™.
Benchmarks	Global and regional benchmarks are available in a format compatible with Axioma software products.
Exchange Traded Funds (ETFs)	Broad coverage of regional, single country, and index linked ETFs. ETF coverage for the model is determined by the model's full coverage of the underlying constituents in order to ensure consistency in the instrument's risk and exposure measures.
Asset Identifiers	Axioma ID, SEDOL, CUSIP, ISIN, local ticker, issuer/company ID.
Market Data	Asset-level data including:

> Price, market capitalization

> 1-, 5-, 20-, and 60-day returns

> 5- and 20-day average daily volume

> Historical and predicted beta

Some items of market data may not be available in delimited text file format.

Appendix: AXWW4 Industry Factors vs. GICS®

Industry factor returns are the residuals after the projection. This table provides the industry classification scheme used in the WW4 model.

GICS® Industry Groups (24)		Axioma Industry Factors (68)	
1010	Energy	101010	Energy Equipment & Services
		101020	Oil, Gas & Consumable Fuels
1510	Materials	151010	Chemicals
		151020	Construction Materials
		151030	Containers & Packaging
		151040	Metals & Mining
		151050	Paper & Forest Products
2010	Capital Goods	201010	Aerospace & Defense
		201020	Building Products
		201030	Construction & Engineering
		201040	Electrical Equipment
		201050	Industrial Conglomerates
		201060	Machinery
		201070	Trading Companies & Distributors
2020	Commercial & Professional Services	202010	Commercial Services & Supplies
		202020	Professional Services
2030	Transportation	203010	Air Freight & Logistics
		203020	Airlines
		203030	Marine
		203040	Road & Rail
		203050	Transportation Infrastructure
2510	Automobiles & Components	251010	Auto Components
		251020	Automobiles
2520	Consumer Durables & Apparel	252010	Household Durables
		252020	Leisure Products
		252030	Textiles Apparel & Luxury Goods
2530	Consumer Services	253010	Hotels Restaurants & Leisure
		253020	Diversified Consumer Services
2540	Media	254010	Media
2550	Retailing	255010	Distributors
		255020	Internet & Direct Marketing Retail
		255030	Multiline Retail
		255040	Specialty Retail
3010	Food & Staples Retailing	301010	Food & Staples Retailing
3020	Food, Beverage & Tobacco	302010	Beverages
		302020	Food Products
		302030	Tobacco
3030	Household & Personal Products	303010	Household Products
		303020	Personal Products
3510	Health Care Equipment & Services	351010	Health Care Equipment & Supplies
		351020	Health Care Providers & Services

		351030	Health Care Technology
3520	Pharmaceuticals, Biotechnology & Life Sciences	352010	Biotechnology
		352020	Pharmaceuticals
		352030	Life Sciences Tools & Services
4010	Banks	401010	Commercial Banks
		401020	Thrifts & Mortgage Finance
4020	Diversified Financials	402010	Diversified Financial Services
		402020	Consumer Finance
		402030	Capital Markets
		402040	Mortgage Real Estate Investment Trusts (REITs)
4030	Insurance	403010	Insurance
4040	Real Estate	404020	Equity Real Estate Investment Trusts (REITs)
		404030	Real Estate Management & Development
4510	Software & Services	451010	Internet Software & Services
		451020	IT Services
		451030	Software
4520	Technology Hardware & Equipment	452010	Communications Equipment
		452020	Technology Hardware, Storage & Peripherals
		452030	Electronic Equipment, Instruments & Components
4530	Semiconductors & Semiconductor Equipment	453010	Semiconductors & Semiconductor Equipment
5010	Telecommunication Services	501010	Diversified Telecommunication Services
		501020	Wireless Telecommunication Services
5510	Utilities	551010	Electric Utilities
		551020	Gas Utilities
		551030	Multi-Utilities
		551040	Water Utilities
		551050	Independent Power & Renewable Electricity Producers

Appendix: AXWWMP4 Results Overview

Factor Performance

Figure 1: Cumulative return to each of the AXWWMP4-MH Commodity factors, 2004-2020.

Figure 2: Cumulative return to each of the AXWWMP4-MH Term Spread factors, 2004-2020.

Figure 3: Cumulative return to each of the AXWWMP4-MH Credit Spread factors, 2004-2020.

Figure 4: Cumulative return to each of the AXWWMP4-MH Inflation factors, 2004-2020.[2]
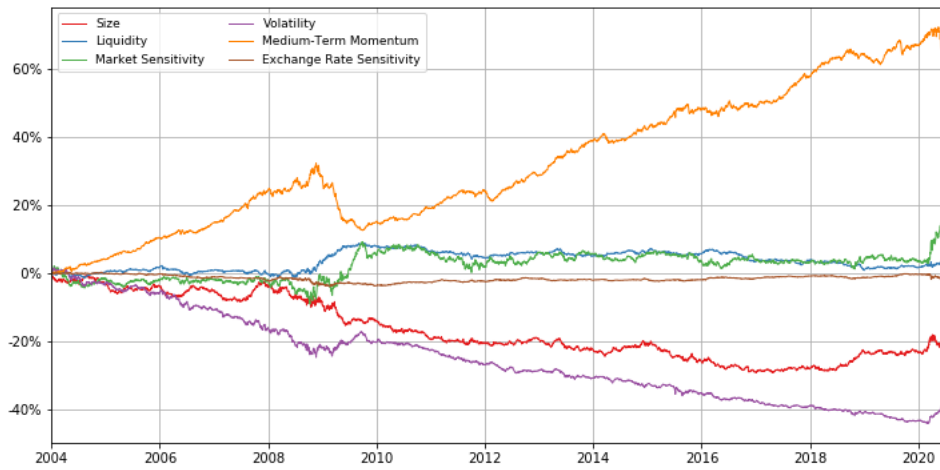
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[2]Inflation factor for GB and EU start on 2011-01-01

Figure 5: Cumulative return to each of the AXWWMP4-MH Market-based Residual Style factors, 2004-2020.
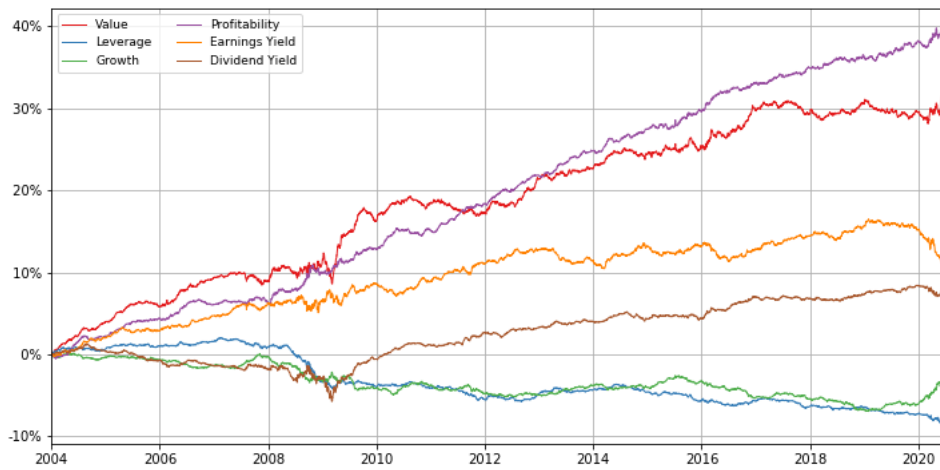
Figure 6: Cumulative return to each of the AXWWMP4-MH Fundamental Residual Style factors, 2004-2020.

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