February 2004

Northfield News

Quarterly Newsletter for the Friends and Clients of Northfield Information Services

Non-Linear Transaction Costs in the Open Optimizer

By Dan diBartolomeo

An important new feature allowing the inclusion of non-linear trading costs has been added to the Northfield Open Optimizer. The new function allows users to create a formula to specify a "market impact" portion of expected transaction costs in addition to the usual fixed costs. Market impact is the extent to which a particular buying or selling trade in a stock can cause the price of that security to move. If a desired trade is large, an imbalance will be created between supply and demand that will result in a change in the stock price before the trade occurs. *The new Non-Linear Transaction Cost function will be included free with all future Optimizer releases*.

It should be clear that Northfield is not supplying a "market impact" model with the Optimizer. We are merely making facilities available in the Optimizer so that users, who are comfortable with a cost forecasting model obtained from another source, can have such a model as optimization input. Northfield has extensively studied the issues of forecasting market impact in considerable detail over the years. Unfortunately, we find that models currently available to practitioners, while descriptive on average (i.e. significant t-statistics on input variables), they are not terribly accurate in forecasting the costs for any particular transaction (low r-squared). The situation is reminiscent of the old joke about statisticians:

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Revised Northfield Risk Models are Here

By Dan diBartolomeo

A new generation of Northfield risk models has been under development for almost a year. Our goal in this process has been to take the successful features in each of our particular models and apply these methods to all of our models (with the exception of the US Short Term Model that will be revised as a separate project). This "best practices" approach will also unify the risk models, making both the structure and the analytical output of the models more similar.

We expect to release the new models to clients during March or April of 2004. All of the changes have been subjected to very extensive "out of sample" testing, and we are convinced that each change is a meaningful improvement in the predictive power of the models concerned. In some cases, the change is more relevant to tracking error prediction, while others are more relevant to the forecasting of absolute volatility.

As shown in the accompanying table, there are a number of analytical methods that will be made standard on all of our risk models. The first of these is the application of the Parkinson volatility estimator to adjust asset specific risk for serial correlation and heteroskedasticity. The Parkinson method uses the observed low-to-high range of an asset's price over each time period to infer asset total volatility. We then incorporate this infor-

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Inside this Issue

Special points of Interest:

Recent and Upcoming Events

Cutter Associates Portfolio Modeling and Manufacturing Study Research Meeting

Boston, February 10, 2004

Northfield and our strategic partner Softpak exhibited at the Cutter Associated Portfolio Modeling Research Meeting in Boston on February 10th. The meeting focused on the changing role of technology in the investment management process. The agenda presented in-depth research and analysis of 20 portfolio manufacturing systems, of which the Northfield/ Softpak Managed Accounts Rebalancing System (MARS) was included.

Further details are available at http://www.cutterassociates.com

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Northfield Party at the PMRA Conference

The Brewery • Chiswell Street, London • February 25, 2004

Northfield is sponsoring a party from 17:00 onwards at the PMRA (Performance Measurement Risk and Attribution) conference on the 25th February at the Brewery in Chiswell Street, London. The Northfield party reputation will be sustained -within the confines of the venue.

Northfield's Dan diBartolomeo and Russ Hovanec will be there, as well as Rupert Goodwin and Christine Milne from Northfield's London office. A limited number of Northfield clients who may not wish to attend the conference but do wish to join us at the party are very welcome - please get in touch with Rupert at +44-(0)20-7801-6260 or by e-mail at Rupert@northinfo-europe.com to arrange for a pass. Details of the conference itself are available at http://www.pmracongress.com.

2004 Newport Annual Summer Seminar

Tennis Hall of Fame • Newport, Rhode Island • June 4, 2004

International Tennis Hall of Fame

We are pleased to invite you and your colleagues to our annual summer seminar. The purpose of the seminar is to present recent research and technical advances to our clients and friends while enjoying the many pleasures afforded by our unique venue.

This year we return to the International Tennis Hall of Fame. Our meeting date has been selected to coincide with the US Professional Championships of Court Tennis.

After tennis on Friday evening, Northfield will host a dinner party for the seminar attendees and their guests at the Castle Hill Inn and Resort, 590 Ocean Drive in Newport.

There is no charge for participation in any aspect of this event. Please RSVP to Kathy Prasad at 617.208.2020, or e-mail, kathy@northinfo.com. Detailed information, and the full seminar agenda will be posted to www.northinfo.com/events as it becomes available. Send an e-mail to events@northinfo.com, to be added to our mailing list for future events.

2004 Northfield Annual Research Conference

The Fairmont Scottsdale Princess • Scottsdale, Arizona • May 2-5, 2004

We are pleased to announce our 17th annual research conference at the Fairmont Scottsdale Princess, in Scottsdale, Arizona. The Scottsdale Princess is an acclaimed luxury resort which offers one of the nations highest rated spas, two 18-hole championship golf courses, as well as championship tennis courts. In addition, this is a family friendly venue which offers something for everyone in the family to enjoy. Scottsdale, Arizona offers participants a peaceful atmosphere conducive to full attention on the issues under discussion, while also offering immense natural beauty and recreational opportunities.

The Fairmont Princess

The conference will start on Sunday evening, May 2nd, with an "Unofficial" welcome cocktail party and dinner. As is customary at Northfield events, a complete recreational and social calendar will accompany the working sessions. Monday morning will be reserved for recreational pursuits. We are offering attendees their choice of three activities appropriate to our beautiful venue: golfing, a four-wheel jeep excursion and river rafting. To enliven the program, Monday evening will feature an elegant "black tie" gala and Tuesday evening will feature a Southwestern themed event.

Northfield is holding a block of rooms for the nights of Sunday, May 2nd through Tuesday, May 4th. The conference room rate is discounted at $249.00 (for a standard room) plus applicable taxes and service charges and is payable directly to the hotel. Casitas and suites are available at an additional cost. Reservations are on a first come basis so it is a good idea to register early. The deadline for all reservations is April 1, 2004.

To Register for the conference and make your hotel reservations, contact Kathy Prasad at 617.208.2020, kathy@northinfo.com. Further program updates and details will be posted to http://www.northinfo.com/events .

Agenda

The agenda will consist of eleven 1-hour long presentations. A 12th presentation may be added.

Information Ratio of Active Management
Edward Qian, Putnam Investments

Portable Alpha-Philosophy, Process & Performance
Larry Pohlman, PanAgora Asset Management

Measuring the Risk of Directly-Owned Real Estate Using a Securities' Market Framework
Richard Gold and Emilian Belev, Northfield

The Transfer Coefficient: Implications for Portfolio Management
Angelo Lobosco, State Street Global Advisors

The Short-Term and Long-Term Market Efficiencies and Their implications
Charles Wang, Acadian Asset Management

The PB-ROE Valuation Model Revisited
Thomas Philips, Paradigm Asset Management, and Jarrod Wilcox, Wilcox Investment

Top 10 Investment Modeling Mistakes
John F. Elder, Ph.D. and Mark T. Finn, Vantage Consulting Group, Inc.

US Dollar Impact on S&P 500 and Sector Returns
Melanie Petsch, Dresdner Kleinwort Wasserstein

Advances in Market Implied Credit Risk Analysis
Dan diBartolomeo, Northfield

Methodological Issues in Designing and Implementing Valid Backtests
Marcus C. Bogue, III, Charter Oak Investment Systems, Inc.

Risk, Volatility and Value
Rosemary Macedo, Baillard Biehl and Kaiser

(Non Linear Transaction Costs, Continued from page 1)

> Two statisticians go deer hunting. Upon seeing a deer, the first statistician fires at the deer and misses by five feet to the front. The second statistician now fires, missing the deer by five feet to the rear. Despite the deer scampering away, the two statisticians jubilantly congratulate each other for "hitting the deer on average."

However circumspect we remain about market impact forecasting, it is certainly reasonable for investors to make some effort to account in their optimizations for the fact that unusually large trades are apt to move stock prices adversely. We therefore chose to provide the NLTC feature.

There are three unique aspects to the approach implemented in the Optimizer:

- The first is that the algebraic formulation allows for a wide variety of market impact models to be implemented.
- Our structure also allows for rapidly increasing costs after trade sizes reach a threshold at which market liquidity is likely to be exhausted, and the use of block positioning by an investment bank is required.
- Our formulation of the problem takes into account the "market cross-impacts" (portfolio effect) that occurs when a particular investor is trying to *concurrently* execute more than one large trade.

Here is the basic specification of a "per share" transaction cost. To get "total $ (or other currency)" transaction cost one would have to multiple all terms by the number of shares being traded (X). Only the cost of buying is illustrated, as selling is algebraically identical.

$$TCostBuying_i = A + BX_i + CX_i^{1/2} + D \times Max[X_i - L_i, 0]^2 + Max[Z_i, -A]$$

Where X is the absolute value of the number of shares being traded.

The "A" term is the existing transaction cost function of the Optimizer (i.e. a fixed amount or fixed % per share). Typical costs to be included in the "A" term would be brokerage commissions, processing costs and half the bid/asked spread.

The "B" and "C" terms allows users to specify "market impact" that causes trade prices to be shifted either proportionately to the number of shares being traded or proportionately to the square root of the number of shares traded, or a combination of the two. There have been a large number of empirical studies of market impact. Almost all have found that impact increases with trade size but at a decreasing rate. By allowing both linear and "square root" terms, our function can accommodate essentially all of the models put forward in the published finance literature.

The "D" term allows uses to specify a number of shares "L" above which trades get very expensive very quickly (proportional to the square of the excess of X above L). The logic behind this term is that published empirical studies cannot estimate the impact of very, very large transactions because human traders know these trades will move the market a great deal, and so just don't do them. As such, there is no data available from which to estimate a function. However, an optimization algorithm can't know this, so it is important to have a sensible upper bound for the size of trade that can be handled using the "B" and "C" terms described above.

We assume that once a trade size gets above "L" shares, doing this trade in one large transaction will require "block positioning" from an investment bank. Such transactions are only done by a handful of large banks, so an oligopoly regime will exist for trade pricing. Our theoretical derivation of the problem suggests that "pricing" models for sell-side firms will be governed by a function that rises with trade size in a way that is between linear and second order. Since our "B" term already addresses the linear aspect, our "D" term considers only the incremental second order costs for trade sizes above "L". Anecdotal discussions with traders produced the notion that one-half an average day's trading volume is a sensible baseline value for "L".

The values for A, B, C, D and L can be separately specified for each stock and separately for buying and selling. Like A, the B, C and D coefficients can be specified in either "$ per share" or "% of value" units.

The "Z" term accounts for the "portfolio effect" of market impact arising from concurrent trades. Obviously, simultaneously doing a very large buy in GM stock and a very large buy in Ford might impact prices differently than doing a very large buy in GM, while at the same time doing a very large sell in Ford.

The use of the Z term can be turned on or off by the user. The computation of Z for a particular stock i, Z_i is not dependent on the number of shares being traded (X), but is dependent on the market impact arising from all other stocks (B & C & D terms) and the correlation of stock i with the every other stock being traded. The correlation between stocks is derived from the risk model in use in the Optimizer at the time.

$$Z_i = \sum_{j=1}^{m} (B \times X_j + C \times X_j^{1/2} + D \times Max[X_j - L_j, 0]^2) \times P_{ij} \times Q_{ij} \quad [for\ all\ i <> j]$$

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(Non –Linear Transaction Costs, Continued from page 4)

where:

m = the number of stocks being traded (i.e. non-zero X_i)

P_{ij} = the correlation between stock i and stock j

$Q_{ij} = 1$ if $[\Delta Shares_i \times \Delta Shares_j] > 0$

$Q_{ij} = -1$ if $[\Delta Shares_i \times \Delta Shares_j] < 0$

So the value of the "cross-stock market impact" for stock i is the summation across all other stocks being traded of their market impact times their correlation with stock *i*. The minimum value of Z_i is -A.

In this way, the sum of the first and last terms can never be negative (we get paid to trade). If we are trading several stocks simultaneously, it is possible that selling a lot of GM, might push the price of Ford (positively correlated with GM) down enough so that buying Ford would be cheaper (a negative market impact for buying). "Z" terms should usually be relatively small, since in a typical case about half the terms will be positive and half the terms will be negative.

There is one important caveat with respect to use of the NLTC feature. If the coefficients for B,C, and D are irrationally large, the "jumps" in the values of transaction costs can make the optimization process unstable. We have incorporated modifications to the optimization process that should allow the optimization process to get sensible answers in all but the most egregious cases. The revised optimization is active whenever the NLTC function is enabled. In essence, the change makes the Optimizer trade in smaller increments so it has more opportunity to assess market impact in building up a position.

In terms of further research, it should be noted that we are currently working on the formulation of the "trade scheduling" problem, wherein a mathematical algorithm is used to determine how one or more (concurrent) overly large trades should be broken up into a series of smaller trades for execution. We believe this research will be of considerable practical value to buy-side traders.

While we remain agnostic on the effectiveness of currently available market impact models, the new non-linear transaction cost feature is an important new tool for those of our users who are comfortable with such forecasts.

Selected References

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Northfield Staff Speaking Engagements

Northfield President Dan diBartolomeo will be speaking on March 22, at the Financial Research Associate's Investment Performance Measurement and Attribution Analysis Conference, in Amelia Island Plantation, Florida. The topic will be on Analytical Flaws in Daily Performance Attribution. Dan will also be giving this same presentation at the second Annual International Performance Measurement, Attribution & Risk Conference in NY on May 18th.

Dan will be speaking at three one day Factset conferences in Amsterdam, Paris, and London on April 22, 27 and 29th. The topics are to be announced. Visit http://www.factset.com for more information

Lastly, Dan will be speaking at the Green Mountain Summit: Symposium on Investor Social Responsibility, in Stowe VT, May 23-26th. The topic is to be announced.

New Frontier Advisors

Congratulations are in order for our strategic alliance partner, New Frontier Advisors. The NFA resampling technique that has been incorporated into the Northfield Optimizer has recently received a good deal of favorable review. The current issue of the *Journal of Investment Management* carries a paper by Nobel laureate Harry Markowitz and Professor Nilufer Usman of Montclair State University that tested the effectiveness of the NFA methodology in reducing estimation errors in asset allocation problems. The study employed a technique called a "diffuse Bayesian prior" as an alternative method of reducing estimation errors but found the NFA resampling provided better results. A related article containing comments from interested parties appeared in *Pensions and Investments* on December 22.

Technical Support Tip: Using Composite Assets

By Christine Milne

The Composite Assets utility provides a way of including indices and fund-of-funds structures in the optimizer. Each composite is referenced in the same way as a single security in the portfolio or benchmark. This utility recognizes the individual holdings in the composite and thereby takes account of the correlation between the residual risk of the composite and that of the other holdings in the portfolio or benchmark.

All output reports treat each composite as a single line item, with the same risk and return figures computed as for a single security. The Main Table includes an extra column for each composite, listing its component weights.

Composites in the optimizer

For each composite asset in the problem, a file containing the constituents and their values is needed. The file should be in comma or tab delimited format; the first column being the security identifier and the second the value of the security in the composite. Security values can be percent, shares, equal or market cap weighted. For equal or market cap weighting (calculated by the optimizer) the second column in the composite file can take any value, but must be present. If the holdings are weights they should add to 100 for each composite.

The Composite Assets Table file is a list of all of the composites, allowing the optimizer to locate the individual composite files. This file should be loaded into the optimizer under Input Tables / User / Composite Assets.

The columns are:

ID –the code used in the portfolio or benchmark to reference the composite

Name –for your reference

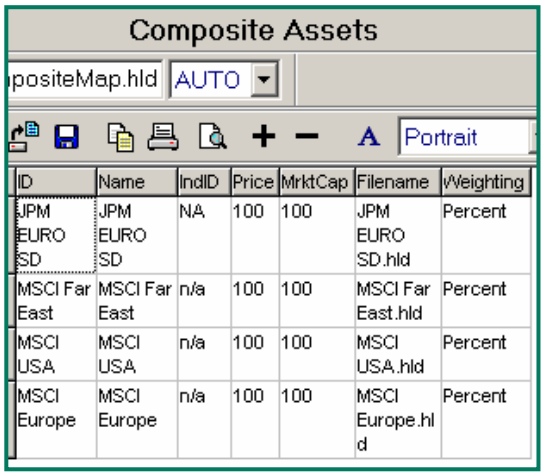
IndID –the whole composite may be allocated to an industry

Price –important when entire portfolio/benchmark is specified in Shares

MrktCap –important when portfolio/benchmark is specified in Market Cap

Filename –with path if the file is not located in the default path

Weighting –choose whether the composite is in 'Percent', 'Shares', 'MrktCap', or 'Equal' weighting.



ID	Name	IndID	Price	MrktCap	Filename	Weighting
JPM EURO SD	JPM EURO SD	NA	100	100	JPM EURO SD.hld	Percent
MSCI Far East	MSCI Far East	n/a	100	100	MSCI Far East.hld	Percent
MSCI USA	MSCI USA	n/a	100	100	MSCI USA.hld	Percent
MSCI Europe	MSCI Europe	n/a	100	100	MSCI Europe.hld	Percent

Optimizer Composite Asset Table

Composites in the Excel Run0 add-in (NER0)

In order to create a new sub-fund, click on the 'New Composite Sheet' icon, which looks like three worksheets.

The name you give the composite will appear on the new composite sheet tab, and in the list of composites in the Wizard.

The information required in the yellow box in the new composite sheet must be filled in. Then fill in the ID and weight or number of shares columns in the composite. Information on this sheet must be entered under the correct headings, and the columns must not be re-ordered. You will find that locating and fixing exceptions is easier and quicker if you also provide security names.

Once all of your composites have been created and their holdings entered you must tell NER0 which composites are needed in the analysis. In the Wizard, under the Composite Assets tab, the composites should be added before running the risk analysis.

For further inquiries contact Technical Support in Boston by e-mail to support@northinfo.com, or call +1 (617) 208-2080 between the hours of 8am to 6:30pm EST Monday through Friday.

European clients can contact Christine Milne in our London office by e-mail to christine@northinfo-europe.com, or by calling +44 (0)20 7801 6260.

(New Risk Models, Continued from page 1)

mation into our factor models as an adjustment to the asset specific risk in those cases where the Parkinson method estimates a higher total volatility than the conventional estimate (standard deviation of past returns). This approach has been used in the US Fundamental Model for many years, and will be used in our US Macroeconomic, Global/Everything Everywhere, and Single Market models going forward Basics of the Parkinson method can be found in: Parkinson, Michael. "The Extreme Value Method For Estimating The Variance Of The Rate Of Return," Journal of Business, 1980, v53(1), 61-66.

A subtle change will occur in the way that factor return variances are calculated in all models. In a normal variance computation, we are measuring the squared differences from the mean of a series of factor returns. In that factors returns often show a trending behavior, we will be calculating variances as the squared value of the factor return. Implicitly, we are pretending that the sample mean for a given factor return is always zero. Empirically, most factor returns do have means close to zero, so this really doesn't do very much. However, when a factor return is consistently large and of one sign (i.e. positive returns to the Internet factor during the tech bubble), this procedure will automatically upward bias the factor variance values to provide a sort of warning of the unusual factor behavior. More on this issue can be found in http://www.northinfo.com/papers/19991025_anomalies_internet.pdf

Another "across-the-board" change will be the exponential weighting of past factor return observations for computation of factor covariance matrices. All factor models are based on observations of the past covariance among securities over some series of past time periods (e.g. past 60 months). Rather than view all of these past observations as being of equal importance, more recent observations will be given greater emphasis. The extent of the emphasis on recent observations will vary from model to model. For example, in emerging markets such as China, the emphasis on more recent data will be substantial, as the constant evolution in such markets makes data from the far past of little analytical value. On the other hand, stable markets such as the United States will have a much lesser degree of emphasis so that we aren't ignoring any of the past data that may still contain useful information.

The introduction of "hybrid" modeling in our line of Single Market models has been extremely well received. We will extend the hybrid approach to our Global / Everything Everywhere model as part of our "best practices" program. In a hybrid model, we first build our usual observable-factor model with whatever known factors are most appropriate to the observed market data. *The hybrid model addresses one of the key limitations of traditional risk models. This structure allows the model to adapt automatically to changes in the set of factors that is influencing market behavior at a particular moment in time.* One of our assumptions in building any factor model is that the factors we specify account for all the sources of correlation between securities. Unfortunately, we can only build our factor models from past data. As such, our model will provide an imperfect representation of future correlations as conditions change, often resulting in an omitted variable bias. We can correct for this bias by performing a statistical procedure called a principal components analysis on the security returns not explained by the model's factors.

Using the output from this analysis, we can then add temporary factors to the model if needed. These new factors can quantify the existence of whatever new forces are influencing the market currently. In this way our hybrid models are adaptive to market changes in a way that traditional observable-factor models are not, yet unlike "blind factor" models wherein the principal components analysis is used to explain all of the security correlation, our hybrid models have a fully specified (and clearly understandable) observable-factor structure. The temporary factors will be used from time to time only to measure the small amount of risk arising from transient abnormalities in market conditions. In that the expected value of the variance explained by the temporary factors is zero, the use of temporary factors in this fashion adapts our model very quickly to new influences in the market.

Users of the Global, Everything Everywhere and European models should note that there will be physical changes in the layout of our risk model data input files, and the number of factors that appear in the diagnostic reports. The first changes arise from the inclusion of the blind factors discussed above into the model files.

The second reason for physical file changes is that we will be putting back into the files the numerous currencies that went out of existence at various points in time due to the adoption of the Euro. For example, the our Global model history extends well back into the pre-Euro period when currencies like the French Franc and the Italian Lira were represented as separate currency factors. In order to make the physical files uniform across time, we will be including all the individual currencies plus the Euro in all factor files. For those periods when a particular currency did not exist, all security factor exposures to that currency will be zero, so there will be no change whatsoever in the actual analysis. By having all data files across time have the same layout, process that stretch across time such as performance attribution and back-testing are made greatly easier.

For our Global, EE and Single Market models, we will be

modifying one of the factors. In these models we currently use a measure of dividend yield to represent the value/growth characteristics of each stock. We chose dividend yield for the global context as there is little accounting ambiguity to this measure, as compared to measures like price/book value ratios. This factor will be modified to include both dividend yield and a response coefficient to the cross-sectional dispersion of stock returns within a market. Our research has found a strong relationship between the return spreads between value and growth style indices and the "net of market effect" dispersion among stock returns. This issue is described more fully in http://www.northinfo.com/papers/dan_crossvol_2003.pdf

Finally, model specific adjustments are being made to particular risk models:

- The Credit Risk Premium factor in our US Macroeconomic model is derived from bond index yields. We are changing the yield time series to indices that have a broader number of bonds so as to be less impacted by dramatic widening of credit spreads on specific issues such as Enron and WorldCom.

- The estimation universe for equity portion of the Global and Everything Everywhere models is being filtered to remove many small illiquid firms. Coverage of these firms will continue in the models but these firms will not be part of the subset of the universe that is used for computing the factor covariance matrix. We have found that removing these illiquid firms (as we have always done in the US Fundamental Model) improves the stability of the factor relationships.

We have made numerous small refinements to the procedures for classifying US firms into the industry groups defined in our Fundamental Model. In addition, the calculation of the Price Volatility Factor exposure in the US Fundamental model to be based on the highest and lowest prices in the last 52 weeks, rather than the highest and lowest week-ending prices in the last 52 weeks.

We are also making some refinements to the fixed income aspects of our Everything, Everywhere model. These changes should make the units in which yield curve volatility and correlations are measured more intuitive. The means by which factor exposures across different bond markets are rescaled to reflect volatility differences across markets will also be more direct.

We believe that the "second generation" Northfield risk models will provide our users with even better risk forecasts than our very successful current models. Please feel free to contact Northfield staff with any questions regarding these matters.

	US Fundamental	US Macroeconomic	Single Market	Global/ Everything Everywhere
Improved Industry Assignments	Yes	Yes (1)	No	No
Price Volatility Factor Calculation	Changed	NA	NA	NA
Factor Variance Calculation	Yes	Yes	Yes	Yes
Parkinson Volatility	Already There	Yes	Yes	Yes
Exponential Weighting Factor Covariance	Yes	Yes	Yes	Yes
Credit Risk Premium Factor Calculation	NA	Yes	NA	NA
Redefined Growth/Value Yield Factor	NA	NA	Yes	Yes
Hybrid "Blind Factors in Residual"	No	No	Already There	Yes
Narrow Estimation Universe	Already There	NA	Yes	Yes
Reinsert Dead Currencies	No	No	Yes (2)	Yes
Fixed Income Factor Units	NA	NA	NA	Yes

(1) The Macroeconomic Model uses industry classifications only as descriptive data

(2) European Model only

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