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Strategic and tactical asset allocation with macroeconomic announcements

Macroeconomic announcements drive global equity and bond risk premia

In all 45 countries in the MSCI ACWI, for both equity and fixed income markets, we find significant positive (or negative) risk premia can be earned on the days when important economic indicators are released.

Introducing MEAM – MacroEconomic Announcement Model

We find low-risk investing by avoiding macroeconomic uncertainties is different from, additive to, and even dominating the traditional risk-based asset allocation techniques. We can boost the average Sharpe ratios for the global equity and bond markets by 34% and 28%, respectively, by switching to cash (or hedging our exposures) on the days when certain economic indicators are announced. We further demonstrate that the performance of GTAA and SAA can be improved significantly with the MEAM model.

The global capital market becomes increasingly integrated

It is critical that we research beyond domestic and US economic indicators. Foreign economic reports are becoming more and more essential. The underlying economic drivers also change over time.

Source: gettyimages.com

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A letter to our readers

Introducing the MEAM or MacroEconomic Announcement Model

In the paper, we study global tactical asset allocation (GTAA) and strategic asset allocation (SAA) using macroeconomic indicators, a topic that we have been publishing extensively[1], but this time from a completely new angle.

We find both equity and bond markets in all of the 45 countries[2] comprising the MSCI ACWI earn substantially higher (or lower) returns on days when essential macroeconomic data items are published.

Some economic indicators are consistently associated with positive equity (or bond) risk premia on the announcement dates, most likely when investors over-pay for insurance for macro risk – these are typically widely watched "headline" type of economic news. While for other economic reports, hedging equity (or bond) exposures on the announcement days can avoid consistent negative risk premia – these are typically less watched or economic news from foreign countries.

As we are living in an increasingly integrated global economy and as the world capital markets continue to evolve, we find economic data from other countries can be as important as or even more important than domestic economic announcements. The underlying economic drivers are also changing over time.

Consistent with our low-risk investing theme in single stocks[3] and asset allocation[4], we recommend strategies that invest in equity (and bond) market most of the time, while hedging (or switching to cash) on a few select trading days in the year. These days are when certain economic indicators (the ones that are expected to generate negative risk premia on their release days) are announced. Essentially, we try to avoid certain types of macroeconomic uncertainties or risks – a model we called MEAM (MacroEconomic Announcement Model). For the 45 countries, we can improve our average Sharpe ratios for equity and bond by 34% and 16%, respectively. More importantly, we attain higher Sharpe ratios with both higher returns and lower volatilities.

Our MEAM model can be applied to both GTAA and SAA decisions. For example, it can boost our baseline GTAA model by 51% in Sharpe ratio. Our MEAM model can also significantly improve the performance of risk-based SAA portfolios, without the need of leverage. More importantly, we find low risk investing in the macroeconomic uncertainties of the MEAM-based strategy is different from, additive to, and more beneficial than the traditional low-risk asset allocation strategies.

Yin, Rocky, Miguel, Javed, John, and Sheng

Deutsche Bank Quantitative Strategy Team

"Live as if you were to die tomorrow. Learn as if you were to live forever."

Mahatma Gandhi

[1] See Luo, et al [2010] "Style Rotation", Luo, et al [2011] "Quant Tactical Asset Allocation", Mesomeris, et al [2012] "A New Asset Allocation Paradigm", and Jussa, et. al [2012] "Cross Asset Class Momentum", among many others.

[2] For equity markets, we have data for all 45 countries, while for bond – we use mid-term sovereign bond – we have data for 25 countries.

[3] See Alvarez, et al [2011] "Minimum Variance: Exposing the 'Magic'" and Avettand-Fenoel, et al [2011] "Low Risk Strategies".

[4] See Alvarez, et al [2011] "Risk Parity and Risk-based Allocation", Luo, et al [2012] "New Insights in Country Rotation", and Mesomeris, et al [2012] "A New Asset Allocation Paradigm".

Research outline

Literature review

Existing academic literature on asset pricing with macroeconomic data tends focus on how asset price changes in response to a given economic release, e.g., whether stock markets rise when industrial production picks up, or when non-farm payroll surprises on the positive side[5]. Some influential papers in this area include Pearce and Roley [1985], Chen, Roll, and Ross [1986], Andersen, Bollerslev, Diebold, and Vega [2003], Hautsch and Hess [2007], Beber and Brandt [2010], Evans [2011], Hussain [2011], and Gilbert [2011].

Savor and Wilson [2011] suggests stock market average returns and Sharpe ratios are significantly higher on days when critical macroeconomic news about inflation, unemployment, or interest rates is scheduled for announcement. Dicke and Hess [2012][6] find both stocks and bonds earn substantial excess returns on days when macroeconomic reports are released. More importantly, they find that stocks earn a risk premium only on days when economic growth is released, while bonds are compensated only for bearing the risk of inflation related news. Goeij, Hu, and Werker [2010], Flannery and Protopapadakis [2002], and Jones, Lamont, and Lumsdaine [1998] are a few other related papers on the announcement day effects.

However, existing literature almost exclusively focuses on a few selected economic indicators, e.g., GDP, CPI/PPI, consumer confidence, ISM, etc. In practice, we know that the capital markets care about a much wider range of economic factors[7]. These few selected economic variables, despite being widely followed by the market participants, are *ad hoc* at best and subject to significant in-sample selection bias[8]. More importantly, the vast majority of macroeconomic research is done on the US market, using only US economic data.

To the best of our knowledge, our research is the first to analyze the impact of macroeconomic announcements (around 1,400 economic indicators in 45 countries globally) on both equity (45 countries in the MSCI ACWI) and bond (sovereign bonds in 25 countries) risk premia. We also further demonstrate the significant implications to both strategic and tactical asset allocation strategies.

Data

The research universe in our paper is the 45 countries comprising the MSCI All Country World Index (ACWI). The most challenging data required is macroeconomic announcement data. Economic data have a few interesting features stated below.

[5] For example, in Luo, et al [2010] "Style Rotation", we use economic data and economic surprises to predict style factor performance.

[6] We provide a more in-depth interpretation of the paper in Cahan, et al [2011] "Academic Insights", Deutsche Bank Quantitative Strategy, August 23, 2012.

[7] A widely used reference book on economic indicators by Baumohl [2008], for example, listed and explained hundreds of economic reports in the US alone.

[8] If we study a large number of variables, even randomly, a few are likely to be statistical significant. If we write a paper and only publish those ones that are statistically significant, it seems to be quite interesting, but the variables may have no predictive power out-of-sample.

First of all, most economic series are announced with time lags. For example, one of the most widely watched economic announcements in the US is non-farm payroll data. The non-farm payroll data is typically reported on the first Friday of each month, for the previous month. For example, the non-farm payroll data for December 2012 was announced only on January 4, 2013. Therefore, as elaborated in Luo, et al [2010] "Style Rotation", for real-time prediction, we need to take into account reporting lags.

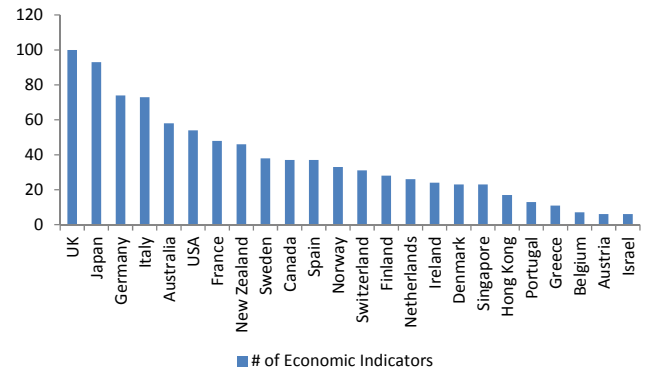
An even more challenging issue with economic data is re-statement bias. As we know, companies may re-state their financial statement for various reasons, but re-statements in economic data are more commonplace. As shown in Luo, et al [2010] "Style Rotation", we also found re-statement could be statistically significant and serial correlated. Therefore, to avoid look-ahead bias, we need to use originally as-reported data. The problem is that in most economic databases, data vendors tend to only carry the final re-stated data.

For the purpose of this study, we focus on the impact of economic announcements on the reporting days. To control for the size and direction of economic surprises, we need economic surprise data. Academic research is more likely to define economic surprises as the difference between announced and model-predicted numbers. The problem is, of course, that the market does not use the same econometric model as ours; therefore, surprises defined this way are not necessarily surprises to market participants. To follow the convention in quantitative equity research[9], we define economic surprises as the difference between as-reported and consensus estimates by economists.

We also need precise announcement date and time for our research, as the main strategy rebalancing frequency is daily.

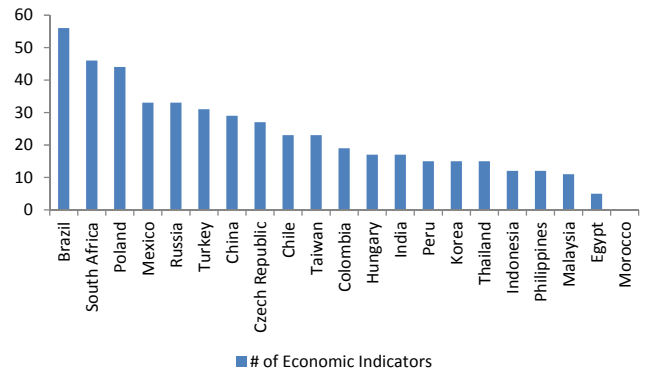
To conduct this research, we have collected a large number of originally as-reported and consensus economic indicators for 44 of the 45 countries in our sample. The only country without economic data in our database is Morocco. In total, we have 1,389 economic time series, or around 31 economic indicators per country. As shown in Figure 1 and Figure 2, on average, we have better coverage in developed countries than in emerging markets. Among developed countries, we have the best coverage in UK, Japan, Germany, Italy, Australia, and US. Among emerging countries, we have the best coverage in Brazil, South Africa, and Poland.

Figure 1: # of economic series in developed countries



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 2: # of economic series in emerging countries

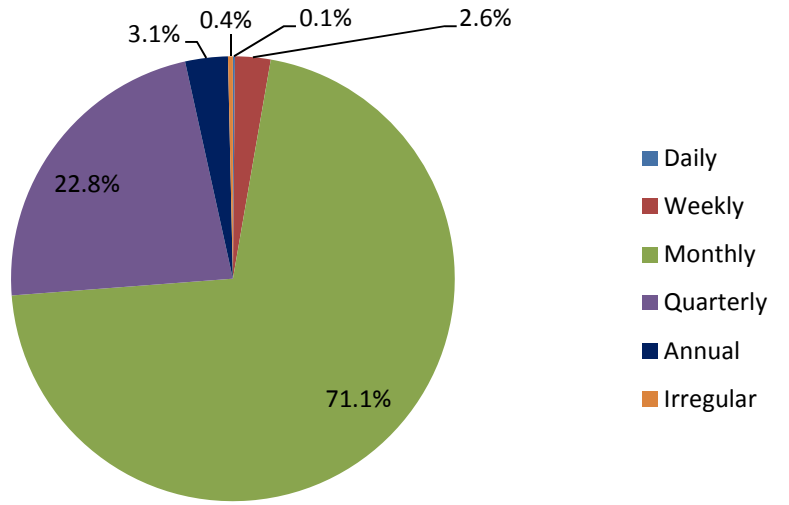


Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

[9] In quantitative equity research, a widely followed factor is earnings surprise, which is generally defined as the difference between reported earnings per share and consensus forecasted earnings per share.

As shown in Figure 3, most economic data series are of monthly frequency (71%), followed by quarterly (23%), while few economic series are of yearly, weekly, or daily frequency.

Figure 3: # of economic data series by reporting frequency



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

In addition to the traditional economic data series, we also include scheduled central bank rate decisions from US Federal Reserve, Bank of England, ECB, Bank of Japan, and People's Bank of China. For central bank data, our database only has the announcement date, but not the surprise data. Central banks' rate decisions also tend to be irregular, albeit we do know the future announcement dates ahead of time.

To conduct our research, we also need daily equity, bond, and cash return data for each of the 45 countries. Country-level equity returns are based on MSCI country total return indices. For country-level bond data, we focus on 10-year government bond total return indices calculated by Bloomberg. We are able to collect government bond data for 25 countries in the MSCI ACWI. We use overnight USD LIBOR for the cash return. For the purpose of this study, all asset returns are translated into USD; therefore, our strategies are unhedged[10].

Market microstructure issues

Because the main frequency of the strategies is daily and the scope of our research is global, market microstructure issues are vital. We need to know the precise announcement date/time in local time and translate that into the subject country's local date/time. The daylight saving time (and its changes[11]) further complicates the calculation. We also need to make adjustments for holidays. Different countries have different holidays and trading hours. Even in the same country, equity and bond markets may have different trading day/trading hour conventions. For example, on New Year's eves, US equity markets typically open in regular hours, but US bond markets typically close at 2PM.

[10] We plan to write another research studying the impact of macroeconomic announcements on FX, commodities, and other asset classes.

[11] For example, beginning in 2007, US, Canada, and Mexico extended the daylight saving time one month, which is different from the daylight saving time for UK/Europe.

The actual reporting time is also important. For our purpose, as we want to understand the implication of announcement date effect, we need to differentiate those announcements made before/during market hours and those made after market hours. For announcements made before/during market hours, we can take a trading position (long or short/hedge) on the same day, while for after-hour announcements, we treat them as if they are released before market open the next trading day (because we can only take a position on the next trading day).

For example, let's assume the subject country of our interest is the US, and we want to understand the impact of Japan trade balance[12]. We need to know that when Japan's trade balance was announced on Monday, February 20, 2012 (local date) at 8:50AM Tokyo time, it was actually 6:50PM EST, on Sunday, February 19, 2012 in the US. Therefore, it was almost equivalent to be announced before the market open on the next week day in the US, i.e., Monday, February 20, 2012. However, we also note that February 20, 2012 is the President day (stock exchanges closed) in the US; therefore, for US investors, we can treat this data point as if it were announced on Tuesday, February 21, 2012, before market open. Similarly, we also need to make adjustments for those economic data series announced in the Americas, if the subject country is in Asia Pacific.

Risk premium

In this research, what we really try to understand is how investors view upcoming macroeconomic announcements or how market participants react to economic uncertainties. Specifically, do upcoming economic announcements carry a risk premium? If the answer is yes, whether the risk premium is positive or negative?

Classic economic and finance theories suggest that an asset should be rewarded with a premium (i.e., higher return) for bearing risk, if this risk can't be diversified. However, from our own research[13] and many recent academic papers, we often find the opposite empirically, i.e., the realized returns for more risky assets are more likely to be lower, rather than higher, than less risky assets.

A positive risk premium means that investors view an upcoming economic announcement as a risky event, and investors demand a positive risk premium to be compensated for taking that extra risk. This seems to suggest that investors on average over-pay for insurance; therefore, a risky asset (e.g., equity) is sold off prior to the announcement day. On average, asset price would appreciate after the announcement day, generating a positive risk premium. These types of economic news are likely to be the widely watched headline indicators that investors are generally concerned about.

For example, on the days when US ISM manufacturing composite index data were released, the average daily return for the US equity market was 0.25%, while for all other days, the average return was only 0.03% (see Figure 4). The average volatility on the ISM announcement days is only marginally higher than it on regular trading days. The Sharpe ratio on announcement days was 4.0x versus 0.5x on regular days. As shown in Figure 5, interestingly enough, on those days when US ISM data were announced, UK equity market also earned a higher risk premium of 0.33% per day

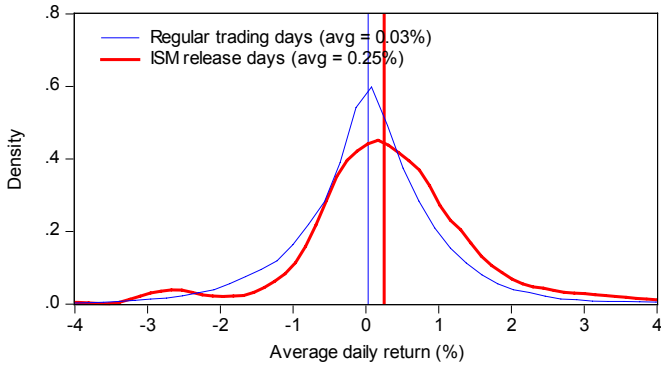
[12] As we will show later, Japan's trade balance is one of the widely watched global economic barometers and impacts the equity risk premium in many countries.

[13] See Alvarez, et al [2011] "Minimum Variance: Exposing the 'Magic'", Alvarez, et al [2011] "Risk Parity and Risk-based Allocation", Avettand-Fenoel, et al [2011] "Low Risk Strategies", and Luo, et al [2012] "New Insights in Country Rotation".

(0.34% on the announcement days versus 0.00% on regular days). This further highlights that foreign economic reports could have significant implications for domestic capital market.

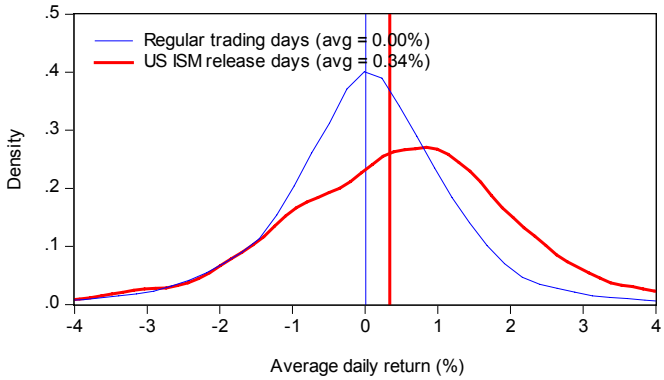
We find similar patterns for the fixed income markets. As shown in Figure 6, Japanese government bond market earns a daily risk premium of 0.08% on the days when German industrial product data were announced. As the world economy is further integrated, economic data in Europe give Japanese bond investors insights on domestic inflation pressure; therefore, impacting bond prices. We also find similar evidence in emerging markets. For example, China's equity market has earned a daily risk premium of 0.30% on Japanese unemployment rate publication days (see Figure 7).

Figure 4: US equity returns on US ISM release days



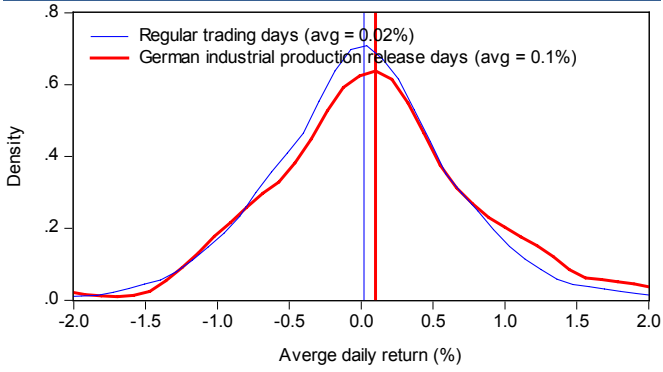
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 5: UK equity returns on US ISM release days



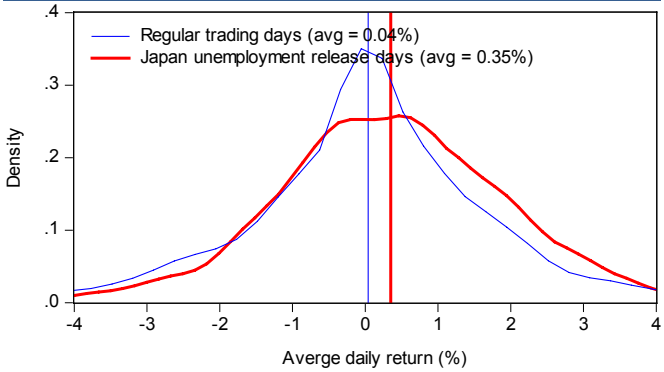
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 6: Japan government bond returns on German industrial production release days



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 7: China equity returns on Japan unemployment release days



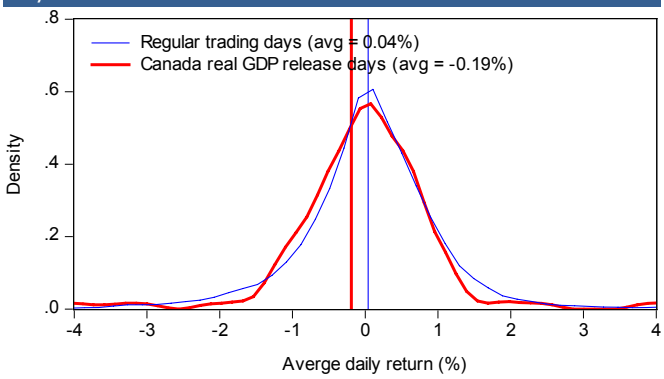
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

A negative risk premium, on the other hand, may suggest investors on average are overly optimistic and/or not paying enough attention to upcoming risky events. Investors are then caught up by surprises and asset prices are depressed after the announcement. These are likely to be the less watched economic events for the general investment public, or foreign economic news releases.

An interesting example of a negative risk premium is the impact of Canada real GDP announcement on the Canadian equity market. As shown in Figure 8, on average, on the days when Canada real GDP was reported, Canadian equity generated a negative return of -0.19% (versus 0.04% on regular trading days). Similarly, an example in the

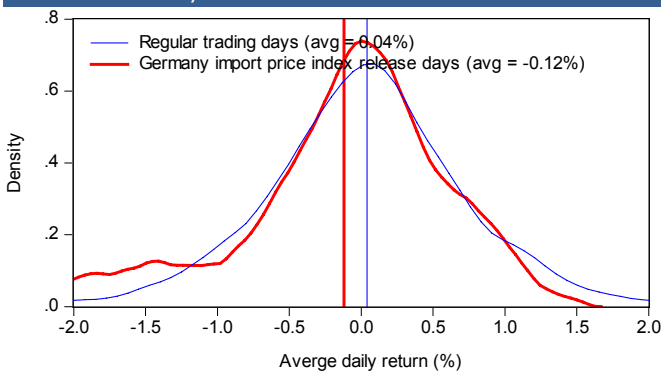
fixed income world is that Greek sovereign bond earned a negative risk premium of -0.16% on the days when German import price index was published (see Figure 9). Finally, in Figure 10 and Figure 11, we illustrate the impact of foreign economic news on domestic capital markets with two other examples – Hong Kong CPI on Australian equity market and Chilean Economic Activity Index on South African equity market.

Figure 8: Canada equity returns on Canada GDP release days



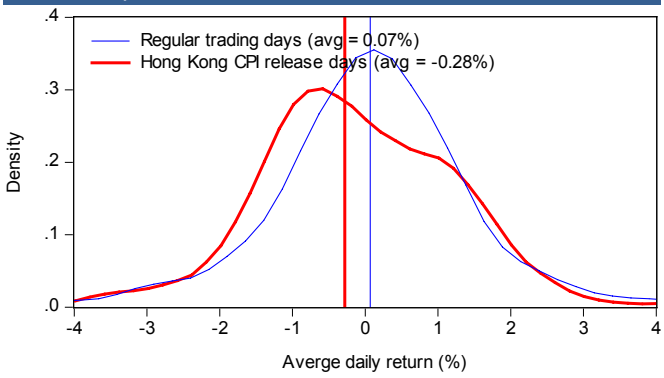
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 9: Greece bond returns on Germany import price index release days



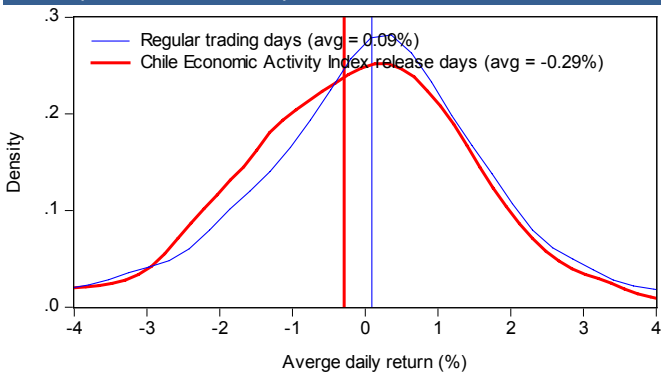
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 10: Australia equity returns on Hong Kong CPI release days



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 11: South Africa equity returns on Chile Economic Activity Index release days



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

We argue investors are slow to adjust. Therefore, for those economic releases that have generated higher (or lower) abnormal returns on the announcement days, the same abnormal returns (with the same direction) are likely to continue in the subsequent years. To test this hypothesis, we design a few macroeconomic indicator selection algorithm (MISA) to identify a list of economic indicators for each country and each capital market, as of each year end. The same list of economic indicators is then applied to the empirical trading strategies for the following year.

Macroeconomic indicator selection algorithm (MISA)

The empirical backtesting is conducted by country. For each country, it is further conducted by asset class (i.e., equity versus fixed income). We use a five-year rolling window for each country at each year end from 2002 to 2012 to conduct our backtesting. Backtesting starts from 2002, as most of our global economic data starts from the end of 1997.

From 2002 year end, we use a five-year rolling window for each of the approximately 1,400 economic series and apply the following three different variable selection algorithms:

1. TTEST: Simple t-test of different means on the announcement days versus non-announcement days.

2. REG (Regression with control variables): a dummy variable of whether the economic series is announced on that day, the actual surprise, previous day's market return, the squared previous day's market return, dummy variables for the days of the week (i.e., Monday, Tuesday, Wednesday, Thursday, and Friday). Details are elaborated below.

3. MULTIREG (Multivariate regression): we put all economic variables together and use a step-wise regression to choose those variables that are statistically significant.

As of the end of each year from 2002, each of the above three MISA approaches will give us a list of economic indicators that are statistically significant in determining asset risk premia on their announcement days. We then further classify these economic series into one of the following two categories:

1. Positive premium economic indicators (PPEI): these are the economic series that have produced positive risk premia on their announcement days, based on the backtesting; and

2. Negative premium economic indicators (NPEI): these are the economic series that have yielded negative risk premia on their announcement days in the past five years.

The same list of economic variables will be applied to a few trading strategies for the follow year.

REG – controlling for the direction and size of economic surprise

Equity, as a risky asset, often reacts positively to a positive surprise of growth-related economic news, e.g., non-farm payroll, while bond prices are likely to fall (due to the concern that central bank may raise interest rate to combat inflation). Post announcement drift is also well understood, i.e., asset price tends to continue to move in one direction after the announcement of an event (e.g., earnings announcement or economic announcement).

In our research, we are not trying to either predict the direction of economic surprises, or follow post event drift. Rather, we try to understand the risk premium (positive or negative) earned on the announcement days for a given economic indicator, after controlling for the direction and size of the economic surprise. Specifically, for each country (separately for equity and government bond), as of each year end, we use a five-year rolling window of daily returns to perform the following regression[14]:

$$r_t = \alpha + \beta_1 \cdot D_t^{eco} + \beta_2 \cdot Sur_t^{eco} + \beta_3 \cdot r_{t-1} + \beta_4 \cdot r_{t-1}^2 + \sum_{i=1}^{5} \gamma_i \cdot D_t^{weekday} + \varepsilon_t$$

[14] The list of control variables is consistent with Kicke and Hess [2012] and Savor and Wilson [2011].

where,

r_t is daily asset return on day t,

D_t^{eco} is a dummy variable, equals to 1 on the days when a macroeconomic indicator eco is announced and 0 on all other trading days,

Sur_t^{eco} is the actual surprise in economic series eco, where surprise is defined as the difference between actual (as reported) and consensus estimate prior to the economic release,

Please note that, to control for autocorrelation in returns, we include the previous trading day's return (r_{t-1}). We also account for the risk of the overall market volatility by including previous day's squared returns (r_{t-1}^2). Day-of-the-week effects ($D_t^{weekday}$) are included using dummy variables that equal to 1 for each of the five weekdays (Monday to Friday). Because some economic data series are always announced on the same weekday, e.g., non-farm payroll data is typically published on Friday, sometimes we need to remove one weekday dummy variable to avoid perfect colinearity.

The main interest centers around the coefficient β_1, i.e., after controlling for other variables, whether we still generate a statistically significant (positive or negative) risk premium on the days when a certain economic series is disseminated.

A changing and integrated global capital market

It's not just domestic (and US) economic data that matters

It is well understood that the domestic economic environment influence asset pricing; therefore, essential economic announcements, e.g., US Fed policy announcements, impact equity and bond prices (see Figure 12). However, in an increasingly integrated global economy and global capital market, it is no longer just domestic economic news that matters. Rather, from time to time, foreign economic indicators can be even more important (see Figure 13). Ironically, the majority of academic research and many systematic global macro models are still based on primarily US, domestic and a few selected international economic indicators. As we will demonstrate in later sections, incorporating a broad range of foreign economic indicators can materially boost the performance of macro-based investment strategies.

Figure 12: Fed policy announcement on domestic equity and bond markets

Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 13: China's trade data on US equity and Spanish bond markets

Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Changes in economic drivers

Interestingly, as our economy evolves over time, so do the underlying economic drivers. As the world economy becomes more integrated over time, international economic news has also become more relevant, especially in recent years.

In this section, we use four countries (US, Germany, China, and Japan) and two capital markets (equity and fixed income) to illustrate. We design a simple color coding scheme to show our analysis[15]:

- Green for US/Canada – this represents the largest economic region and attracts much of investors' attention.

[15] The world economy and capital markets are more complicated than what a four-color scheme can show here. This is just a simple example.

- Pink for developed Europe – this region highlights another large and integrated economic entity; the recent European sovereign debt crisis also forces investors to pay close attention to economic reports from this region.
- Yellow for EM/Asia – we group together all EM countries and Asia ex Japan, which measures the sentiment of EM and to a large extent, commodities (both producing countries and consumers).
- Blue for Japan – Japan represents the last piece of the puzzle; Japan's economy and capital market also tend to be somewhat less correlated to the rest of the world.

As displayed in Figure 14, in the early 2000s, the US equity market was predominately driven by domestic, Canadian, some European (mainly German and French), and to a lesser extent Mexican economic releases. In mid-2000s commodities boom, economic news from commodities producing countries like South Africa, Indonesia, and Australia became more relevant. The 2008 subprime crisis and the subsequent global recession highlighted the primary growth driver of world economy at the time, i.e., China's GDP growth. The start of European sovereign debt crisis in 2009 onwards led investors' attention to Europe. As of the end of 2012, interestingly, other than Federal Reserve's rate decision, the underlying economic drivers for US equity market have no other US domestic economic indicators and are predominantly European, Asian, South American, and EM. Using the color coding scheme, we can see green gradually gave away to pink and yellow.

For the German equity market, in the first half of 2000s, US/Canadian economic announcements were more dominant, while in the second half of 2000s, economic news from Europe and EM started to outweigh (see Figure 15). We see similar patterns for China's equity market – the exception being Japanese economic data are more essential for China than for Europe (see Figure 16). Interestingly, US Federal Reserve rate announcements also move the Chinese equity market. For Japan's sovereign bond market, in the first half of 2000s, it was more about Japanese domestic economic indicators, while for the second half of 2000s, it was more related to European economic development (see Figure 17).

Figure 14: The evolution of macroeconomic drivers for the US equity market

2002	2003	2004	2005	2006	2007
Canada: Manufacturing Shipments	Canada: Imports of Goods [BOP]	Canada: Retail Sales	USA: Government Surplus/Deficit	Canada: Ivey Purchasing Managers Index	USA: Construction Spending
Canada: Real Gross Domestic Product	USA: Government Surplus/Deficit	USA: Government Surplus/Deficit	USA: Construction Spending	Canada: New Auto Sales	USA: Domestic Light Truck Sales
USA: Construction Spending	USA: Construction Spending	USA: Construction Spending	France: Manufacturing Production (MoM)	USA: Construction Spending	USA: ISM: Mfg Composite Index
USA: Real GDP: Preliminary	USA: Real GDP: Preliminary	USA: ISM: Mfg Composite Index	Switzerland: Unemployment Rate	USA: ISM: Mfg Composite Index	USA: GDP Chain Price Index: Final
Switzerland: GDP (annualized) (QoQ)	France: Consumer Price Index (MoM)	France: Consumer Price Index (MoM)	Switzerland: Producer & Import Prices (YoY)	USA: Exports: Goods & Services [BOP]	France: Non-Farm Payrolls (QoQ)
UK: RPI (MoM)	France: Consumer Price Index (YoY)	France: Consumer Price Index (YoY)	UK: Public Finances (PSNCR)	France: Industrial Production (MoM)	Switzerland: SECO Consumer Climate
UK: RPI (YoY)	UK: RPI (MoM)	Italy: 13-City CPI (NIC w/tobac)(YoY)	New Zealand: Retail Sales (MoM)	France: Industrial Production (YoY)	Switzerland: KOF Swiss Leading Indicator
UK: RPI Ex Mort Int.Payments (YoY)	UK: RPI Ex Mort Int.Payments (YoY)	UK: RPI (MoM)	Brazil: Current Account - Monthly	France: Manufacturing Production (MoM)	UK: Visible Trade Balance GBP/Mn
Australia: Private Capital Expenditure	Mexico: Retail Sales (INEGI)	UK: RPI Ex Mort Int.Payments (YoY)	Mexico: Retail Sales (INEGI)	Brazil: Current Account - Monthly	Mexico: Consumer Prices (MoM)
Federal reserve rate decision	Mexico: Unemployment	UK: Public Finances (PSNCR)	Indonesia: Inflation (YoY)	Mexico: Retail Sales (INEGI)	Peru: Consumer Price Index (MoM)
		Brazil: Current Account - Monthly	Indonesia: Exports (YoY)	Poland: CPI (MoM)	South Africa: CPI (all items) (YoY)
		Mexico: Retail Sales (INEGI)	Indonesia: Imports (Ex Trade Zones) (YoY)	Indonesia: Inflation (YoY)	South Africa: CPI (core rate) (YoY)
		South Africa: M3 Money Supply (YoY)		Indonesia: Trade Balance (Ex Trade Zones)	South Africa: CPI (all items) (MoM)
		South Africa: Private Sector Credit (YoY)			South Africa: CPIX (Metro & Urban) (YoY)
					South Africa: CPIX (Metro & Urban) (MoM)
					Indonesia: Inflation (YoY)
					Indonesia: Imports (Ex Trade Zones) (YoY)
					Malaysia: Industrial Production YoY

2008	2009	2010	2011	2012
USA: Domestic Light Truck Sales	Canada: Real Gross Domestic Product	Canada: Building Permits	Israel: Consumer Prices (MoM)	Norway: Norwegian Deposit Rates
France: Producer Prices (MoM)	USA: Empire State Mfg Index	Canada: Real Gross Domestic Product	Netherlands: Producer Confidence	Norway: Credit Indicator Growth (YoY)
Germany: Unemployment Change (000's)	Israel: Consumer Prices (MoM)	USA: Domestic Auto Sales	Switzerland: Industrial Production (YoY)	Sweden: Riksbank Interest Rate
Israel: Consumer Prices (MoM)	Italy: PPI (MoM)	USA: Nonfarm Output Per Hour: Preliminary	UK: Net Consumer Credit	Switzerland: Producer & Import Prices (MoM)
Sweden: Retail Sales n.s.a. (YoY)	Italy: Industrial Orders s.a. (MoM)	Israel: Consumer Prices (MoM)	UK: PPI Output n.s.a. (MoM)	UK: Net Lending Sec. on Dwellings
Sweden: CPI - Headline Rate (MoM)	UK: Visible Trade Balance GBP/Mn	UK: Visible Trade Balance GBP/Mn	UK: Imports	UK: PPI Output n.s.a. (MoM)
Sweden: CPI - Underlying Infl. (MoM)	UK: PPI Output n.s.a. (MoM)	UK: PPI Output n.s.a. (MoM)	Australia: Gross Domestic Product (QoQ)	Australia: Gross Domestic Product (QoQ)
UK: Manufacturing Production (YoY)	Australia: Company Operating Profit QoQ%	UK: PPI Input NSA (YoY)	Hong Kong: CPI - Composite Index (YoY)	Hong Kong: CPI - Composite Index (YoY)
UK: Visible Trade Balance GBP/Mn	Hong Kong: CPI - Composite Index (YoY)	Australia: Retail Sales Ex Inflation(QoQ)	New Zealand: Consumer Prices (QoQ)	Japan: Current Account Total
UK: PPI Output n.s.a. (MoM)	Singapore: CPI (YoY)	Australia: Company Operating Profit QoQ%	New Zealand: Unemployment Rate	New Zealand: Consumer Prices (QoQ)
Australia: Employment Change	Mexico: Consumer Prices (MoM)	Hong Kong: CPI - Composite Index (YoY)	Peru: Economic Activity Indx YoY NSA	New Zealand: Unemployment Rate
Australia: Participation Rate	Peru: Economic Activity Indx YoY NSA	New Zealand: Unemployment Rate	Czech Republic: CPI (MoM)	Chile: CPI (MoM)
Australia: Inventories	Czech Republic: Industrial Output (YoY)	Peru: Economic Activity Indx YoY NSA	Czech Republic: Industrial Output (YoY)	Chile: CPI (YoY)
Hong Kong: CPI - Composite Index (YoY)	Poland: Avg Gross Wages (MoM)	Czech Republic: Industrial Output (YoY)	Poland: Sold Industrial Output (MoM)	Colombia: Retail Sales (YoY)
Japan: All Industry Activity Index (MoM)	China: Real GDP (YoY)	Poland: GDP (YoY)	Russia: Producer Prices (MoM)	Czech Republic: Industrial Output (YoY)
Mexico: Consumer Prices (MoM)	Federal reserve rate decision	Russia: Producer Prices (MoM)	Russia: Producer Prices (YoY)	Poland: Sold Industrial Output (MoM)
South Africa: CPI (all items) (YoY)		Russia: Producer Prices (YoY)	China: Real GDP (YoY)	Russia: Producer Prices (MoM)
South Africa: CPI (all items) (MoM)		China: Real GDP (YoY)	Taiwan: Total Exports (YoY)	Russia: Producer Prices (YoY)
South Africa: CPIX (Metro & Urban) (YoY)		Federal reserve rate decision	Taiwan: Current Account Balance (USD)	Federal reserve rate decision
China: Real GDP (YoY)			Federal reserve rate decision	
Korea: Industrial Production (YoY)				
Thailand: Gross Domestic Product (YoY)				

Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 15: The evolution of macroeconomic drivers for the Germany equity market

2003	2004	2005	2006	2007
Canada: Retail Sales	Canada: Retail Sales	Canada: Retail Sales	Canada: Retail Sales	Canada: Capacity Utilization
Canada: Imports of Goods [BOP]	USA: Consumer Credit	Canada: Retail Sales ex Autos	Canada: Retail Sales ex Autos	USA: Consumer Credit
Canada: Exports of Goods [BOP]	USA: Government Surplus/Deficit	USA: Personal Consumption Expenditures	USA: Government Surplus/Deficit	USA: Government Surplus/Deficit
USA: Consumer Credit	USA: Construction Spending	USA: Chicago Purchasing Manager's Index	USA: Personal Consumption Expenditures	USA: Personal Consumption Expenditures
USA: Construction Spending	USA: Mfrs' New Orders: Durable Goods: Median Forecast	USA: Trade Balance: Goods & Services [BOP]	USA: Construction Spending	USA: Construction Spending
USA: Mfrs' New Orders: Durable Goods: Median Forecast	USA: Domestic Light Truck Sales	Switzerland: Unemployment Rate	USA: ISM: Mfg Composite Index	USA: Domestic Light Truck Sales
USA: Domestic Light Truck Sales	USA: ISM: Mfg Composite Index	UK: RPI (MoM)	USA: Trade Balance: Goods & Services [BOP]	USA: ISM: Mfg Composite Index
USA: ISM: Mfg Composite Index	USA: Trade Balance: Goods & Services [BOP]	UK: RPI (YoY)	Switzerland: Unemployment Rate	USA: Chicago Purchasing Manager's Index
UK: PPI Input s.a. (MoM)	UK: PPI Input s.a. (MoM)	UK: RPI Ex Mort Int.Payments (YoY)	Australia: Unemployment Rate	USA: Trade Balance: Goods & Services [BOP]
UK: PPI Output n.s.a. (MoM)	UK: PPI Output n.s.a. (MoM)	Hong Kong: Unemployment Rate SA	Hong Kong: Unemployment Rate SA	USA: Real GDP: Preliminary
UK: Public Finances (PSNCR)	UK: RPI (MoM)	Japan: Adjusted Current Account Total	Japan: Current Account Total	USA: Real GDP: Final
Czech Republic: Trade Balance (Koruna)	UK: RPI Ex Mort Int.Payments (YoY)	Japan: Merchnds Trade Balance Total	New Zealand: Imports	Germany: Retail Sales (MoM)
	UK: Public Finances (PSNCR)	Japan: Adjusted Merchnds Trade Bal.	Singapore: CPI (YoY)	Germany: Retail Sales (YoY)
	Hong Kong: Unemployment Rate SA	New Zealand: Retail Sales (MoM)	Czech Republic: Trade Balance (Koruna)	Germany: Producer Prices (MoM)
	Japan: Adjusted Merchnds Trade Bal.	New Zealand: Imports	South Africa: CPI (all items) (YoY)	Sweden: GDP s.a. (QoQ)
	Mexico: Unemployment	Brazil: Current Account - Monthly	South Africa: CPI (core rate) (YoY)	Sweden: GDP w.d.a. (YoY)
	Czech Republic: Trade Balance (Koruna)	South Africa: Trade Balance (Rand)	South Africa: CPIX (Metro & Urban) (YoY)	Switzerland: CPI (YoY)
		South Africa: CPI (all items) (YoY)	Indonesia: Inflation (YoY)	Switzerland: Unemployment Rate
		South Africa: CPI (core rate) (YoY)	Indonesia: Exports (YoY)	Switzerland: SECO Consumer Climate
		South Africa: CPIX (Metro & Urban) (YoY)	Indonesia: Imports (Ex Trade Zones) (YoY)	UK: Net Lending Sec. on Dwellings
		Indonesia: Inflation (YoY)	Bank of England rate decision	UK: BOE ANNOUNCES RATES
		Indonesia: Exports (YoY)	ECB rate decision	Australia: Employment Change
		Indonesia: Imports (Ex Trade Zones) (YoY)		Japan: Housing Starts (YoY)
				Japan: Current Account Total
				Peru: Consumer Price Index (MoM)
				Czech Republic: Trade Balance (Koruna)
				South Africa: M3 Money Supply (YoY)
				South Africa: PPI (YoY)
				South Africa: Trade Balance (Rand)
				South Africa: PPI (MoM)
				South Africa: GDP (Annualized)
				South Africa: SARB Announce Interest Rate
				Turkey: Industrial Production (YoY)
				Indonesia: Inflation (YoY)
				Indonesia: Imports (Ex Trade Zones) (YoY)
				Malaysia: Industrial Production YoY
				ECB rate decision

2008	2009	2010	2011	2012
Canada: Ivey Purchasing Managers Index	USA: Empire State Mfg Index	Canada: Ivey Purchasing Managers Index	USA: GDP Chain Price Index: Advance	USA: Real GDP: Advance
USA: Import Price Index	Denmark: GDP n.s.a. (YoY)	Canada: Building Permits	USA: Nonfarm Output Per Hour: Preliminary	USA: Nonfarm Output Per Hour: Preliminary
USA: Empire State Mfg Index	Denmark: GDP s.a. (QoQ)	USA: Empire State Mfg Index	Germany: Factory Orders YoY (nsa)	Germany: Factory Orders YoY (nsa)
USA: Real GDP: Final	Israel: Base Rate Announcement	USA: Nonfarm Output Per Hour: Preliminary	Germany: Current Account (EURO)	Germany: IFO - Business Climate
Denmark: GDP n.s.a. (YoY)	UK: PPI Output n.s.a. (MoM)	Denmark: GDP s.a. (QoQ)	Germany: Trade Balance	Germany: GfK Consumer Confidence Survey
Denmark: GDP s.a. (QoQ)	Chile: Economic Activity Indx YoY NSA	Germany: Current Account (EURO)	Germany: IFO - Business Climate	Norway: Norwegian Deposit Rates
Israel: Base Rate Announcement	Chile: GDP (YoY)	UK: PPI Output n.s.a. (MoM)	Germany: Unemployment Change (000's)	UK: Net Lending Sec. on Dwellings
Sweden: CPI - Headline Rate (MoM)	Mexico: GDP (YoY)	Hong Kong: CPI - Composite Index (YoY)	Germany: GfK Consumer Confidence Survey	UK: Halifax House Price 3Mths/Year
Sweden: CPI - Underlying Infl. (MoM)	Mexico: Bi-Weekly CPI	New Zealand: Unemployment Rate	Israel: Base Rate Announcement	Australia: Gross Domestic Product (QoQ)
Switzerland: CPI (MoM)	Mexico: Consumer Confidence	Chile: Nominal Overnight Rate Target	Netherlands: Consumer Confidence (sa)	Japan: Corp Service Price Index (YoY)
UK: PPI Output n.s.a. (MoM)	Russia: Consumer Prices (MoM)	Chile: Economic Activity Indx YoY NSA	Norway: Norwegian Deposit Rates	New Zealand: RBNZ Official Cash Rate
Australia: Unemployment Rate	China: Real GDP (YoY)	Chile: GDP (YoY)	UK: PPI Output n.s.a. (MoM)	New Zealand: Private Wages Inc Overtime QoQ
Australia: Participation Rate	Thailand: Gross Domestic Product (YoY)	Mexico: Consumer Confidence	UK: Halifax House Price 3Mths/Year	Chile: Economic Activity Indx YoY NSA
New Zealand: Unemployment Rate	ECB rate decision	Hungary: Retail Trade (IA) (YoY)	Australia: Company Operating Profit QoQ%	Chile: GDP (YoY)
Chile: GDP (YoY)		Russia: Consumer Prices (MoM)	Australia: Gross Domestic Product (QoQ)	Mexico: Consumer Confidence
Mexico: GDP (YoY)		Russia: Consumer Prices (YoY)	New Zealand: Unemployment Rate	Czech Republic: Industrial Output (YoY)
Mexico: Bi-Weekly CPI		Russia: Industrial Production (YoY)	New Zealand: RBNZ Official Cash Rate	Hungary: Retail Trade (IA) (YoY)
Mexico: Consumer Confidence		China: Real GDP (YoY)	New Zealand: Private Wages Inc Overtime QoQ	Russia: Consumer Prices (MoM)
South Africa: CPI (all items) (MoM)		Taiwan: CPI YoY%	New Zealand: Private Wages Exc Overtime QoQ	Russia: Consumer Prices (YoY)
China: Real GDP (YoY)		ECB rate decision	Chile: Economic Activity Indx YoY NSA	Russia: Consumer Price Index Core MoM
Taiwan: Export Orders (YoY)			Chile: GDP (YoY)	Russia: Russia Consumer Prices YtD
Thailand: Gross Domestic Product (YoY)			Mexico: Consumer Confidence	Philippines: Consumer Price Index (YoY)
Bank of England rate decision			Czech Republic: Industrial Output (YoY)	Philippines: Consumer Price Index NSA (MoM)
ECB rate decision			Hungary: Retail Trade (IA) (YoY)	Taiwan: CPI YoY%
			Russia: Consumer Prices (MoM)	
			Russia: Consumer Prices (YoY)	
			Russia: Russia Consumer Prices YtD	
			Taiwan: CPI YoY%	
			Taiwan: Current Account Balance (USD)	

Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 16: The evolution of macroeconomic drivers for the China equity market

2003	2004	2005	2006	2007
Canada: Industrial Product Price Index	Canada: Retail Sales	USA: Chicago Purchasing Manager's Index	Canada: Real Monthly GDP	USA: ISM: Mfg Composite Index
Canada: Retail Sales	USA: Construction Spending	Singapore: Non-oil Domestic Exports (YoY)	USA: Personal Consumption Expenditures	USA: Trade Balance: Goods & Services [BOP]
Canada: Building Permits	USA: Consumer Price Index	Chile: CPI (MoM)	USA: Construction Spending	USA: Real GDP: Preliminary
Canada: Securities Flows	USA: ISM: Mfg Composite Index	Indonesia: Inflation (YoY)	USA: Employees on Nonfarm Payrolls	Norway: Unemployment Rate
USA: Import Price Index	USA: Chicago Purchasing Manager's Index	Indonesia: Exports (YoY)	USA: Unemployment Rate	Switzerland: Producer & Import Prices (YoY)
USA: Chicago Purchasing Manager's Index	Singapore: Non-oil Domestic Exports (YoY)	Indonesia: Imports (Ex Trade Zones) (YoY)	USA: ISM: Mfg Composite Index	UK: Visible Trade Balance GBP/Mn
Germany: Producer Prices (MoM)	Mexico: Unemployment		USA: Trade Balance: Goods & Services [BOP]	UK: PPI Input s.a. (MoM)
Germany: Producer Prices (YoY)			USA: GDP Chain Price Index: Preliminary	UK: PPI Output n.s.a. (MoM)
Australia: Unemployment Rate			New Zealand: RBNZ Official Cash Rate	Australia: Private Capital Expenditure
Australia: Private Capital Expenditure			South Africa: M3 Money Supply (YoY)	Japan: Domestic CGPI (MoM)
			South Africa: CPI (all items) (YoY)	Japan: Tankan Lge Manufacturers Index
			South Africa: Private Sector Credit (YoY)	New Zealand: Imports
			South Africa: CPI (core rate) (YoY)	New Zealand: RBNZ Official Cash Rate
			South Africa: CPI (all items) (MoM)	Chile: CPI (MoM)
			South Africa: CPIX (Metro & Urban) (YoY)	Mexico: Consumer Prices (MoM)
			South Africa: CPIX (Metro & Urban) (MoM)	Czech Republic: Retail Sales (YoY)
			Indonesia: Inflation (YoY)	South Africa: M3 Money Supply (YoY)
			Indonesia: Exports (YoY)	South Africa: PPI (YoY)
			Indonesia: Imports (Ex Trade Zones) (YoY)	South Africa: Private Sector Credit (YoY)
				South Africa: PPI (MoM)
				South Africa: GDP (Annualized)
				Indonesia: Inflation (YoY)
				Indonesia: Imports (Ex Trade Zones) (YoY)

2008	2009	2010	2011	2012
USA: GDP Chain Price Index: Preliminary	France: Producer Prices (MoM)	Canada: Manufacturing Shipments	Canada: Manufacturing Shipments	Canada: Manufacturing Shipments
France: Producer Prices (MoM)	Germany: Unemployment Change (000's)	USA: Chicago Purchasing Manager's Index	Canada: Current Account Balance	USA: Chicago Purchasing Manager's Index
Germany: Unemployment Change (000's)	Norway: Unemployment Rate	Germany: IFO - Expectations	USA: New Home Sales	USA: ECI: Compensation Civilian Workers
Norway: Unemployment Rate	Sweden: Swedbank PMI Survey	Germany: Unemployment Change (000's)	USA: Wholesale Sales	Germany: Unemployment Change (000's)
Norway: Retail Sales - vol sa (YoY)	UK: Net Consumer Credit	Norway: Unemployment Rate	USA: Chicago Purchasing Manager's Index	Germany: GfK Consumer Confidence Survey
Sweden: Industrial Prod. n.s.a. (YoY)	Hong Kong: Retail Sales - Value (YoY)	Sweden: Consumer Confidence	USA: Empire State Mfg Index	Italy: Unemployment Rate (s.a)
Hong Kong: Unemployment Rate SA	Japan: Current Account Total	Sweden: Swedbank PMI Survey	Germany: Unemployment Change (000's)	Italy: PMI Manufacturing
Japan: Current Account Total	New Zealand: Current Account Balance	UK: Net Consumer Credit	Norway: Unemployment Rate	Sweden: Consumer Confidence
Japan: Tankan Lge Manufacturers Index	New Zealand: Imports	UK: Visible Trade Balance GBP/Mn	Sweden: Consumer Confidence	Sweden: Swedbank PMI Survey
New Zealand: Retail Sales (MoM)	Colombia: Consumer Price Index (MoM)	Hong Kong: Retail Sales - Value (YoY)	Sweden: Swedbank PMI Survey	Australia: Wage Cost Index QoQ
South Africa: M3 Money Supply (YoY)	Poland: Avg Gross Wages (MoM)	Japan: Current Account Total	Switzerland: GDP (QoQ)	Hong Kong: CPI - Composite Index (YoY)
South Africa: Private Sector Credit (YoY)	Poland: Avg Gross Wages (YoY)	New Zealand: Current Account Balance	UK: Net Consumer Credit	Hong Kong: Retail Sales - Value (YoY)
Federal reserve rate decision	Russia: Exports (USD)	Singapore: Advance GDP Estimate (YoY)	UK: Visible Trade Balance GBP/Mn	Japan: Corp Service Price Index (YoY)
	Russia: Imports (USD)	Brazil: Current Account - Monthly	UK: Imports	New Zealand: Current Account Balance
	Korea: Consumer Price Index (MoM)	Colombia: Consumer Price Index (MoM)	Hong Kong: CPI - Composite Index (YoY)	Brazil: Foreign Investment
	Korea: Consumer Price Index (YoY)	Colombia: Consumer Price Index (YoY)	Hong Kong: Retail Sales - Value (YoY)	Peru: Economic Activity Indx YoY NSA
	Federal reserve rate decision	Peru: Economic Activity Indx YoY NSA	New Zealand: Current Account Balance	Peru: Consumer Price Index (MoM)
		Peru: Consumer Price Index (MoM)	Singapore: Non-oil Domestic Exports (YoY)	Poland: Avg Gross Wages (MoM)
		Peru: Unemployment	Singapore: Non-oil Domestic Exp SA (MoM)	Poland: Employment (MoM)
		Poland: Avg Gross Wages (MoM)	Brazil: Foreign Investment	Korea: Consumer Price Index (MoM)
		Poland: Avg Gross Wages (YoY)	Colombia: Consumer Price Index (MoM)	Federal reserve rate decision
		Russia: Exports (USD)	Peru: Economic Activity Indx YoY NSA	
		Russia: Imports (USD)	Peru: Consumer Price Index (MoM)	
		India: Industrial Production YoY	Poland: Avg Gross Wages (MoM)	
		Federal reserve rate decision	Russia: Imports (USD)	
			India: Industrial Production YoY	
			Philippines: GDP (YoY)	
			Federal reserve rate decision	

Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 17: The evolution of macroeconomic drivers for the Japan bond market

2002	2003	2004	2005	2006	2007
Germany: GDP s.a. (QOQ)	UK: BOE ANNOUNCES RATES	Australia: Current Account Balance	UK: M0 Money Supply (MoM)	Germany: Industrial Production MoM (sa)	Canada: Manufacturing Shipments
Germany: CPI PG (FSO) (MoM)	Australia: Retail Sales Trend (MoM)	South Africa: GDP (Annualized)	UK: M0 Money Supply (YoY)	Australia: Current Account Balance	Canada: Wholesale Trade
UK: BOE ANNOUNCES RATES	Japan: Tankan Lge Manufacturers Index		UK: RPI (MoM)	Japan: Jobless Rate	Sweden: Riksbank Interest Rate
Mexico: Unemployment			UK: RPI (YoY)	Japan: Tokyo SA CPI MoM	UK: Retail Sales Ex Auto Fuel(MoM)
			UK: RPI Ex Mort Int.Payments (YoY)	Japan: Natl SA CPI MoM	Japan: Tertiary Industry Index (MoM)
			Australia: Current Account Balance	Japan: Natl CPI Ex-Fresh Food YoY	Japan: Merchnds Trade Balance Total
			Japan: Jobless Rate	Japan: Tertiary Industry Index (MoM)	Japan: Adjusted Merchnds Trade Bal.
			Japan: Workers' Hhold Spending (YoY)	Japan: Merchnds Trade Balance Total	Brazil: Primary Budget Balance
			Chile: CPI (MoM)	Japan: Adjusted Merchnds Trade Bal.	Peru: Economic Activity Indx YoY NSA
				South Africa: PPI (YoY)	Czech Republic: Industrial Output (YoY)
				South Africa: PPI (MoM)	Malaysia: GDP YoY%
				Taiwan: Export Orders (YoY)	

2008	2009	2010	2011	2012
Canada: Wholesale Trade	Canada: Wholesale Trade	USA: Univ of Michigan Consumer Sentiment:	Canada: Value of Building Permits	USA: Univ of Michigan Consumer Sentiment: Final
USA: Empire State Mfg Index	USA: New Orders	Italy: GDP sa and wda (QoQ)	USA: Univ of Michigan Consumer Sentiment: Final	Spain: Unemployment Rate (Survey)
Italy: GDP sa and wda (YoY)	USA: Univ of Michigan Consumer Sentimer	Italy: GDP sa and wda (YoY)	USA: Nonfarm Output Per Hour: Preliminary	New Zealand: Retail Sales Ex Inflation(QoQ)
Sweden: Riksbank Interest Rate	USA: Empire State Mfg Index	Italy: Exports	Germany: GfK Consumer Confidence Survey	Russia: Investment In Productive Capac
Australia: Company Operating Profit QoQ9	USA: Real GDP: Preliminary	Italy: Total investments	Italy: GDP sa and wda (QoQ)	Russia: Unemployment Rate (%)
Singapore: Retail Sales (YoY)	Denmark: Retail Sales (MoM)	Sweden: Manufacturing Confidence s.a.	Netherlands: Producer Confidence	
Peru: Economic Activity Indx YoY NSA	Italy: GDP sa and wda (QoQ)	UK: PPI Output n.s.a. (MoM)	Sweden: Manufacturing Confidence s.a.	
	Italy: GDP sa and wda (YoY)	UK: PPI Input NSA (YoY)	UK: Visible Trade Balance GBP/Mn	
	Italy: Exports	Mexico: Consumer Prices (MoM)	Russia: Investment In Productive Capac	
	Norway: Norwegian Deposit Rates	Russia: Investment In Productive Capac	Russia: Unemployment Rate (%)	
	Sweden: Consumer Confidence	Russia: Real Wages (YoY)	South Africa: Manufacturing Prod. nsa. (YoY)	
	UK: PPI Output n.s.a. (MoM)	Russia: Retail Sales (Real) (YoY)	Taiwan: Current Account Balance (USD)	
	Russia: Consumer Prices (MoM)	Russia: Unemployment Rate (%)		

Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Which countries drive the global capital market

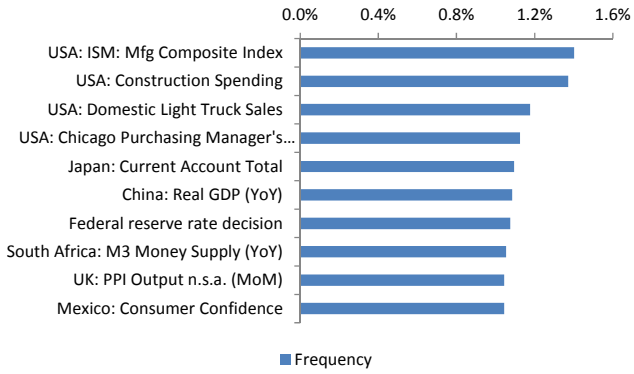
Equity

In the 11 years from 2002 to 2012, for all 45 equity markets, in total 533 economic indicators were used at least once. US ISM manufacturing index and US construction spending are the top two variables, each being used about 1.4% of all times (see Figure 18). The top two international economic series are (probably not a big surprise) Japan's current account balance and China's GDP growth, ranked #5 and #6 (each being used about 1.1% of all time), respectively. Central bank interest rate decisions, especially the Federal Reserve (ranked #7), are also important.

As shown in Figure 19, if we count all economic variables by their originating countries, as expected, US plays a dominating role for global equity markets, accounting for almost 17% of all economic indicators. Interestingly, South Africa follows as #2, as a good proxy for Emerging Markets and a barometer for commodities. UK, Russia, Australia, Germany, Japan, Canada, New Zealand, and France round up the top 10. Although a few of China's economic series, e.g., GDP growth, are top ranked, China is only ranked #22 overall. The top 10 countries highlight a balance of four main themes:

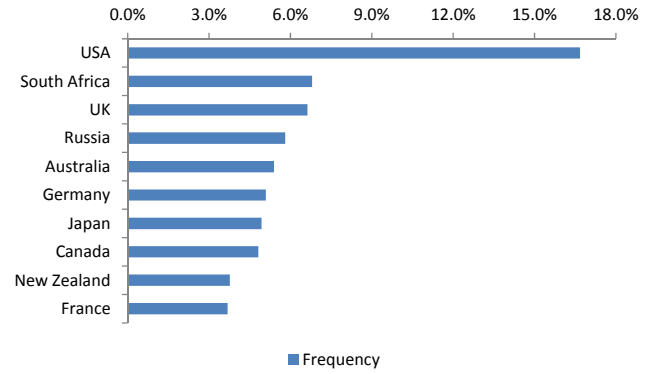
- US/Canada as a proxy for the overall global economic sentiment
- EM and commodities producing countries: South Africa, Russia, Australia
- UK, Germany and France as a proxy for Europe
- Japan as an idiosyncratic and large economy

Figure 18: Top 10 economic data series



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 19: Top 10 contributing countries



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

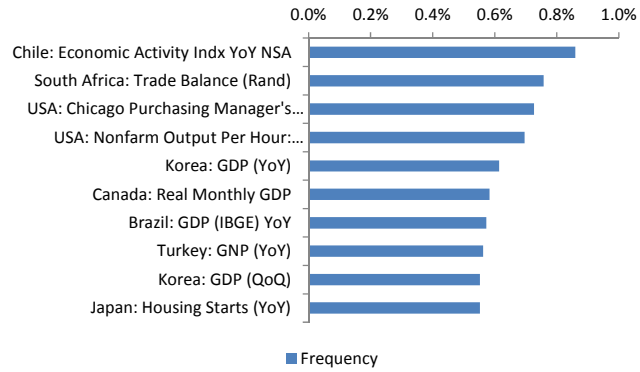
Fixed income

For the sovereign bond market, there were in total 403 economic indicators used, for the 11 years from 2002 to 2012, for all 25 countries. The top five global economic variables are: Chilean economic activity index, South Africa's trade balance, US Chicago purchasing managers index, US non-farm payroll, and Korean GDP growth (see Figure 20). Interestingly, GDP growth is actually vital in determining bond risk premia, as the GDP growth in Korea, Canada, Brazil, and Turkey are all in the top 10 list.

If we count all economic variables by their originating countries, as expected, US economic news dominates the list, accounted for almost 14% of all economic data series, followed by Canada, France, and Germany (see Figure 21). Different from the equity study above, Chile and Italy make the top 10 country list for government bond markets, while UK and Russia drop out. The top 10 countries highlight a balance of four main themes:

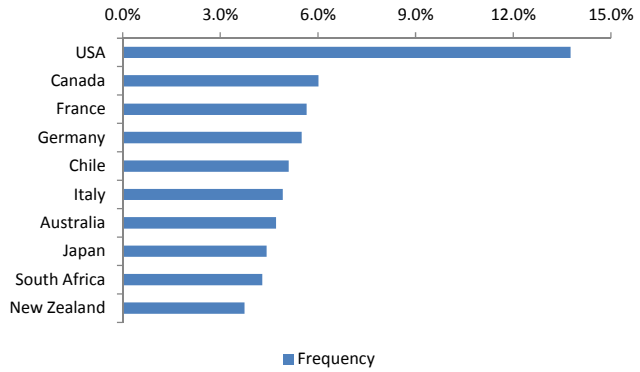
- US/Canada as a proxy for the overall global economic barometer
- France, Germany and Italy as a proxy for Europe
- Chile, South Africa, and Australia as a proxy for EM credit and commodities related countries (both commodities producing countries and consumers)
- Japan as an idiosyncratic and large economy

Figure 20: Top 10 economic data series



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 21: Top 10 contributing countries



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Why do economic indicators carry positive or negative risk premia on the announcement days?

As we argued in the above sections, those "positive premium economic indicators" or PPEI's (meaning they tend to lead to positive equity risk premia on their reporting days) are more likely to be "headline" news, i.e., economic news are widely watched by market participants, and vice versa, "negative premium economic indicators" or NPEI's are more likely to be less followed by investors. To test this hypothesis, we break down global economic variables into two categories:

- Domestic and US: these are economic variables announced by either domestic agencies or US entities; therefore, they are more likely to be widely watched by domestic investors.
- Foreign: these are economic indicators from other countries (except US); therefore, market participants are likely to pay less attention to these.

Equity

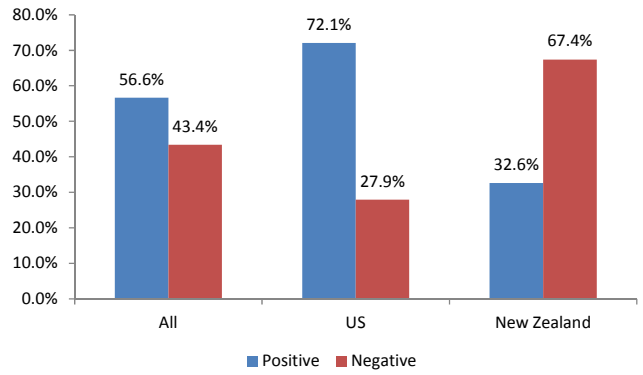
Among the 9,772 global economic announcement items[16] that have ever been used in the past 11 years by any of the 45 countries in MSCI ACWI, 5,532 (or 57%) are classified as PPEI, meaning they are more likely to lead to positive equity risk premia on their announcement days.

[16] Please that an economic indicator can be used multiple times by multiple countries, which is why the total number of economic announcement items (9,772 is larger than the total number of economic indicators (553) ever being used.

As we shown earlier in Figure 22, economic indicators from US and New Zealand are both on top of the all country list (see Figure 19). However, US economic releases are more likely to catch investors' attention than reports from New Zealand. Interestingly, as shown in Figure 22, most US economic series (72%) are classified as PPEI while only 33% from New Zealand are classified as "positive" (the average if 57%).

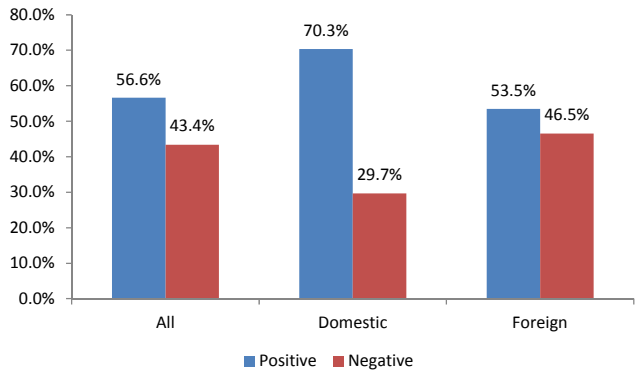
Similarly, 70% of domestic and US economic indicators generate positive equity risk premia on their release days (PPEI), while only 54% (this is lower than the average of 57%) of foreign economic data items are classified as PPEI (see Figure 23). As domestic and US economic indicators tend to attract investors' attention, market participants are more likely to over-react and over-pay for insurance, which leads to positive returns on the announcement days.

Figure 22: % of positive versus negative news



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

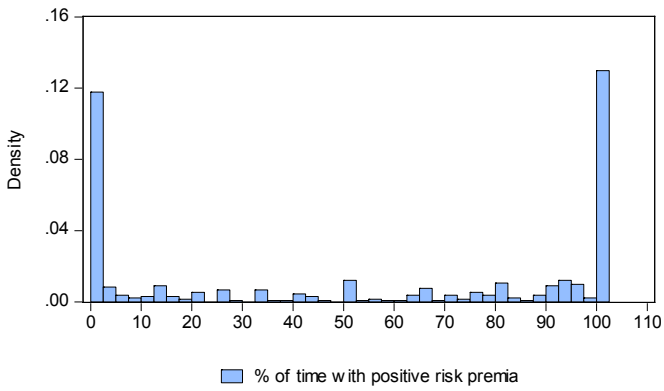
Figure 23: % of positive versus negative news



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

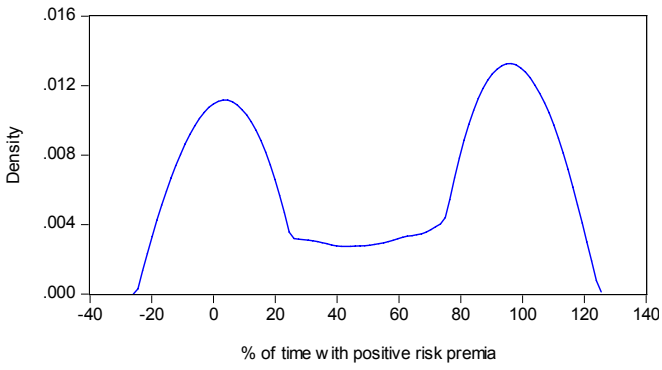
The other interesting observation is that the majority (almost 60%) of these economic indicators consistently generate 100% either positive or negative risk premia for all countries over the entire 11 years of backtesting. Figure 24 and Figure 25 show the distribution of all these 553 economic variables, by the percentage of time with positive risk premia. The distribution is clearly bimodal, peaking around 0% (all negative) or 100% (all positive).

Figure 24: Histogram



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 25: Kernel density



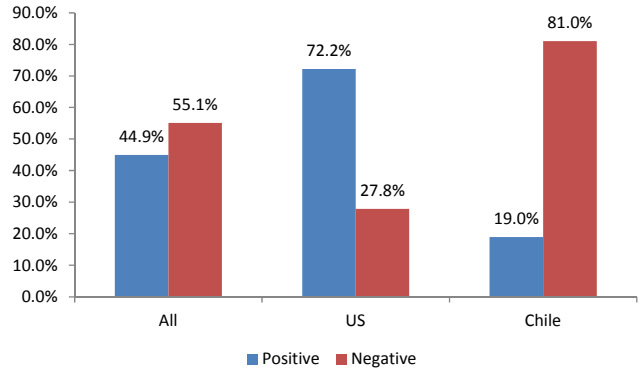
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Fixed income

For the government bond markets, there are 3,823 global economic variables that have been used in the past 11 years, by the 25 countries. Roughly 45% of these economic variables generate positive bond risk premia on the announcement days (i.e., PPEI). We know that US and Chile are both ranked on the top of originating country list (see Figure 21), but US economic news are likely to generate more interest from investors than Chilean economic releases. Interestingly, as shown in Figure 26, 72% US economic releases are classified as PPEI, while only 19% Chile economic series are PPEI.

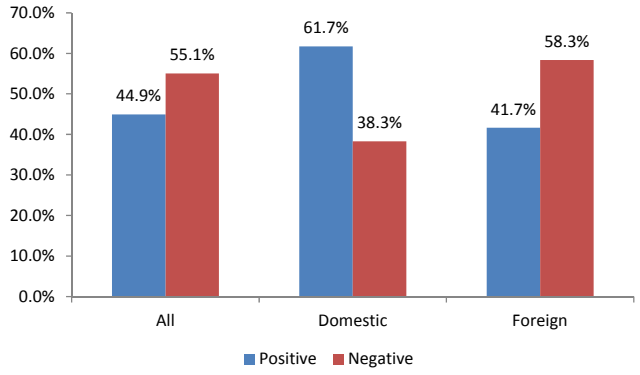
If we break down economic data items into domestic (including US) and foreign, as shown in Figure 27, 62% domestic/US economic indicators generate positive risk premia on the reporting days, while only 42% foreign economic data items are PPEI.

Figure 26: % of positive versus negative news



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

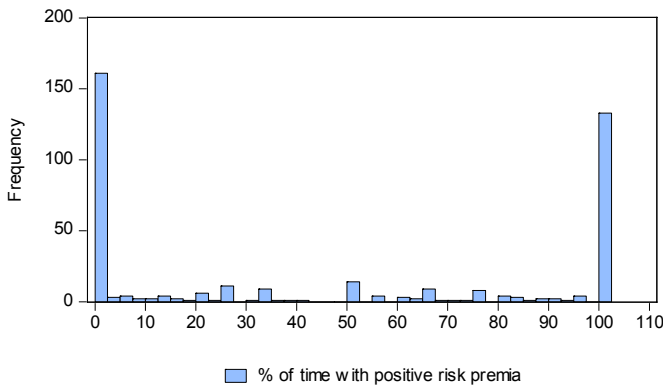
Figure 27: % of positive versus negative news



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

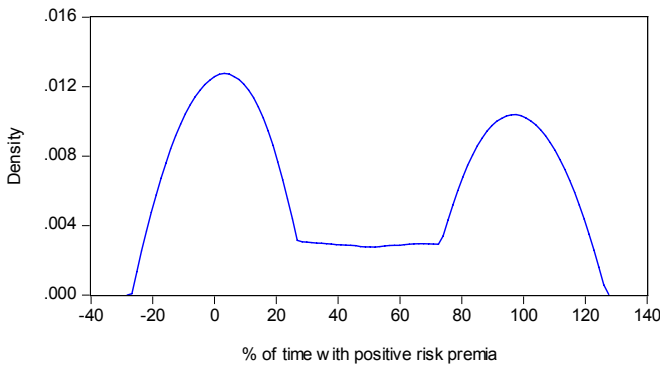
Similar to the equities, in the fixed income space, the majority (more than 72%) of these economic indicators consistently generate 100% either positive or negative risk premia for all countries over the entire 11 years of backtesting. Figure 28 and Figure 29 show the distribution of all these 403 economic variables, by the percentage of time with positive risk premia. The distribution is clearly bimodal, peaking around 0% (all negative) or 100% (all positive).

Figure 28: Histogram



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 29: Kernel density



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Conclusion

Both global equity and bond markets seem to confirm our hypothesis about PPEI and NPEI – it is more about investors' over- and under-reaction to macroeconomic news and uncertainties. More importantly, most economic indicators product either positive (or negative) risk premia on the announcement days consistently.

Empirical trading strategies – introducing MEAM

Similar to the behavioral argument about value and momentum investing, for instance, we argue the same over-/under-reaction patterns in global capital markets (equity and sovereign bond) to macroeconomic announcements will persist, at least in the near term. We can then design investment strategies to explore these patterns.

Starting from December 31, 2002, we will use the list of economic indicators, for each country and each asset class (equity or sovereign bond), determined by each of the previous three MISA approaches, for the following year. These economic indicators are then classified as either PPEI or NPEI, depending on whether they have produced positive or negative risk premia on their announcement days in the previous five years. Our decision variables (i.e., economic indicators) are then re-adjusted at the end of each year.

For each country's equity (and then bond) market, we use the list of statistically significant economic indicators to classify each trading days in the following year as:

1. No news days: days with no essential economic releases, or
2. Positive news days: days when PPEI's are announced, or
3. Negative news days: days when NPEI's are announced.

The critical condition to note is that economic data items are announced on regular schedules; therefore, we know the announcement days ahead of time, which allows us taking trading positions at least one day before the announcement days.

Equity

For each of the 45 equity markets in the MSCI ACWI, we test four trading strategies:

1. Base cash + long equity: Investing in cash as the baseline, switch to domestic equity index on positive news days. This strategy tries to capture the positive risk premia.
2. Base equity + cash: Investing in domestic equity as the baseline, switch to cash (or completely hedge the equity exposure) on negative news days. This is mostly to avoid negative risk premia. As we will show later, this strategy proves to have the best performance, be the easiest to implement, and be the most intuitive. For simplicity, we call this strategy MEAM (MacroEconomic Announcement Model) and it will be our main investment strategy for the rest of this research.
3. Base cash + long/short equity: Investing in cash as the baseline, switch to domestic equity on positive news days and shorting domestic equity on negative news days. This is to take advantage of positive risk premia and capture negative risk premia.

4. Base equity + leveraged equity/cash: Investing in domestic equity as the baseline, leveraging domestic equity 2x on positive news days and switching to cash (or completely hedging the equity exposure) on negative news days. This is to take advantage of both positive and negative risk premia.

For the global equity market, we generally find the REG-MISA model, i.e., using regression with control variables to select macroeconomic data items to have the best performance; therefore, for the rest of our research, we use this as our main approach[17].

Let's use the US and Hong Kong equity markets as two examples to show how these strategies have performed in the past 10 years. For US and Hong Kong equity markets, it is interesting to note that simply avoiding all those days when those economic series with negative predicted risk premia are announced (i.e., MEAM strategy above) improves Sharpe ratios by 43.3% and 43.9%, respectively (see Figure 30 and Figure 31). Taking further advantage of positive risk premia days (i.e., strategy #4 above) adds marginal benefits of 16.4% and 20.3%, respectively. This seems to suggest that we can capture most of the benefit by avoiding macroeconomic uncertainties. This is an even more attractive strategy than what implied by Dicke and Hess [2012], where they found positive risk premia can be earned on the days when important economic reports are released, i.e., taking on macroeconomic risk to earn positive risk premia.

We would argue that our findings are more consistent with the low risk anomaly being proposed in the academic and practitioner's literature in recent years[18]. Interestingly, in one of our previous research papers (see Cahan, et al [2011] "Quant 2.0"), we also find that, at the single stock level, avoiding material upcoming company specific news days can improve risk-adjusted returns[19]. In addition, low risk theme seems to not only apply in finance, but also in sports. Robinson [2012] found evidence of low volatility outperformance in NFL football games.

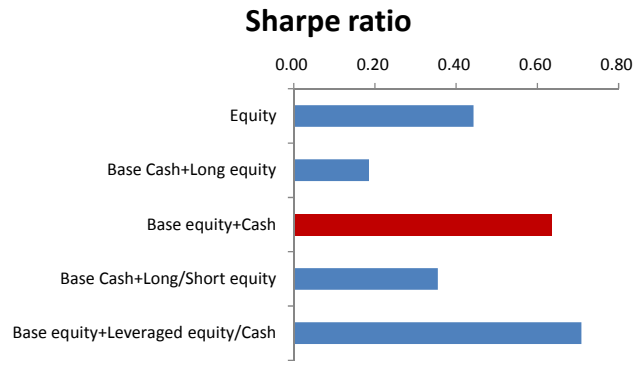
Only trading on the negative news days also reduces our strategy turnover considerably. As shown in Figure 32 and Figure 33, if we maintain our equity position most of the time, while hedging our equity exposure on negative news days, we only need to trade around 42 trading days in the US (17% of the time) and 37 trading days in Hong Kong (15% of the time).

[17] The other two approaches (TTEST and MULTIREG) produce qualitatively similar and comparable results. Details are available upon request.

[18] The so-called "low risk anomaly" generally refers to either equities or asset allocation. In equities, stocks with lower risk (defined as beta or volatility) tend to produce higher returns than more risky stocks. In asset allocation, less risky assets (e.g., bonds) are more likely to deliver higher *risk-adjusted* returns than assets with higher risks (e.g., equities). Our research, however, is probably either the first or among the first ones of low-risk investing on macroeconomic uncertainties.

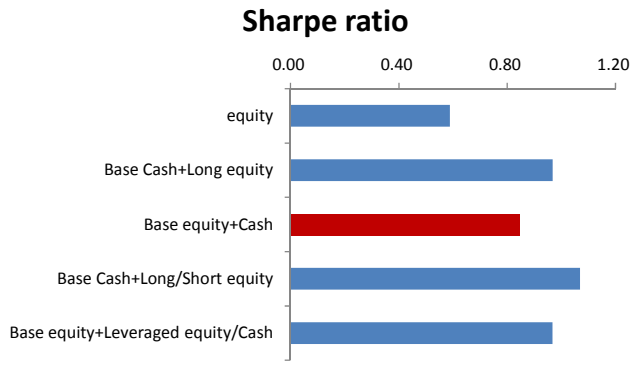
[19] In Cahan, et al [2011], we use a database of web data to identify future events related to each company.

Figure 30: US equity – Sharpe ratio



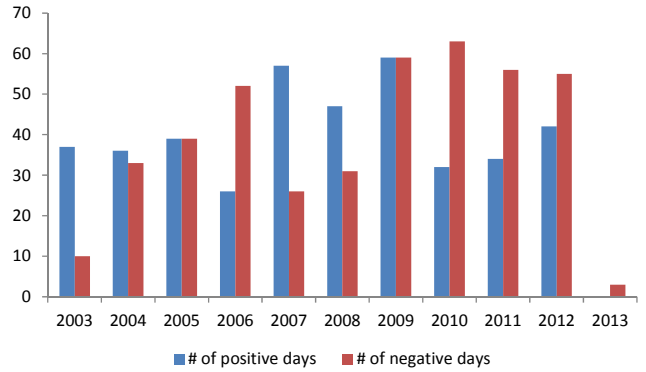
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 31: Hong Kong equity – Sharpe ratio



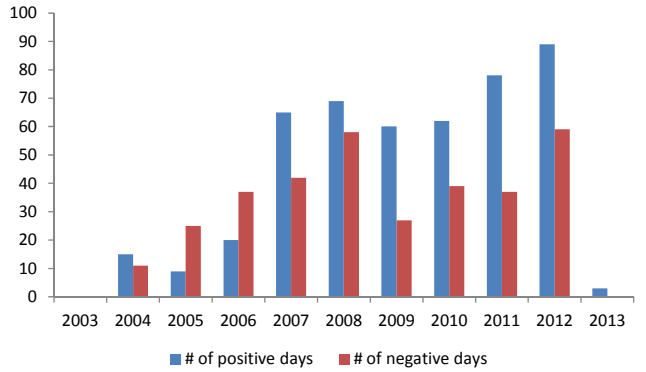
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 32: US equity – # of positive and negative days



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

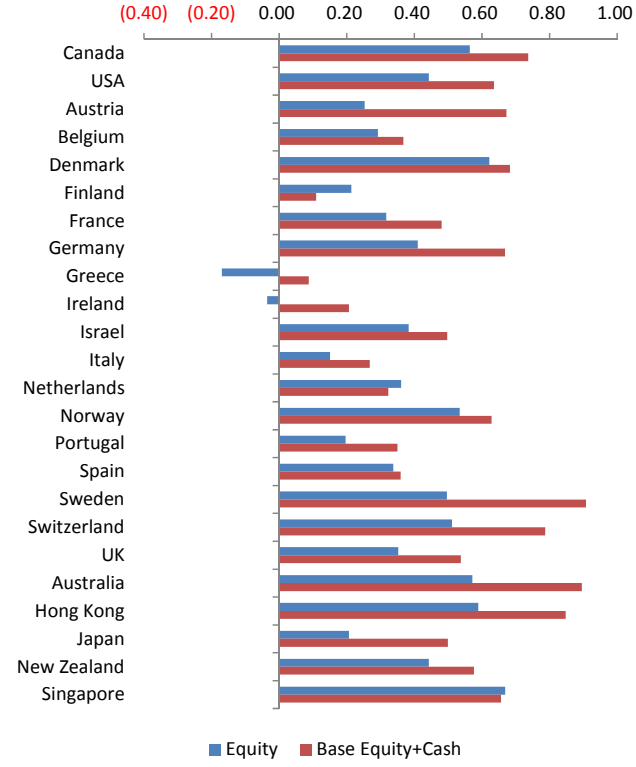
Figure 33: HK equity – # of positive and negative days



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

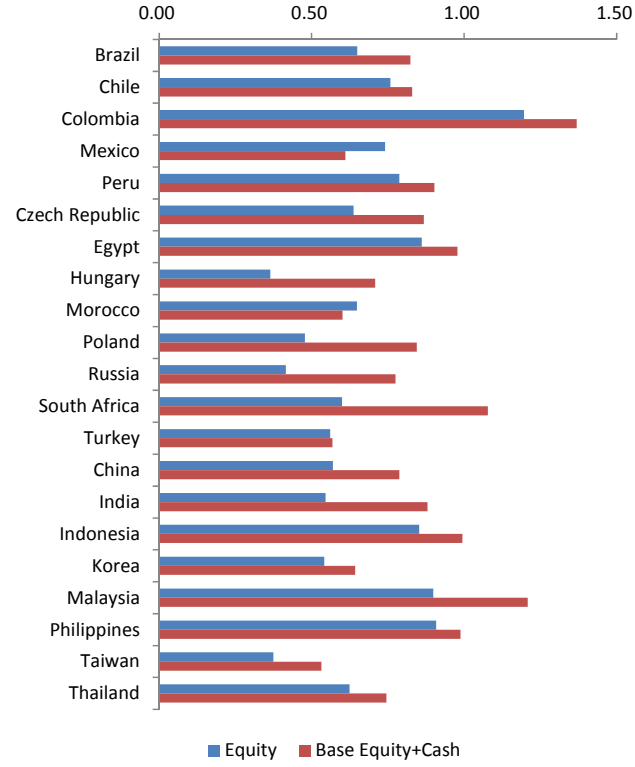
This is not unique to US and Hong Kong equity markets. In fact, using the "base equity + cash" investment strategy or MEAM (MacroEconomic Announcement Model), we find for 40 out of the 45 countries in the MSCI ACWI, avoiding those negative macroeconomic news days can significantly lift the baseline equity performance (see Figure 34 and Figure 35). The average Sharpe ratio for these 45 equity indices can be boosted by 34%, for 89% of the countries.

Figure 34: Improvement in Sharpe ratio for developed countries, by avoiding days when economic series with negative expected risk premia are announced



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 35: Improvement in Sharpe ratio for emerging markets, by avoiding days when economic series with negative expected risk premia are announced



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Fixed income

For each of the 25 sovereign bond markets in the MSCI ACWI, we test four trading strategies:

1. Base cash + long bond: Investing in cash as the baseline, switch to sovereign bond on positive news days. This strategy is mostly to capture the positive risk premia.

2. Base bond + cash: Investing in sovereign bonds as the baseline, switch to cash (or completely hedge the bond exposure) on negative news days. This is mostly to avoid negative risk premia. As we will show later, this strategy has the best performance and seems to be the easiest to implement and the most intuitive. For simplicity, we call this strategy MEAM (MacroEconomic Announcement Model) and use it as main strategy for government bonds.

3. Base cash + long/short bond: Investing in cash as the baseline, switch to sovereign bonds on positive news days and short sovereign bond on negative news days. This is to take advantage of both positive and negative risk premia. Shorting on many of these government bonds can be difficult and expensive.

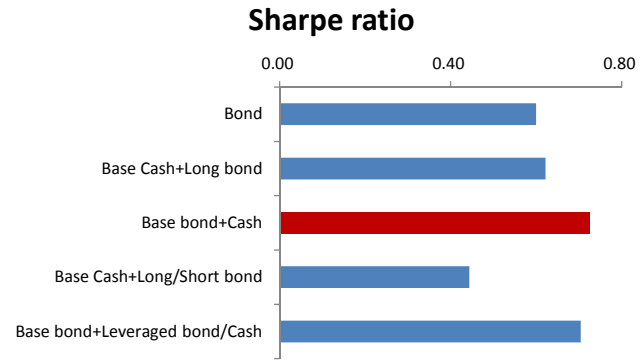
4. Base bond + leveraged bond/cash: Investing in sovereigns as the baseline, switch to 2x leveraged sovereign bonds on positive news days and cash (or completely hedge out of the bond exposure) on negative news days. This is to take advantage of both positive and negative risk premia. However, it does require leverage.

For the sovereign bond market, we generally find the TTEST-MISA model, i.e., using t-test of equal means on announcement versus non-announcement days to select macroeconomic indicators to have the best performance; therefore, for the rest of our research, we use this as our main approach[20].

Let's use the Italian and Australian sovereign bond markets as two examples to show how these strategies have performed in the past 10 years. For Italian and Australian sovereign bond markets, it is interesting to note that simply avoiding all those days when those economic series with negative predicted risk premia (NPEI) are announced (i.e., MEAM strategy above) improves Sharpe ratios by 21.0% and 11.5%, respectively (see Figure 36 and Figure 37). Taking further advantage of positive risk premia days (i.e., strategy #4 above) adds only marginal benefit to Italian bonds, but actually hurt performance for Australian bonds. Consistent with what we find for the global equity market, this seems to suggest that we can capture most of the bond market returns by avoiding macroeconomic uncertainties.

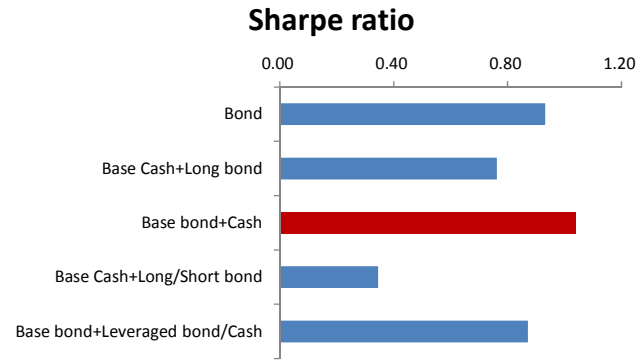
Only trading on the negative news days also slows down our strategy turnover. As shown in Figure 38 and Figure 39, if we maintain our bond position most of the time, while hedge our bond exposure on negative news days, we only need to trade around 23 trading days in Italy (9% of the time) and 32 trading days in Australia (13% of the time).

Figure 36: Italy bond – Sharpe ratio



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

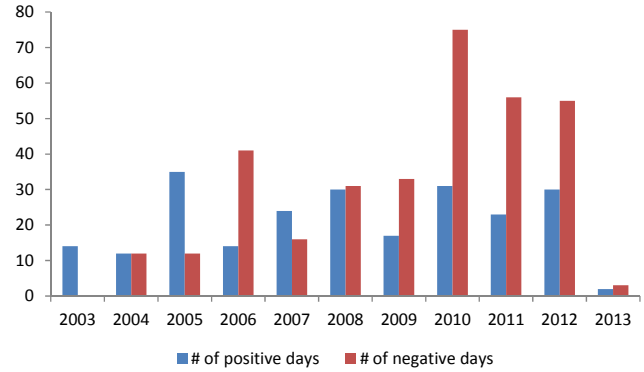
Figure 37: Australia bond – Sharpe ratio



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

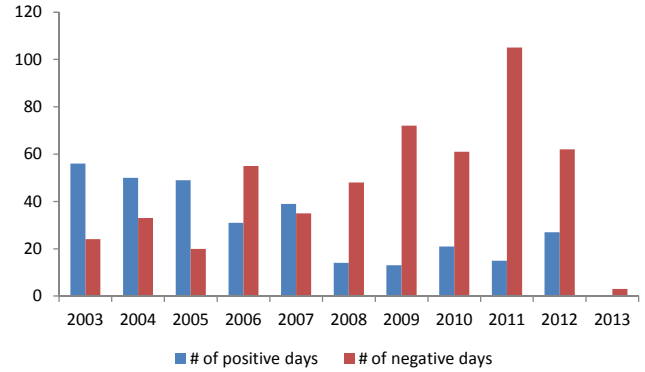
[20] The other two approaches (REG and MULTIREG) produce qualitatively similar and comparable results. Details are available upon request.

Figure 38: Italy bond – # of positive and negative days



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

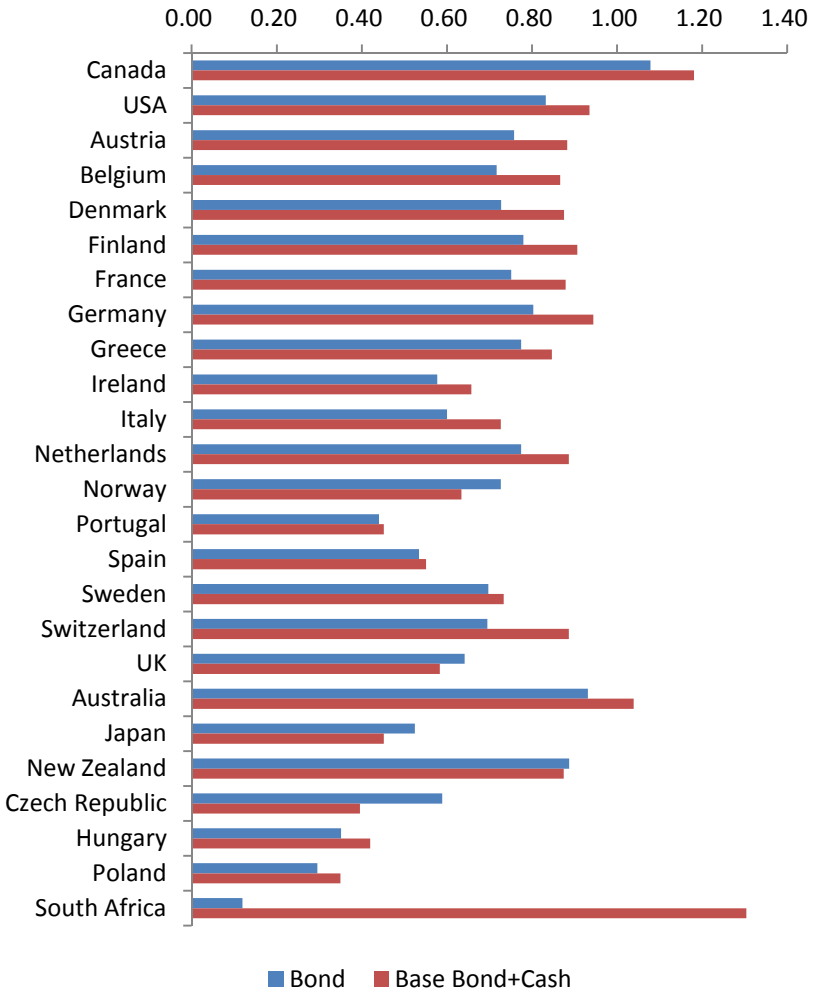
Figure 39: Australia bond – # of positive and negative days



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

The same "base bond + cash" investment strategy or MEAM (MacroEconomic Announcement Model) can also be implemented for other sovereign bond markets. We find for 20 out of the 25 countries in the MSCI ACWI, hedging those negative macroeconomic announcement days can boost the baseline bond performance (see Figure 40). The average Sharpe ratio for the 25 government bond indices can be lifted by 16%, for 76% of the countries.

Figure 40: Improvement in Sharpe ratio for sovereign bond market, by avoiding days when economic series with negative expected risk premia are announced



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

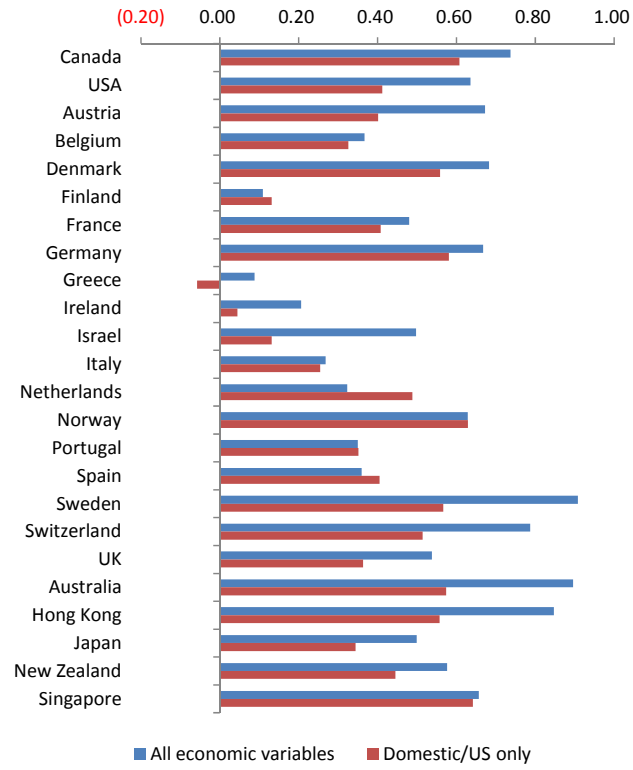
The global capital markets are increasingly integrated

As we have shown in the previous sections, for both equity and bond markets in most countries, it is not only the domestic economic indicators determining domestic equity (and bond) risk premia, but in most occasions, economic variables from other countries can be just as important or even more important.

Equity

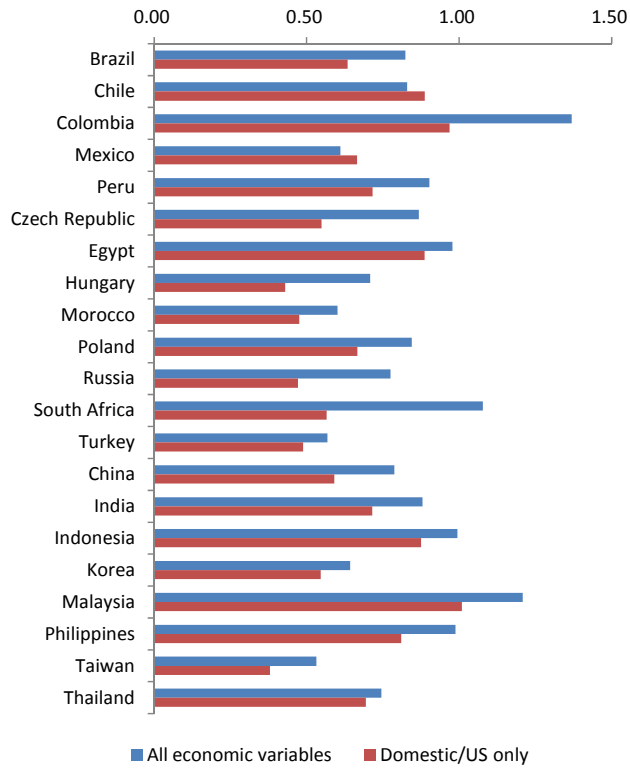
To illustrate the impact of foreign economic reports, we re-run the same MEAM strategy, with only domestic and US economic indicators. As shown in Figure 41 and Figure 42, the average Sharpe ratio for the 45 equity markets is reduced from 0.68x to 0.53x (a -22% decline).

Figure 41: Sharpe ratio for developed countries



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 42: Sharpe ratio for EM

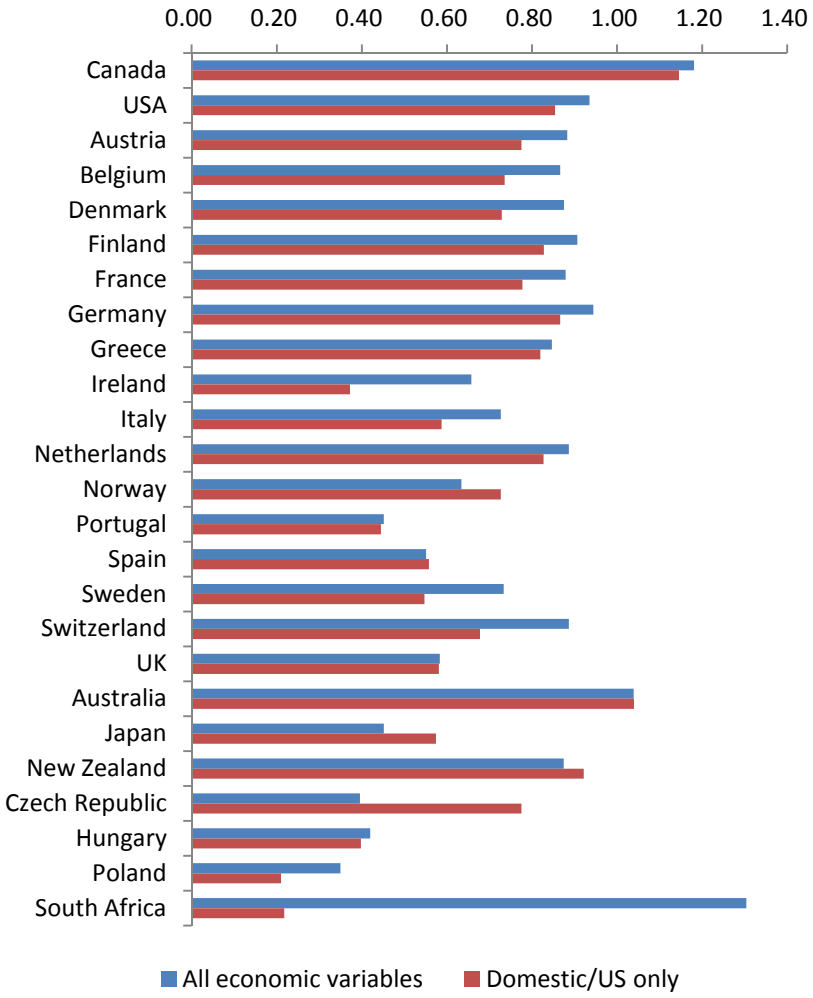


Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Fixed income

If we run the same MEAM strategy for the 25 sovereign bond markets with only domestic and US economic indicators, we find the average Sharpe ratio drops by -12% (see Figure 43). Sharpe ratios are lower for 19 out of the 25 countries (or 76%).

Figure 43: Sharpe ratio for sovereign bonds



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

GTAA

The interesting findings in the previous sections have significant implications for global tactical asset allocation strategies. In this section, we explore a specific example using our country rotation model.

As shown in Luo et al [2012] "New Insights in Country Rotation", our CCRM (Composite Country Rotation Model) has strong ability to predict future country returns and therefore can be applied in country rotation strategies. The CCRM model uses six factors:

- VRP (variance risk premium) – the difference between market implied risk and realized risk
- Kelly's tail risk factor – a measure of a country's tail risk using cross-sectional returns
- MCRM (Macromomentum Country Rotation)[21] – using international trade flow and fund flow data to predict a country's performance
- Country valuation
- Country price momentum
- Country earnings momentum

A long only mean-variance optimized country portfolio based on the CCRM model that invests in the 45 countries comprised the MSCI ACWI has generated an IR (information ratio) of 1.12x and Sharpe ratio of 0.78x, compared to a Sharpe ratio of 0.42x for the benchmark (an increase of 86% in Sharpe ratio), from January 31, 2004 to December 2012.

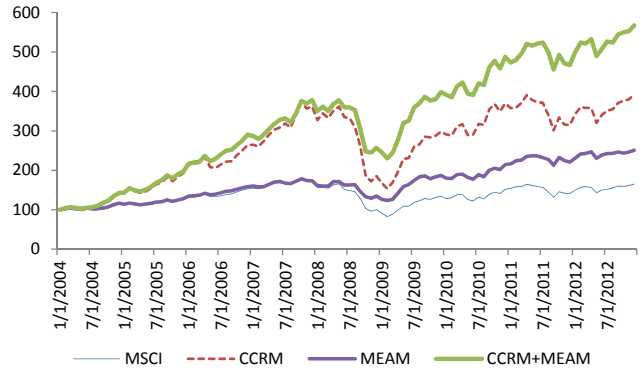
Similarly, a long-only MEAM country portfolio, weighted by each country's weight in the MSCI index, delivers a Sharpe ratio of 0.85x, more than doubled the Sharpe ratio of the benchmark index. Portfolio drawdown is also substantially lower than the index (-11% versus -29%).

In this section, we demonstrate the benefit of combining the MEAM model with the CCRM model. Because the underlying drivers of the two models are completely different, the performance correlation between the models is low, which provides diversification benefit. We first use the same optimization process above to generate each country's weight in the portfolio each month[22]. Then, instead of investing the capitalization weighted benchmark index of each country, we invest in the MEAM equity portfolio for each country. As shown in Figure 44 and Figure 45, the combined CCRM+MEAM model boosts the Sharpe ratio by 180% compared to the MSCI and 51% compared to the CCRM, to 1.18x[23].

[21] See Mesomeris, et al. [2010]. "Macromomentum Country Rotation", Deutsche Bank Quantitative Strategy, August 15, 2010, for detailed description of the model.
[22] This is mostly driven by the predicted returns for each country, based on the CCRM model.
[23] IR for the CCRM+MEAM strategy also increases to 1.84x.

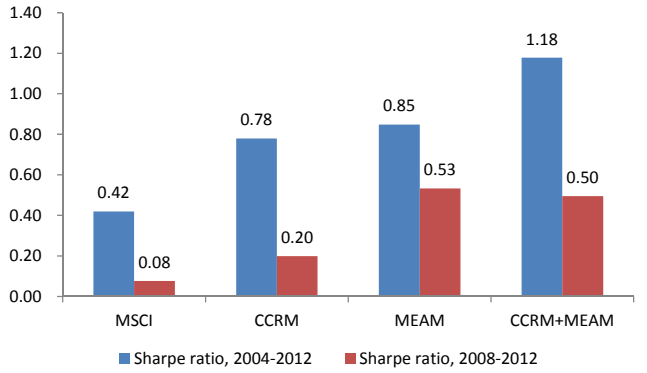
By combining the CCRM (country rotation) with MEAM (event-driven strategy), we see significant improvement in both average performance and the overall shape of the return distribution (see Figure 46). The CCRM model outperforms the MSCI about 66%, while CCRM+MEAM lifts the hit rate to 70%. At the same time, the combined CCRM+MEAM portfolio also reduces the drawdown significantly.

Figure 44: Wealth curve



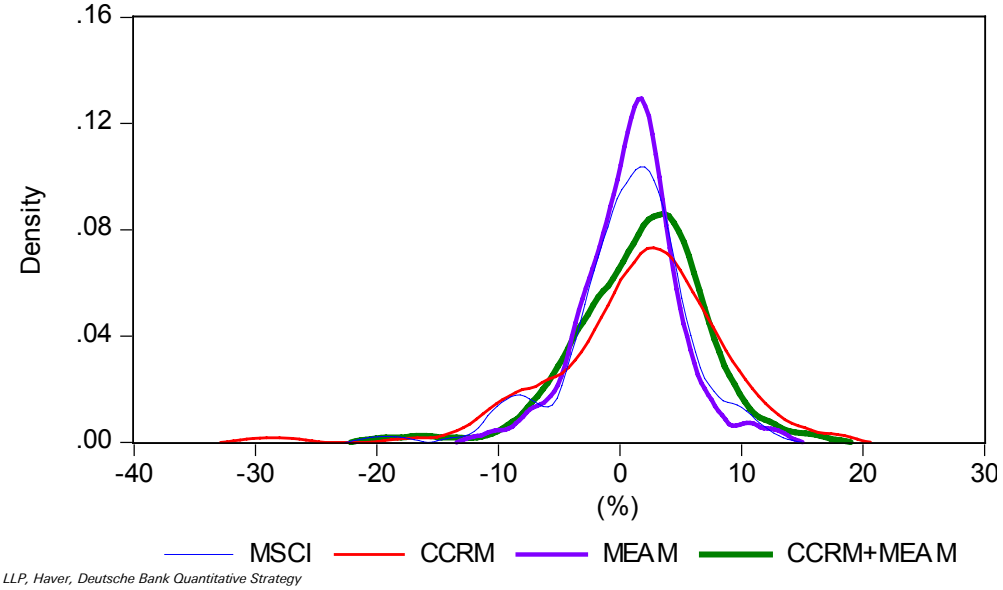
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 45: Sharpe ratio



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 46: Return distribution



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

SAA

Avoiding macroeconomic uncertainties has even more significant implications for strategic asset allocation (SAA) decisions. In this section, we will explore a few examples. Please note that the line between TAA and SAA is becoming increasingly blurred. In the SAA examples in this section, we try to avoid forecasting each asset's long-term return, which is generally believed to be extremely difficult and has too much estimation error. Rather, we focus on risk-based allocations[24].

The benefit of risk-based portfolio construction is that it only requires investors to estimate risk, i.e., the covariance matrix, while no return forecasting is necessary. It is generally accepted that risk estimation has less error than return prediction; therefore, risk-based allocations are more robust. Interestingly, risk-based portfolios often produce comparable or even superior performance than alpha-driven strategies (e.g., Luo, et al [2012] "New Insights in Country Rotation"). In recent years, we have seen increasing popularity of using risk-based allocation in SAA decisions.

Following Alvarez, et al [2011] "Risk Parity and Risk-based Allocation", we study the following four risk-based portfolio construction techniques in this paper:

- Inverse volatility (IV)
- Risk parity (RP) or equal risk contribution (ERP)
- Minimum variance portfolio (MVP)
- Maximum diversification portfolio (MDP)

Risk-based portfolio construction techniques

In this section, we briefly define the four risk-based portfolio construction techniques. More details can be found in Alvarez, et al [2011] "Risk Parity and Risk-based Allocation".

Inverse volatility (IV)

The first allocation technique we explore is Inverse Volatility (IV) – we can also call it a naïve risk parity strategy. IV is easy to implement, in that portfolios are weighted inversely to their volatility. As such, more volatile assets are relatively down weighted. Mathematically, this can be expressed as follows:

$$w_{i,t} = \frac{1/\sigma_{i,t}}{\sum_n 1/\sigma_{i,t}}$$

where,

$w_{i,t}$ is the weight allocated to asset i at time t,

$\sigma_{i,t}$ is the volatility of asset i at time t.

[24] Some of our previous research using risk-based portfolio construction techniques in asset allocation decisions can be found in Alvarez, et al [2011] "Risk Parity and Risk-based Allocation", Mesomeris, et al [2012] "A New Asset Allocation Paradigm", Luo, et al [2012] "New Insights in Country Rotation", and Jussa, et al [2012] "Cross Asset Class Momentum".

The main drawback of IV is that it does not take into account the correlation between assets. An asset may be unnecessarily penalized (i.e. down weighted) simply because it's relatively more volatile, while it may provide more diversification benefits should correlations being considered.

Risk parity (RP) or equal risk contribution (ERP)

Risk parity (RP) or equal risk contribution (ERP) is similar to IV allocation. It seeks to give equal risk budget to each asset in the portfolio (subject to constraints). The purpose of balancing risk equally across the assets in the portfolio is consistent with a "no-alpha" strategy in that it gives each asset "equal opportunity" to contribute to the portfolio's overall performance.

RP/ERC takes into account the correlation between pairs of assets. And it can be implemented via the following optimization algorithm:

$$w_{i,t} = \arg\min_w \sum_{i=1}^{n}\sum_{j=1}^{n}[w_{i,t}\,\mathrm{cov}(r_{i,t},r_{p,t}) - w_{j,t}\,\mathrm{cov}(r_{j,t},r_{p,t})]^2$$

where , $r_{i,t}$ and $r_{p,t}$ are the returns of asset i and portfolio p at time t.

Minimum variance portfolio (MVP)

The next portfolio allocation method we look at is the popular minimum variance portfolio (MVP). The MVP method aims to weight portfolios such that the overall portfolio risk is minimized without taking any particular view on expected returns. This can be implemented via the following optimization algorithm:

$$\arg\min_w \frac{1}{2} w_t' \Sigma_t w_t$$

where,

w_t is the vector of asset weights at time t, and

Σ_t is the asset-by-asset covariance matrix at time t.

MVP portfolios are sensitive to our risk estimates and tend to be highly concentrated on a few assets.

Maximum diversification portfolio (MDP)

Lastly, we look at maximum diversification (MDP) approach. This allocation strategy attempts to create portfolios that are more diversified by maximizing the distance between the weighted average volatility of each underlying portfolio and the overall portfolio volatility. This can be shown in the following equation:

$$\arg\max_{w} \frac{\sum_{n} w_{i,t}\sigma_{i,t}}{w_t' \sum_t w_t}$$

The equation above warrants some further explanation. The numerator is simply the weighted sum of the underlying asset volatilities. The denominator is the total portfolio volatility which takes into account the correlation between the underlying assets. The difference between the two is essentially the correlation terms. To maximize the overall ratio, the denominator containing the correlations must be minimized. This allocation strategy attempts to select assets that minimize the correlation between the underlying assets and hence "maximize diversification" as the name suggests.

Risk estimation and portfolio construction

Note that the above portfolio construction techniques require us to estimate the covariance matrix. We use four different approaches for this estimation[25]:

- A 24 month moving window of portfolios returns, equally weighted, i.e., sample covariance matrix
- An exponentially weighted moving average (EWMA) using a 24 month half life and a 24 month moving window.
- An expanding window, equally weighted covariance matrix
- An expanding window, EWMA covariance matrix

To save space, for the rest of our analysis, we only show backtesting using the expanding window, sample covariance matrix. The results of the other three risk models are qualitative similar and available upon request.

All risk-based portfolios are constructed with the following constraints:

- Long only: each country's weight cannot be negative,
- No leverage: total weights add up to 100%, and
- Maximum holding – for country equity portfolios, no single country can be more than 10%, while for country bond portfolios, no single country can have more than 20% weight.

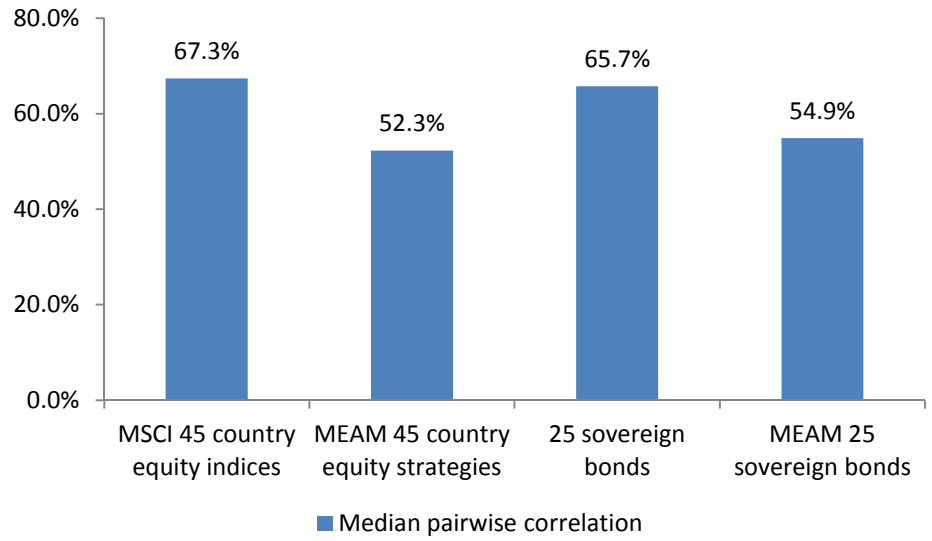
Because we need two years of data to fit our initial risk model, the portfolio simulation starts from January 2006; therefore, our SAA strategies have seven years of history.

[25] As shown in Luo, et al [2011] "Robust Factor Models", structured risk models (e.g., factor-based risk models) and/or shrinkage estimators can improve the accuracy of risk prediction and portfolio performance. For simplicity, we do not consider structured risk models in this research.

Potential diversification benefit

Another interesting finding is that the median pairwise correlation among MEAM portfolios tends to be lower than that among the benchmark indices, for both equity and bond markets. As shown in Figure 47, the median pairwise correlation among 45 countries for the MEAM portfolios is 52.3%, compared to a correlation of 67.3% among MSCI country equity benchmark indices. Similarly, for the 25 sovereign bond markets, the median pairwise correlations are 54.9% and 65.7% for the MEAM bond portfolios and benchmark indices, respectively.

Figure 47: Median pairwise correlation



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Equity

For SAA with global equities, we use the market capitalization-weighted MSCI ACWI as our benchmark index. We also calculate the equally-weighted MSCI ACWI (EQW) as an alternative benchmark.

We run the four risk-based portfolio construction techniques on the 45 countries with two investment instruments:

- Each country's benchmark index, i.e., market capitalization-weighted MSCI index
- Each country's MEAM equity strategy, i.e., investing in the country's main equity index, while switching to cash (or hedging equity exposure) on those days when important macroeconomic indicators are announced (these are the economic indicators with negative expected risk premia, i.e., NPEI)

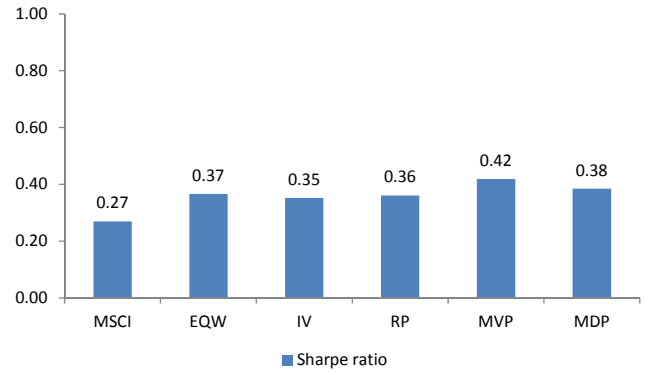
Therefore, we have six portfolios (market capitalization-weighted, equally-weighted, inverse volatility weighted, risk parity portfolio, minimum variance portfolio, and maximum diversification portfolio) for each one of the above two investment instruments. In total, we can compare the performance of these 12 portfolios of global equities.

SAA with benchmark country equity indices

First of all, let's use a few simple examples to demonstrate the benefit of traditional risk-based allocation. As shown in Figure 48, the Sharpe ratios of EQW, IV, RP, MVP, and MDP are all higher than the capitalization-weighted MSCI ACWI. MVP portfolio, as shown in many previous research papers, delivers the highest Sharpe ratio and lowest drawdown (see Figure 49).

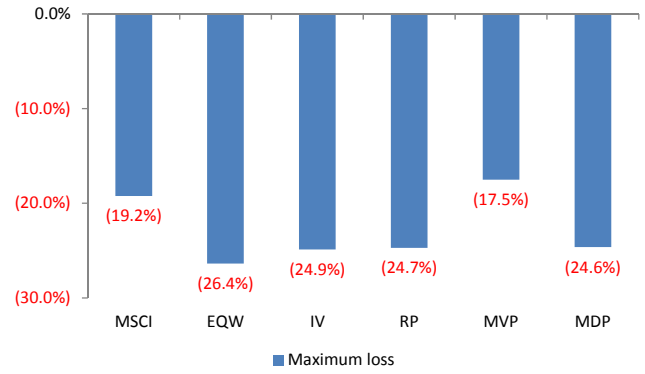
In terms of portfolio weight allocation, MSCI disproportionally overweights developed countries, especially US/Canada (see Figure 50). The EQW portfolio is essentially weighted by the number of countries in each region; therefore developed EMEA accounts for the largest portion (see Figure 51). Interestingly, the IV and RP portfolios also significantly overweight the developed EMEA region (see Figure 52 and Figure 53). The MVP portfolio overweights emerging Asia – the flat weights for most regions reflects the fact the MVP portfolio reaches the 10% maximum holding limits for many countries (see Figure 54), especially after 2009. The MDP portfolio significantly underweights US/Canada and overweights emerging markets, especially LATAM (see Figure 55).

Figure 48: Sharpe ratio



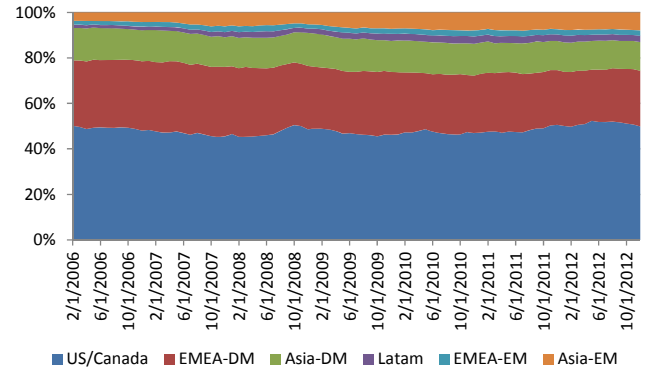
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 49: Maximum drawdown



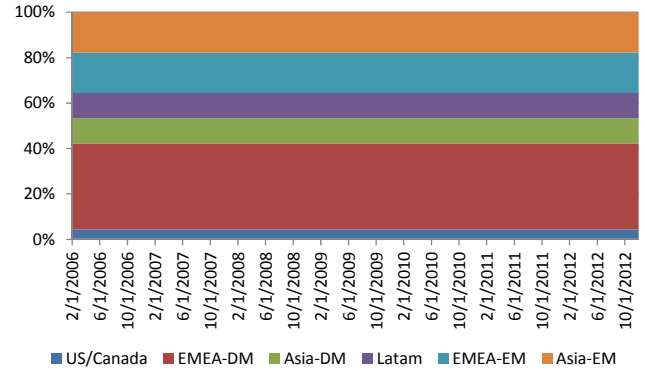
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 50: Regional weights, MSCI ACWI



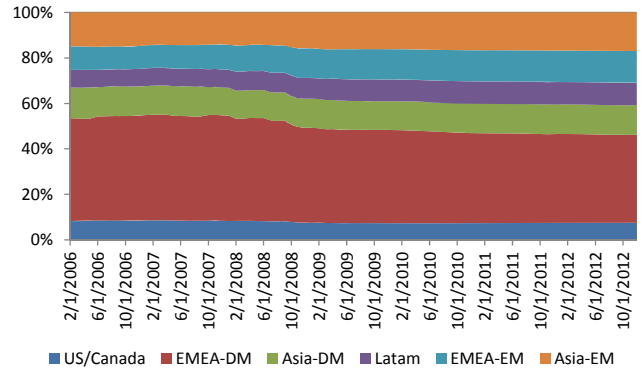
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 51: Regional weights, Equally weighted (EQW)



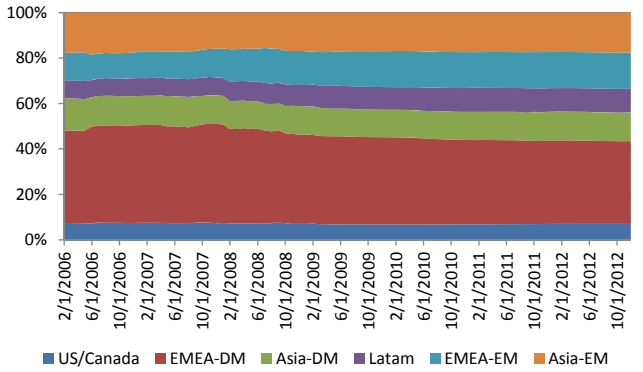
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 52: Regional weights, Inverse volatility (IV)



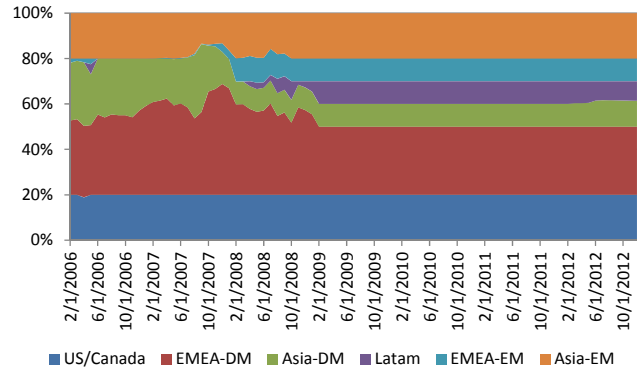
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 53: Regional weights, Risk parity (RP)



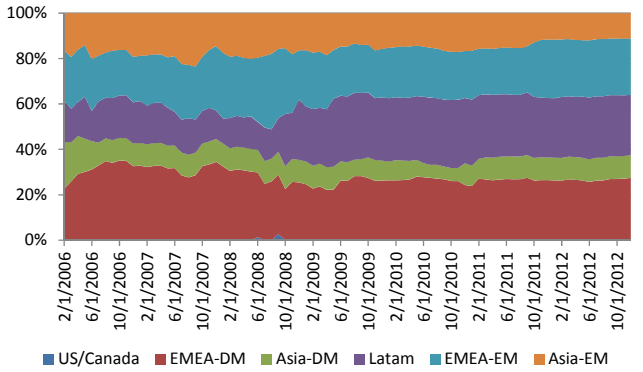
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 54: Regional weights, Minimum variance (MVP)



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 55: Regional weights, Maximum diversification



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

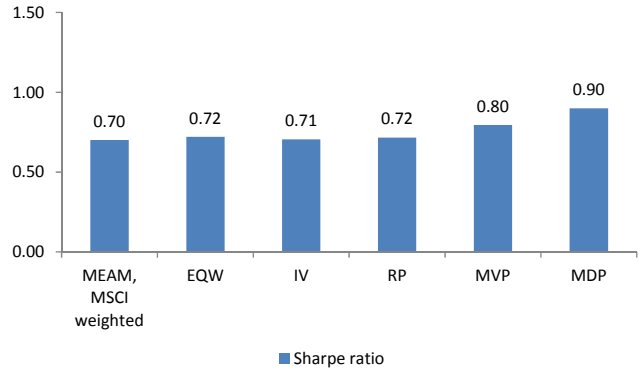
SAA with MEAM country equity strategies

We now re-run our country equity portfolios, but now with the MEAM strategies for all 45 countries (i.e., for each country, we invest in that country's benchmark equity index, but switch to cash or hedge equity exposures on those days when NPEI are announced).

As we can see in Figure 56, now the benefit from risk-based portfolio construction techniques diminishes. Indeed, other than MVP and MDP, the other portfolios are essentially comparable to MSCI weighted MEAM portfolio. This seems to suggest that MEAM-based strategy (low risk in macroeconomic uncertainties) is even more pronounced than low risk in asset allocation (which focus on asset classes with lower volatility and less correlated to other asset classes). More importantly, MSCI-weighted MEAM portfolio actually has the lowest drawdown.

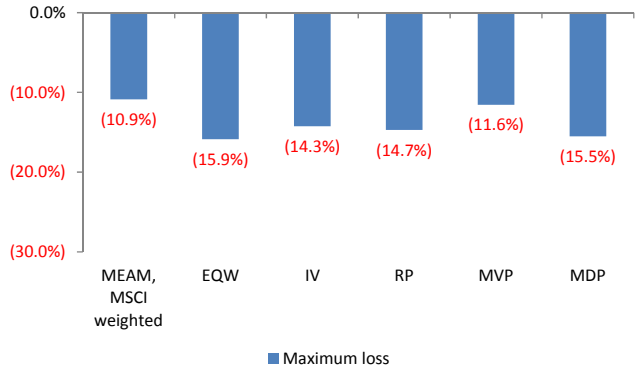
The regional weight allocation under MSCI and EQW is exactly the same as shown in previous section, by design (see Figure 50 and Figure 51). The weight allocation under IV and RP is also similar (see Figure 58 and Figure 59). The MVP portfolio shows slightly more variation, meaning the boundary condition, i.e., maximum holding, has been reached less often (see Figure 60). The MDP portfolio considerably overweights EMEA – both developed and emerging countries (see Figure 61).

Figure 56: Sharpe ratio



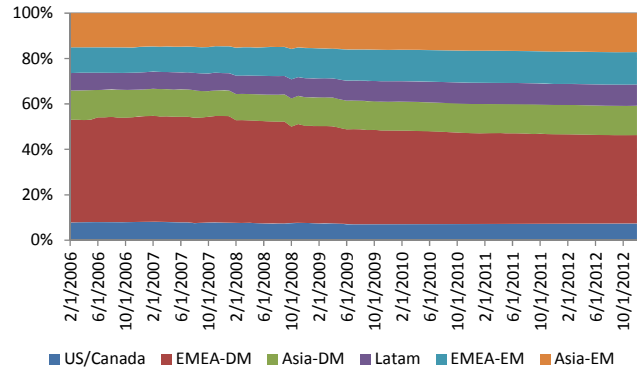
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 57: Maximum drawdown



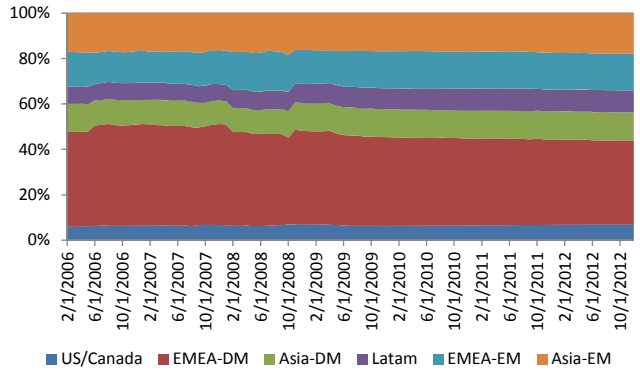
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 58: Regional weights, Inverse volatility (IV)



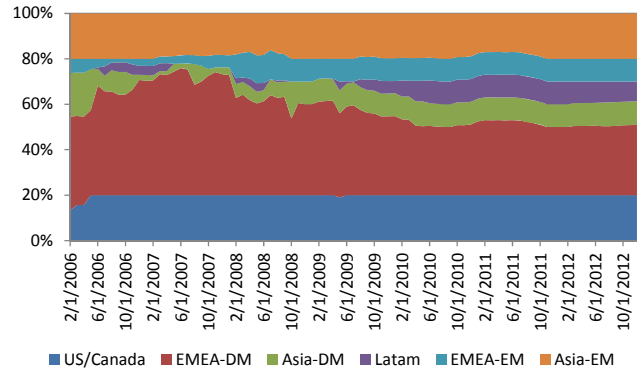
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 59: Regional weights, Risk parity (RP)



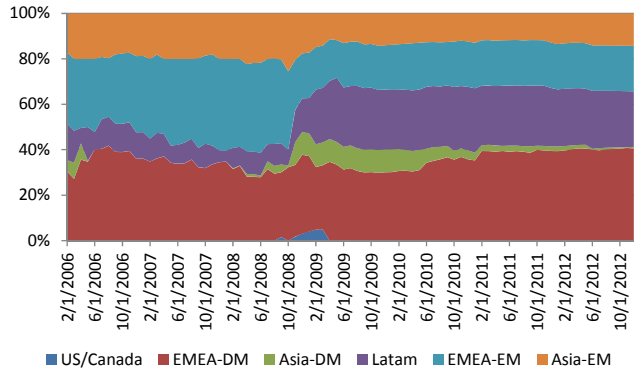
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 60: Regional weights, Minimum variance (MVP)



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 61: Regional weights, Maximum diversification



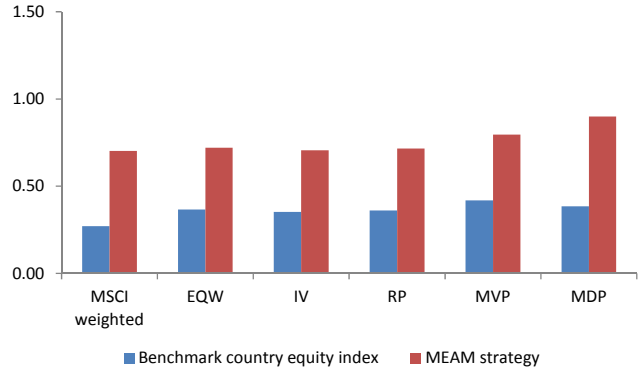
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Avoiding macroeconomic uncertainties

Regardless of the portfolio construction techniques being used, in every single occasion, the MEAM equity portfolio significantly outperforms the benchmark country index portfolio, with higher Sharpe ratio and lower drawdown (see Figure 62 and Figure 63). It is important to note that low risk strategies in avoiding macroeconomic

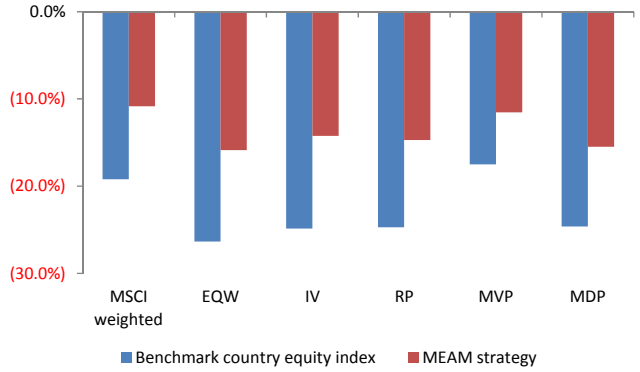
uncertainties is different from, additive to, and more beneficial than the traditional risk-based asset allocation. With capitalization-weighted country benchmark indices, the benefit of risk-based asset allocation is considerable, while with MEAM portfolios, the benefit from further overweight low risk asset classes seems to be only marginal.

Figure 62: Sharpe ratio



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 63: Maximum drawdown



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Conclusion

For strategic asset allocation decisions in global equities, we learn the following important lessons:

- MEAM equity portfolios produce higher Sharpe ratios in most countries than benchmark country equity indices.
- Risk-based portfolio construction techniques can improve the performance of equity portfolios (e.g., higher Sharpe ratio and lower drawdown), for both traditional benchmark country equity indices (significantly) and our new MEAM country equity portfolios (albeit only marginally).
- MEAM strategies, which avoid macroeconomic uncertainties (i.e., low risk strategies in macroeconomic indicators) are different from, incremental to, and produce more benefits than traditional risk-based asset allocation techniques (which tend to overweight asset classes with lower volatility and less correlated to other asset classes).
- Among the four risk-based portfolio construction techniques, MVP and MDP seems to have the best performance, while MDP seems to be more intuitive[26].

Fixed income

Investment universe

To ensure reasonable liquidity, we restrict our sovereign bond universe to the G13 treasuries [27]: Canada, US, Denmark, France, Germany, Italy, Norway, Sweden, Switzerland, UK, Australia, Japan, and New Zealand.

[26] In Jussa, et al [2012] "Across Asset Class Momentum" and Mesomeris, et al [2012] "A New Asset Allocation Paradigm", we found similar evidence supporting MDP.

[27] All results are qualitatively similar using the government bonds from all 25 countries. We also used the same G13 investment universe definition as in Mesomeris, et al [2012] "A New Asset Allocation Paradigm" and Jussa, et al [2012] "Cross Asset Class Momentum".

Benchmark

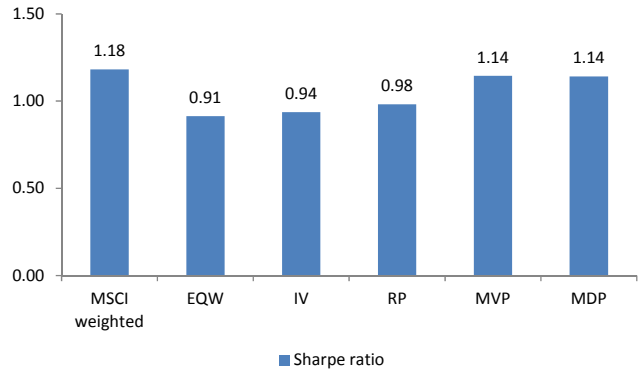
We weight the G13 treasuries based on their respective country's equity market capitalization, because it is somewhat difficult to collect the market capitalization data for the respective government bond universes.

Similar to the country equity portfolios, we also perform the same five allocation schemes (EQW, IV, RP, MVP, and MDP) on two sets of bond portfolios (benchmark country sovereign bond index and MEAM bond portfolio, for each country).

SAA with benchmark country sovereign bond indices

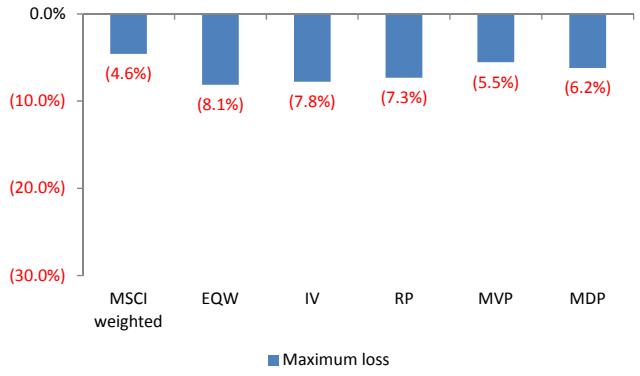
In contrast to equity portfolios, risk-based allocation techniques actually show no benefit in benchmark bond portfolios. The MSCI-weighted bond portfolio outperforms all risk-based portfolios, with the highest Sharpe ratio (see Figure 64) and lowest drawdown (see Figure 65). In terms of portfolio weight allocation, MSCI disproportionally overweights US/Canada (see Figure 66), while all risk-based portfolios tend to overweight EMEA bonds (see Figure 67 to Figure 71). The other issue with risk-based bond portfolios is that, in many occasions, the boundary condition (i.e., maximum holding of 20% by any country) has also been reached too often.

Figure 64: Sharpe ratio



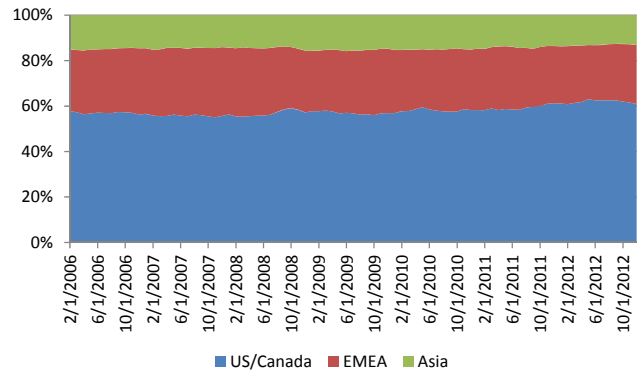
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 65: Maximum drawdown



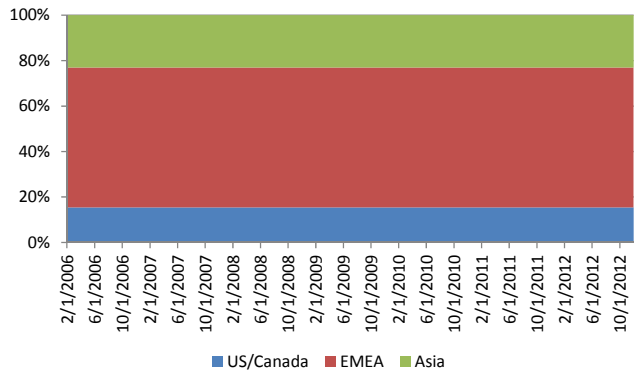
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 66: Regional weights, MSCI



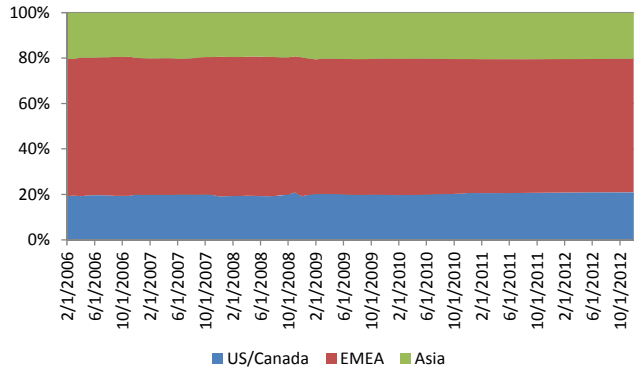
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 67: Regional weights, Equally weighted (EQW)



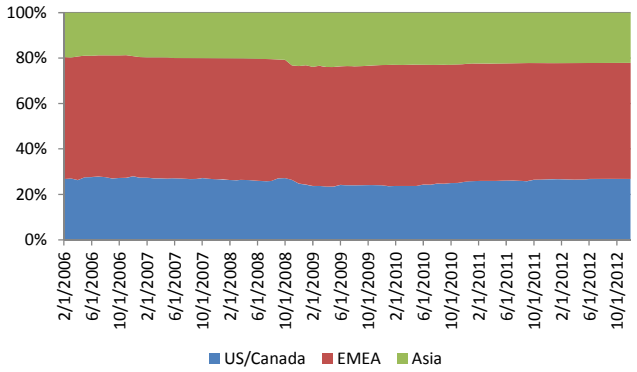
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 68: Regional weights, Inverse volatility (IV)



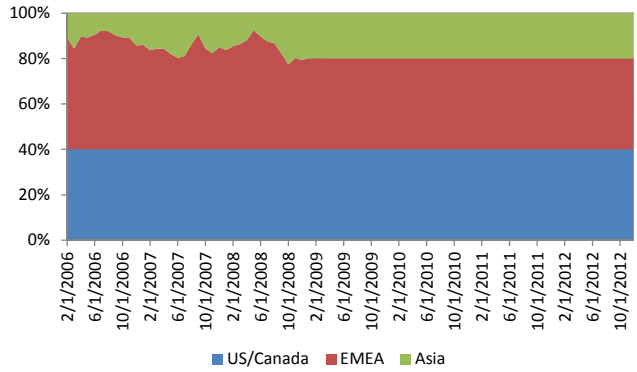
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 69: Regional weights, Risk parity (RP)



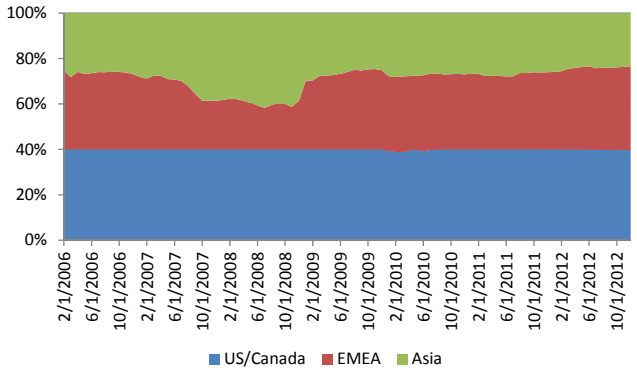
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 70: Regional weights, Minimum variance (MVP)



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 71: Regional weights, Maximum diversification



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

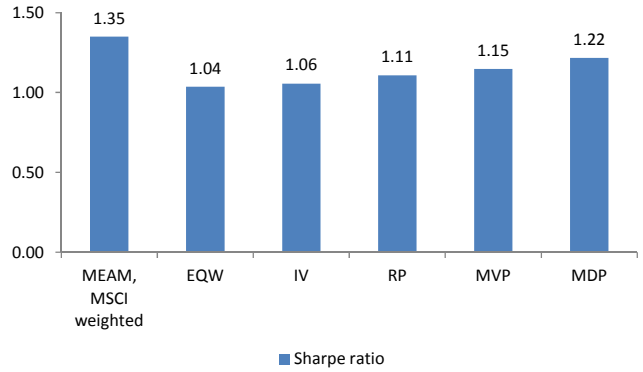
SAA with MEAM country bond strategies

We now re-run our country bond portfolios, but now with the MEAM strategies for all G13 treasuries (i.e., for each country, we invest in that country's benchmark bond index, but switch to cash or hedge bond exposures on those days when NPEI are reported).

Similar to the case of using benchmark bond indices, MSCI-weighted MEAM portfolio also outperforms all risk-based portfolios, with the highest Sharpe ratio (see Figure 72) and the lowest drawdown (see Figure 73). As shown in Figure 74 to Figure 77, the regional weight allocations for risk-based portfolios display the same two issues:

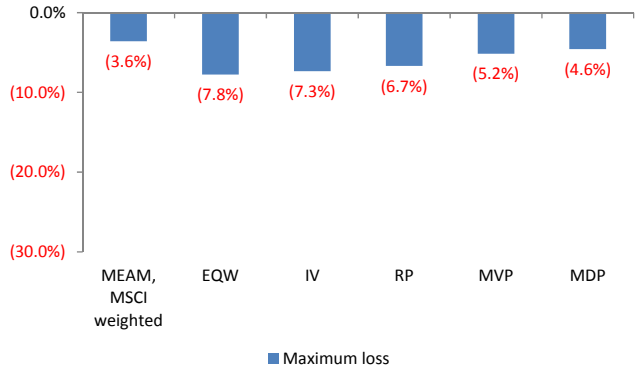
- EMEA bonds are overweighted relative to US/Canada bonds, and
- The maximum holding constraint has been reached too many times.

Figure 72: Sharpe ratio



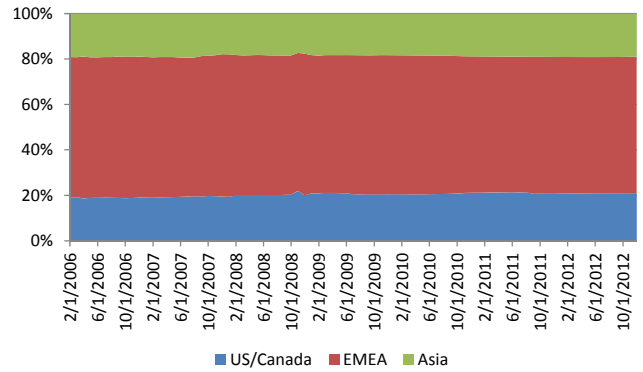
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 73: Maximum drawdown



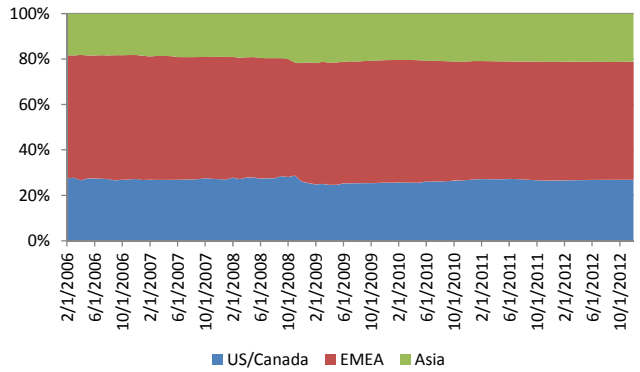
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 74: Regional weights, Inverse volatility (IV)



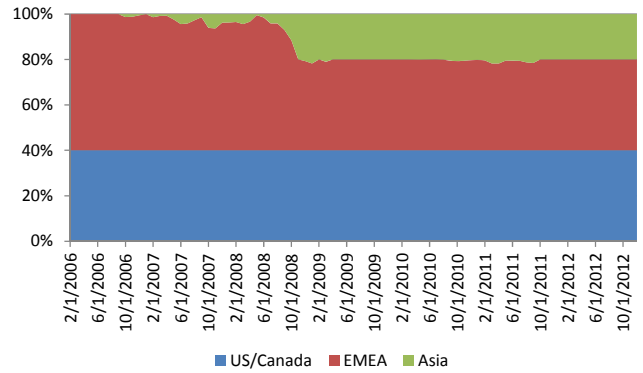
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 75: Regional weights, Risk parity (RP)



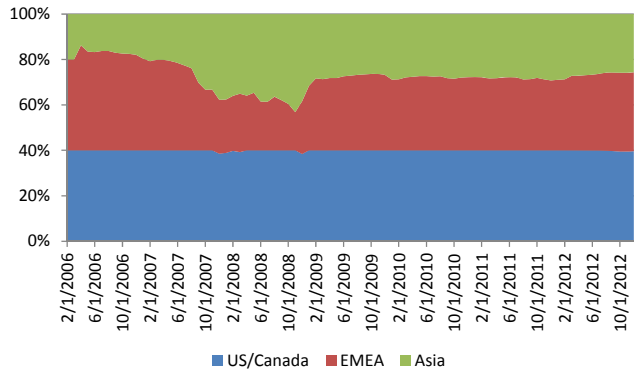
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 76: Regional weights, Minimum variance (MVP)



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 77: Regional weights, Maximum diversification



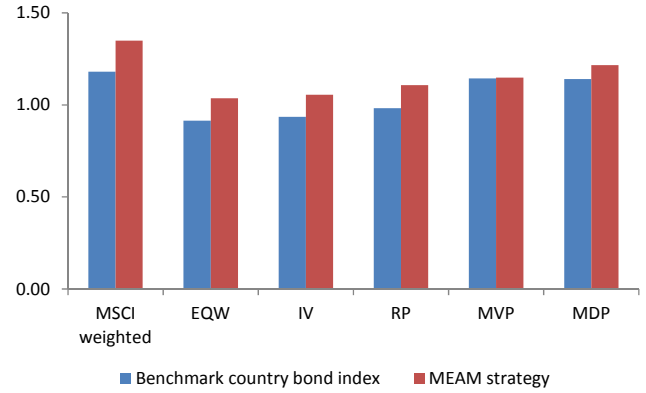
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Avoiding macroeconomic uncertainties

Regardless of the portfolio construction techniques being used, in every single occasion, the MEAM bond strategy significantly outperforms the benchmark country index portfolio, with higher Sharpe ratio and lower drawdown (see Figure 78 and Figure 79). It is important to note that, in the fixed income world, low risk strategies in

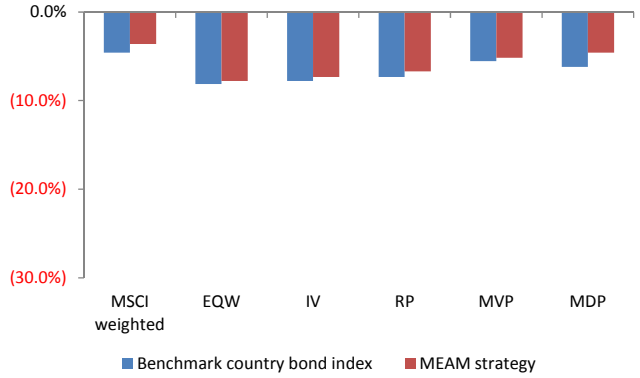
avoiding macroeconomic uncertainties dominates the traditional risk-based asset allocation. The traditional risk-based allocation techniques show no benefit in the sovereign bond space, while our MEAM strategy lifts the portfolio performance considerably.

Figure 78: Sharpe ratio



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 79: Maximum drawdown



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Conclusion

For strategic asset allocation decisions in the sovereign bond space, we learn a few important lessons:

- MEAM bond portfolios produce higher Sharpe ratios in most countries than benchmark country bond indices.
- Risk-based portfolio construction techniques are not necessarily always better than traditional market capitalization-weighted benchmark in the fixed income world.
- MEAM strategies, which avoid macroeconomic uncertainties (i.e., low risk strategies in macroeconomic indicators) are different, incremental to, and more beneficial than traditional risk-based asset allocation techniques.

Combined equity and fixed income portfolio

Investment universe, benchmark, and portfolio simulation

Finally, we combine all country equity indices (45 countries) and government bond portfolios (G13 treasuries) into an overall portfolio. Our benchmark is a classic 60/40 equity bond allocation, i.e., 60% to global equity (MSCI ACWI) and 40% to global bond (G13 treasuries).

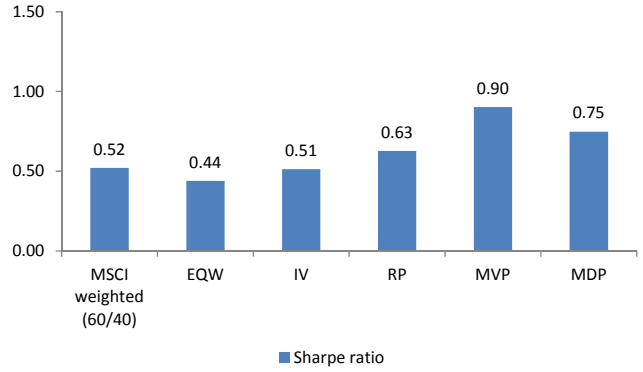
Then, we apply the five portfolio construction techniques (EQW, IV, RP, MVP, and MDP) on all blended 58 assets (45 equity products and 13 bond portfolios) together.

SAA with benchmark country equity and bond indices

After we combine equity indices and bond indices together, we again find risk-based portfolio construction techniques show some promise, especially RP, MVP, and MDP, with higher Sharpe ratio (see Figure 80) and sometimes lower drawdown (see Figure 81).

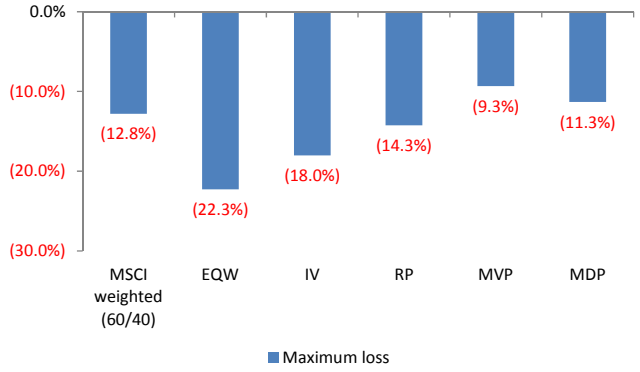
IV portfolio overweights developed EMEA equities and bonds (see Figure 84), while RP portfolio seems to favor bonds, especially Asian bonds (see Figure 85). The MVP portfolio is more extreme – heavily overweighting EMEA bonds (see Figure 86), while MDP portfolio appears to be more balanced (see Figure 87).

Figure 80: Sharpe ratio



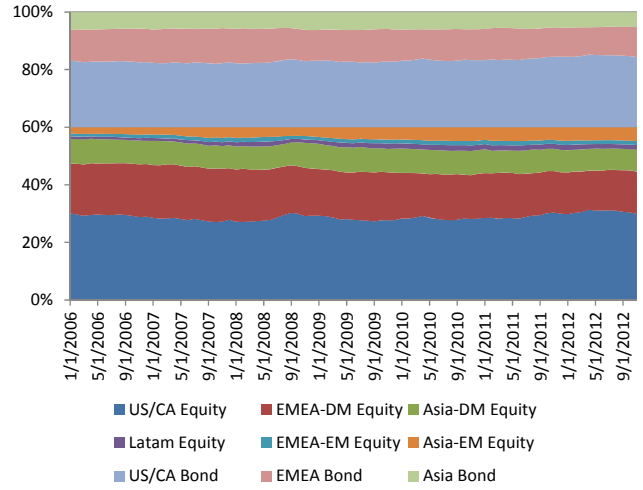
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 81: Maximum drawdown



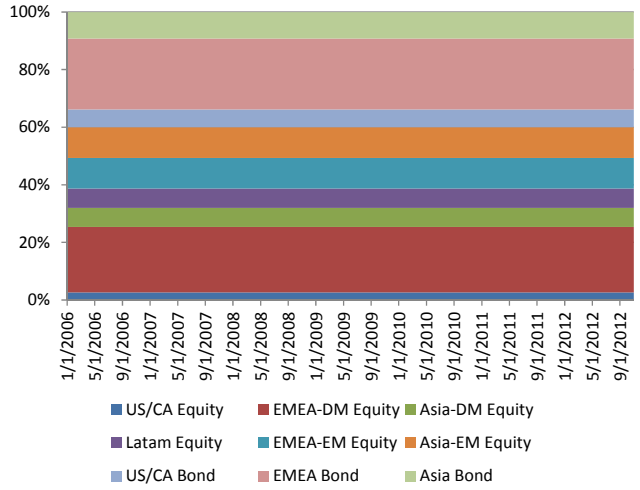
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 82: Regional weights, MSCI ACWI



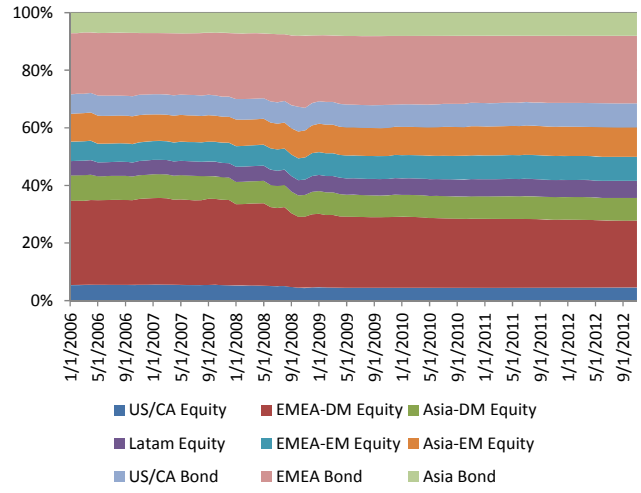
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 83: Regional weights, Equally weighted (EQW)



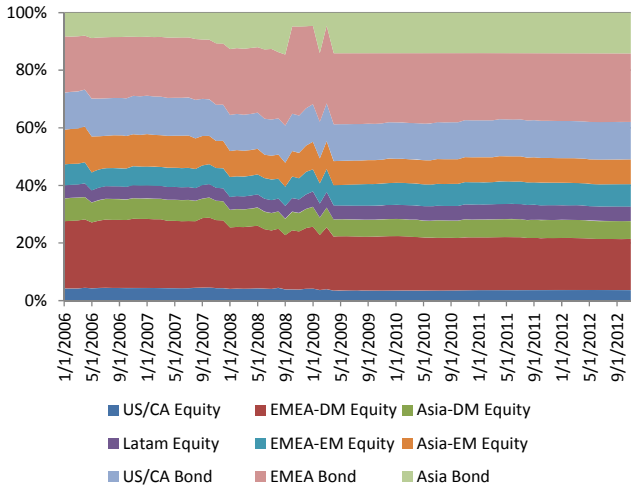
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 84: Regional weights, Inverse volatility (IV)



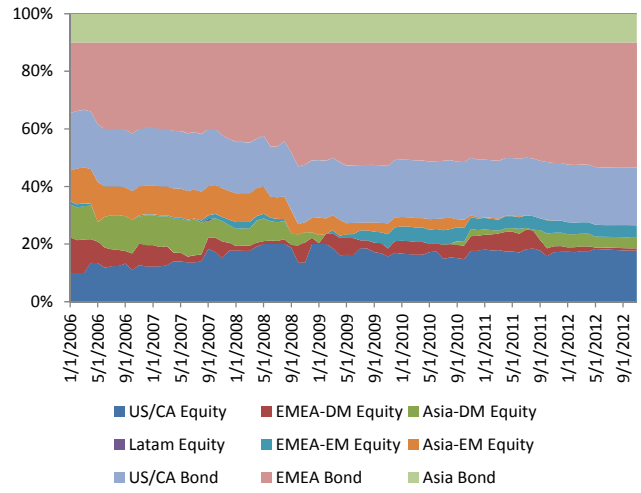
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 85: Regional weights, Risk parity (RP)



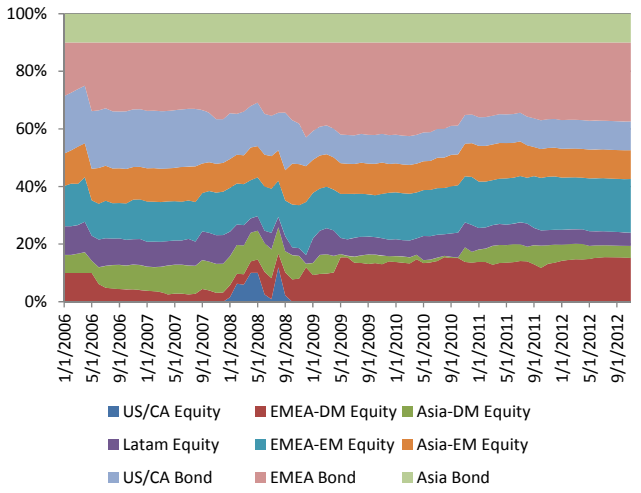
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 86: Regional weights, Minimum variance (MVP)



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 87: Regional weights, Maximum diversification



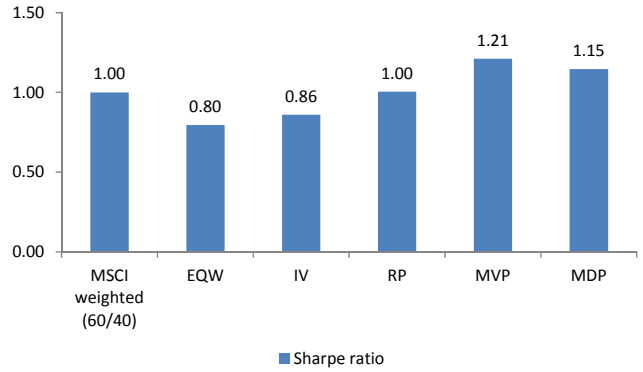
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

SAA with MEAM country equity and bond strategies

If we replace each country's (equity and bond) benchmark index with our MEAM portfolio, we find only MVP and MDP strategies show stronger performance – higher Sharpe ratio (see Figure 88), and in the case of MVP, lower drawdown (see Figure 89).

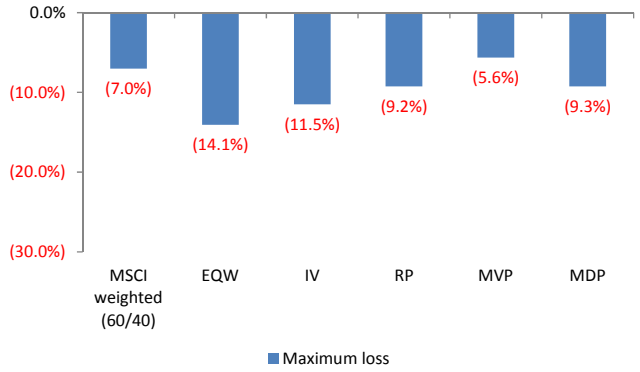
The regional weight allocation under MSCI and EQW is exactly the same as shown in previous section, by design (see Figure 82 and Figure 83). The weight allocation under IV and RP is shows considerable overweights in developed EMEA equities and bonds (see Figure 90 and Figure 91). The MVP portfolio heavily favors EMEA bonds (see Figure 92). The MDP portfolio appears to be more balanced (see Figure 93).

Figure 88: Sharpe ratio



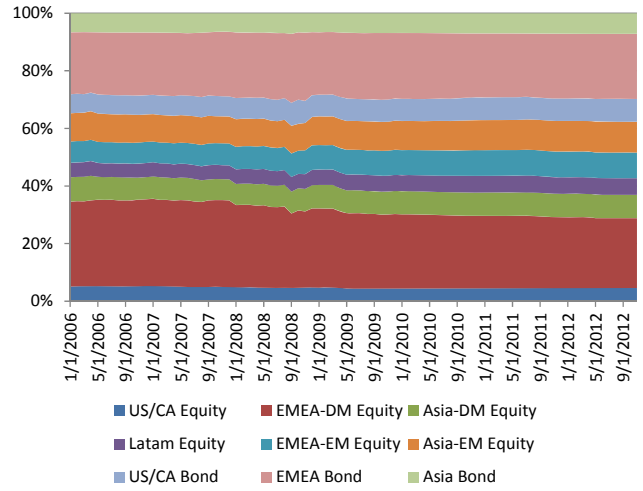
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 89: Maximum drawdown



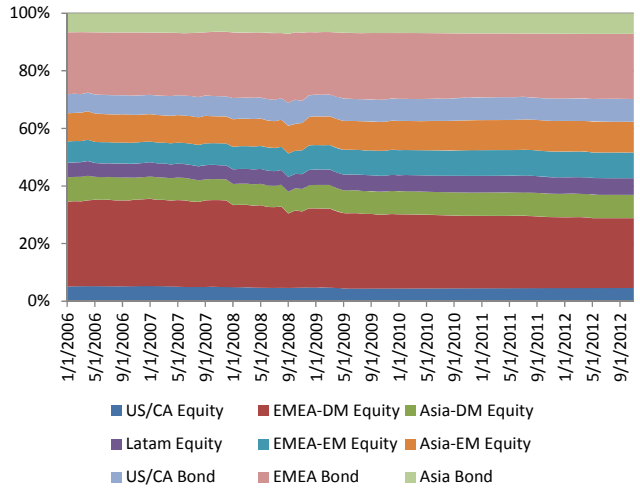
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 90: Regional weights, Inverse volatility (IV)



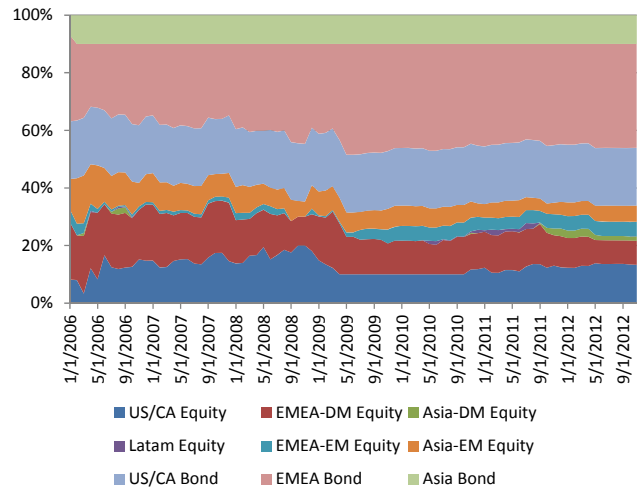
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 91: Regional weights, Risk parity (RP)



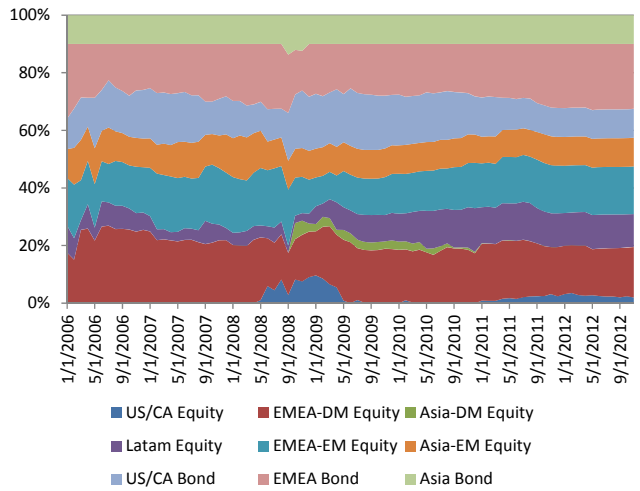
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 92: Regional weights, Minimum variance (MVP)



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 93: Regional weights, Maximum diversification

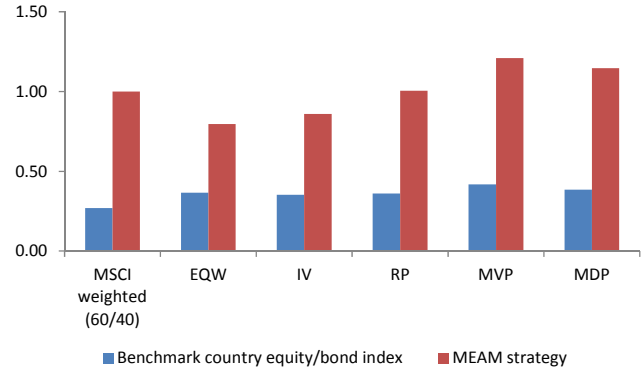


Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Avoiding macroeconomic uncertainties

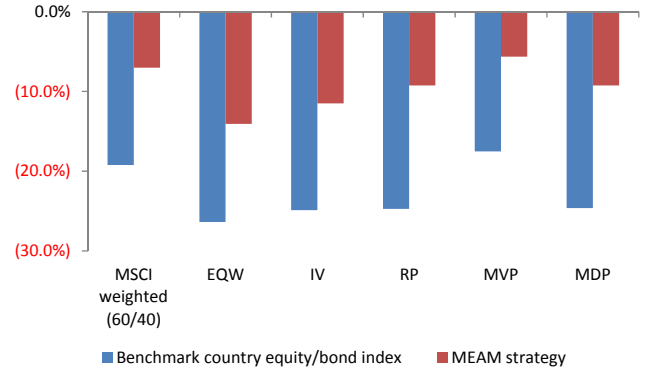
The MEAM strategies significantly outperform those portfolios based on the benchmark country equity/bond index portfolios, with higher Sharpe ratio and lower drawdown (see Figure 94 and Figure 95), no matter which portfolio construction technique is used.

Figure 94: Sharpe ratio



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 95: Maximum drawdown



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Conclusion

For strategic asset allocation decisions with bond equities and bonds, we learn the following important lessons:

- MEAM equity and bond portfolios produce higher Sharpe ratios in most countries than benchmark country equity and bond indices.
- Some risk-based portfolio construction techniques, especially MVP and MDP, can improve the performance of equity/bond portfolios (e.g., higher Sharpe ratio and lower drawdown), for both traditional benchmark country equity/bond indices and our new MEAM country equity/bond portfolios, albeit only slightly.
- MEAM strategies, which avoid macroeconomic uncertainties (i.e., low risk strategies in macroeconomic indicators) are different, incremental to, and produce more benefits than traditional risk-based asset allocation techniques (which tend to overweight asset classes with lower volatility and less correlated to other asset classes).

Leverage? Not required!

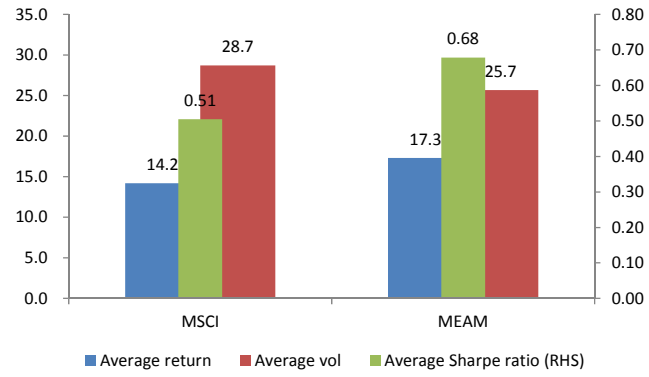
As shown in Luo, et al [2012} "New Insights in Country Rotation", Avettand-Fenoel, et al [2011] "Low Risk Strategies" and Mesomeris, et al [2012] "A New Asset Allocation Paradigm", one of the issues with risk-based allocation is that low risk portfolios tend to have higher Sharpe ratio but lower returns, in both equities and asset allocation frameworks. As many pension funds face funding deficiencies, generating a high enough return is crucial. In order to meet the return target, we need to apply leverage to risk-based strategies. However, we also understand that leverage could be expensive and difficult to implement. In some occasions, leverage also imposes a psychological challenge to plan sponsors. Some funds also have specific mandates that forbid leverage.

The higher Sharpe ratios for the MEAM-based strategies, however, are achieved with both higher returns and lower risk. Therefore, there is no need to apply leverage to reach the target return levels.

Single country MEAM equity and bond portfolios

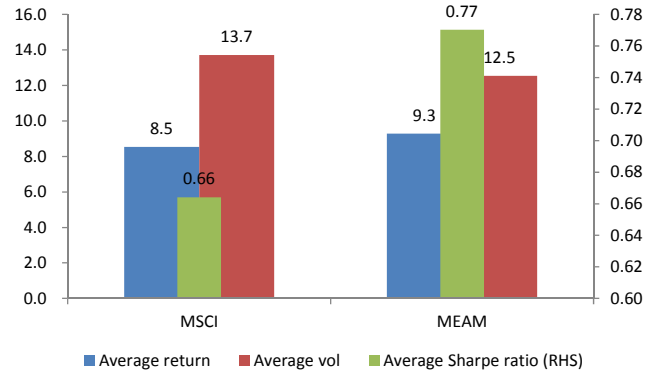
For the 45 countries in MSCI ACWI, the average Sharpe ratio of the MEAM portfolios is 0.68x, about 34% higher than the index (see Figure 96). The higher Sharpe ratio is attained by both higher returns (about 22% higher) and lower risk (about -11% lower). As shown in Figure 97, in the sovereign bond world, the MEAM-based strategies produce an average Sharpe ratio of 0.77x, about 16% higher than the benchmark, which can be attributed to both higher returns (9% higher) and lower volatility (or -9% lower).

Figure 96: Equity portfolios



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 97: Bond portfolio



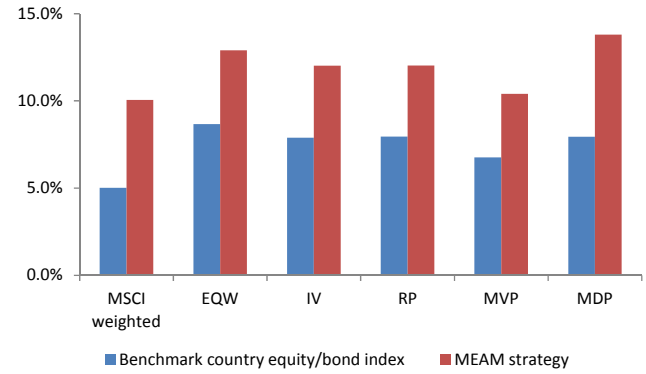
Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

SAA portfolios

Now, let's compare the return and risk profiles of benchmark country equity (and bond) indices versus MEAM-based strategies, when we apply them to SAA. As stated in the previous sections, we use MSCI-weighted and equally weighted (EQS) portfolio as our benchmarks. Then, we test four risk-based portfolio construction techniques – inverse volatility (IV), risk parity (RP), minimum variance portfolio (MVP), and maximum diversification portfolio (MDP).

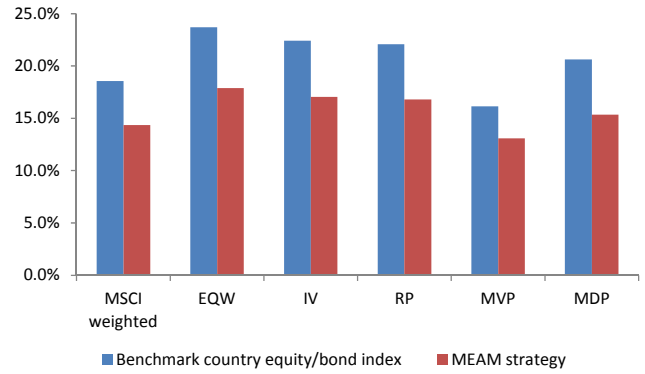
As shown in Figure 98 and Figure 99, for the global equity portfolios, MEAM-based strategies outperform the benchmark country equity index-based portfolios, with both higher returns (61% higher) and lower risk (-24% lower).

Figure 98: Global equity portfolio return



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

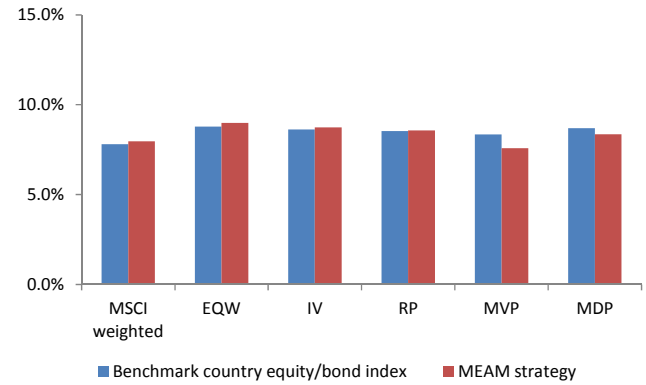
Figure 99: Global equity portfolio risk



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

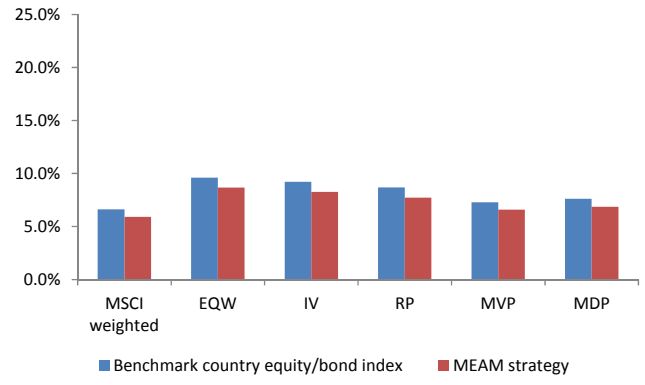
As shown in Figure 100 and Figure 101, when we compare the returns and volatilities of sovereign bonds, we find MEAM-based portfolios have comparable returns to benchmark G13 treasuries (about -1% lower on average), but much lower risk (about -10% lower). It is also interesting to note that, for global government bond portfolios, all six allocation schemes produce very comparable returns; therefore, the differences in Sharpe ratios (see Figure 78) are mostly due to risk reduction.

Figure 100: Global government bond portfolio return



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

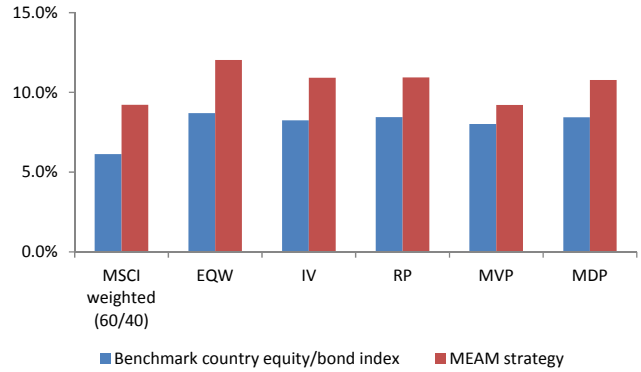
Figure 101: Global government bond risk



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

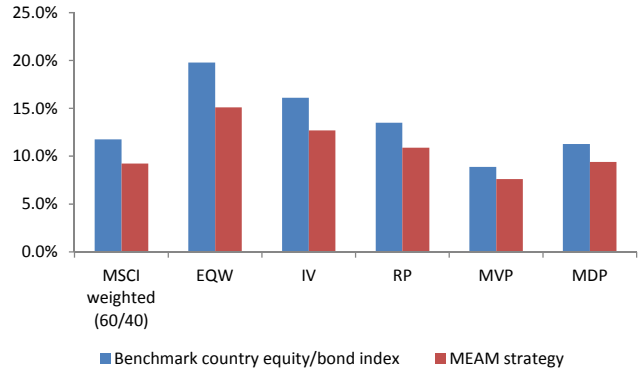
Finally, we compare the overall equity and bond SAA portfolios. Interestingly, the MEAM-based SAA portfolios have once again attained higher returns (about 31% higher on average) and lower risk (about -20% lower on average) – see Figure 102 and Figure 103. MVP demonstrates its ability to minimize risk, with the lowest volatility.

Figure 102: Global equity and bond portfolio return



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Figure 103: global equity and bond portfolio risk



Source: Bloomberg Finance LLP, Haver, Deutsche Bank Quantitative Strategy

Bibliography

Andersen, T.G., Bollerslev, T., Diebold, F.X., and Vega C. [2003]. "Micro Effects of Macro Announcements: Real-time Price Discovery in Foreign Exchange", *The American Economic Review* 93, 38-62.

Alvarez, M., , Y., Cahan, R., Jussa, J., and Chen, J. [2011]. "Minimum Variance: Exposing the 'Magic'", Deutsche Bank Quantitative Strategy, February 9, 2011.

Alvarez, M., Luo, Y., Cahan, R., Jussa, J., Chen, J., and Wang, S. [2011]. "Risk Parity and Risk-based Allocation", Deutsche Bank Quantitative Strategy, October 13, 2011.

Avettand-Fenoel, J.R., Mesomeris, S., Salvini, M., and Wang, Y. [2011]. "Low Risk Strategies", Deutsche Bank Quantitative Strategy, November 16, 2011.

Baumohl, B. [2008]. *The Secrets of Economic Indicators*, 2nd Edition, Wharton School Publishing, 2008.

Beber, A. and Brandt, M.W. [2010]. "When It Cannot Get Better or Worse: The Asymmetric Impact of Good and Bad News on Bond Returns in Expansions and Recessions", *Review of Finance* 14, 119-155.

Cahan, R., Luo, Y., Alvarez, M., Jussa, J., Chen, J., and Wang, S. [2011]. "Quant 2.0", Deutsche Bank Quantitative Strategy, November 18, 2011.

Cahan, R., et al [2012]. "Academic Insights", Deutsche Bank Quantitative Strategy, August 23, 2012.

Chen, N.F., Roll, R., and Ross, S.A. [1986]. "Economic Forces and the Stock Market", *The Journal of Business* 59, 383-403.

Dicke, K. and Hess, D. [2012]. "Information Content Drives Risk Premium of Macroeconomic News on Bond and Stock Markets", SSRN Working Paper, 2012.

Evans, K.P. [2011]. "Intraday Jumps and US Macroeconomic News Announcements", *Journal of Banking and Finance* 35, 2511-2527.

Flannery, M.J. and Protopapadakis, A.A. [2002]. "Macroeconomic Factors do Influence Aggregate Stock Returns", *Review of Financial Studies* 15, 751-782.

Gilbert, T.[2011]. "Information Aggregation around Macroeconomic Announcements: Revisions Matter", *Journal of Financial Economics* 101, 114-131.

Goeij, P., Hu, J. and Werker, B.J. [2010]. "The Price of Macroeconomic Announcement News", Working Paper, Tilburg University.

Hautsch, N. and Hess, D. [2007]. „Bayesian Learning in Financial Markets: Testing fort he Relevance of Information Precision in Price Discovery", *Journal of Financial and Quantitative Analysis* 42, 189-208

Hussain, S.M. [2011]. "Simultaneous Monetary Policy Announcements and International Stock Markets Response: An Intraday Analysis", *Journal of Banking and Finance* 35, 752-764.

Jones, C.M., Lamont, O., and Lumsdaine, R.L. [1998]. "Macroeconomic News and Bon Market Volatility", *Journal of Financial Economics* 47, 315-337.

Jussa, J., Cahan, R., Alvarez, M., Luo, Y., Chen, J., and Wang, S. [2012]. "Cross Asset Class Momentum, November 5, 2012.

Luo, Y., Cahan, R., Jussa, J., and Alvarez, M. [2010]. "Style Rotation", Deutsche Bank Quantitative Strategy, September 7, 2010.

Luo, Y., Cahan, R., Alvarez, M., Jussa, J., and Chen, J. [2011]. "Robust Factor Models", Deutsche Bank Quantitative Strategy, January 24, 2011.

Luo, Y., Cahan, R., Alvarez, M., Jussa, J., and Chen, J. [2011]. "Quant Tactical Asset Allocation", Deutsche Bank Quantitative Strategy, September 19, 2011.

Luo, Y., Sheng, W., Cahan, R., Alvarez, M., Jussa, J., and Chen, J. [2012]. "New Insights in Country Rotation", Deutsche Bank Quantitative Strategy, February 9, 2012.

Mesomeris, S., Salvini, M., Avettand-Fenoel, J.R., and Wang, Y. [2012]. "A New Asset Allocation Paradigm", Deutsche Bank Quantitative Strategy, July 5, 2012.

Pearce, D.K. and Roley, V.V. [1985]. "Stock Prices and Economic News", NBER Working Paper Series No. 1296.

Robinson, M. [2012]. "Super Bowl XLVII", Analytic Investors, https://www.aninvestor.com/pdfs/AnalyticNFL_2013.pdf

Savor, P.G. and Wilson, M.I. [2011]. "How much do Investors Care about Macroeconomic Risk? Evidence from Scheduled Economic Announcements", SSRN Working Paper.

Appendix 1

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