Newsletter

Institute for International Monetary Affairs
公益財団法人 国際通貨研究所

New Publication of IIMA Global Market Volatility Index

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１．Three objectives of the IIMA-GMVI

The Institute for International Monetary Affairs (IIMA) decided to newly compile a Global Market Volatility Index (IIMA-GMVI) that measures global investors' appetite or tolerance for risk in the financial market, and publish it on a weekly basis on the website of the IIMA(http://www.iima.or.jp/en/research/ppp/index.html). The index, which is based on the daily movements (percentage of daily change) of market rates for equities, bonds, and foreign exchanges in the world's major markets, is intended to provide market participants with an objective indicator to help (1) analyze the movements of the markets in the short and medium run, (2) gauge the investment risks and (3) assess the timing of the transition of the markets between normal and crisis phase.

The prices of such financial assets as equities, bonds, and foreign exchanges are considered to be determined in the long term by the total present value of the expected cash flows that will accrue from the original assets over a certain period of future, whereas in the short and medium

term, they widely fluctuate depending on the relative relationship between the risks for a change in asset prices (volatility) and investors' appetite to take those risks (hereinafter referred to as risk factors) .

We can summarize this relation as bellow.

R = f (ra, v)

R: Risk factor

ra: investors' risk appetite

v: volatility of asset prices

Risk factor changes positively to changes of volatility of asset prices (v) and negatively to changes of investors' risk appetite (ra).

In particular, in the present world where the financial and investment activities are largely globalized, there has emerged a situation generally called a "risk on" phase, where the lowering of market volatility or rising appetite of the market participants for taking risks or both trigger a ballooning international credits (expanded financial leverage), increased inflows of capital into emerging economies, and higher prices of various risk assets. On the other hand, in the situation called a "risk-off" phase, the international credits tend to decrease (financial deleverage), causing outflows of capital from emerging economies and plunge of risk asset prices. The risk off situation has, in extreme cases, led to financial and currency crises, and inflicted enormous damage on the real economy.

It is impossible to directly measure the change of risk appetite of global investors but market risks can be assessed by the degree of volatility of asset prices. Furthermore, the volatility of asset prices is interdependent with the risk appetite of investors where the lowering of investors' risk appetite tends to increase the volatility of asset price through the plunge of the market price and vice versa. So it is assumed that there is a strong correlation between the risk appetite of investors and the market risk. In this sense the volatility of market prices that can be directly measured might be a good barometer to gauge risk factors.

Currently VIX of the Chicago Board Options Exchange is the indicator that is most frequently referred to in the world to gauge these risk factors[1]. It is calculated using the quotes of S&P 500 Index Options traded on the Board. It represents the implied measure of the expected volatility of the 30-day future option.

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[1] As preceding studies on this point, Shaghil Ahmed & Andrei Zlate(2013) analyzes international money flows and their contributing factors in the emerging countries in the periods of pre-crisis and post-crisis of the 2000s. In particular, McCauley(2012) focuses on the movements of the dollar exchange rates. Both point out interest rate differentials and risk aversion sentiment of investors as major factors for these money flows. McCauley& McGuire(2009) also analyzes the influence of risk factors focusing on the movements of many foreign exchange rates including those of emerging countries. All of them use VIX as an indicator to measure the risk factors. Takenaka and Sakuma (2013) verify the effectiveness of US corporate bond premiums published by the FRB as a risk factor that explains the asymmetric movements of the Japanese yen and the Korean won in the period from pre-crisis of the 2000s to present.

VIX also rises when the volatility of stocks increases, or the risk appetite of investors deteriorates, or both situations occur at the same time and falls in the reverse case. Therefore it is considered that VIX is the movement regulated by the interdependent relationship between stock market and investors' sentiment.

VIX is considered to have certain effectiveness as an indicator to gauge global risk factors in the sense that the US stock market constitutes a central market for the global capitals to flow in and out. However, we cannot rule out its limitation that the original assets for the index incorporate only US stocks represented in the S&P500 Index.

Taking into account the rising share of the emerging economies in the field of finance and investment, and the increased diversification of investment assets and regions, it seems likely that a new indicator is desired that reflects the risk factors more comprehensively. Therefore, through our new initiative, we would like to present the IIMA-GMVI as a comprehensive indicator that is based on the historical volatility of the daily movements of price of stocks, bonds, and foreign exchanges in the major countries both in advanced and emerging world.

２．**How is IIMA Global Market Volatility Index calculated?**

In calculating IIMA-GMVI, we used objective market data that are available relatively easily, such as stock index, yields on 10 year government bond, foreign exchange rates against the dollar for coverage, and nominal GDP denominated in US dollars of selected countries for the weights to average the index.

First, we picked up the GDP data of 22 countries for 2012 from the IMF *World Economic Outlook Database* to fix the countries to review[2]. Next we calculate historical volatilities (hereinafter referred to as HV)[3] of daily changes of stock indices, yields on 10 year government bonds, and foreign exchange rates[4] over the preceding 20 days on each business day since 1994. Then we calculate weighted averages of the daily HV based on the weights of dollar-denominated nominal GDP to produce a global HV for each market category (stocks,

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[2] Targeted 22 countries + HK include for stock markets: the United States (S&P500), China (Shanghai Stock Exchange Composite Index), Japan (TOPIX), Germany (DAX), the United Kingdom (FTSE100), France (CAC40), Brazil (IBOVESPA), Russia (MICEX), Italy (FTSE MIB), Canada (S&P/TSX Composite Index), Australia (S&P/ASX 200), India (S&P BSE SENSEX), Spain (IBEX35), Mexico (MEXBOL), Korea (KOSPI), Indonesia (Jakarta Composite Index), Turkey (ISE national 100), Poland (Warsaw Stock Exchange WIG Index), South Africa (FTSE/JSE Africa All share Index), Thailand (SET Index), Malaysia (FTSE Bursa Malaysia KLCI Index), Chile (IGPA Index), and Hong Kong (Hang Seng Index).

[3] Historical volatility is calculated as a standard deviation of the daily changes of closing prices for the past 20 business days of each business day, annualized by multiplying by a square root of 250, average business days for a year. This conforms to the general method to express the volatility in the option markets.

[4] 18 countries for exchange rates: Chinese Yuan (RMB), Japanese Yen, Euro, British Pound, Brazilian Real, Russian Ruble, Canadian Dollar, Australian Dollar, Indian Rupee, Mexican Peso, Korean Won, Indonesian Rupiah, Turkish Lira, Polish Zloty, South African Rand, Thai Baht, Malaysian Ringgit, Chilean Peso.

bonds[5], and foreign exchanges).

Finally, we divide each business day HV of each global HV by the average figure of the whole data under review to adjust the different levels of each category into a comparable level. (When the each global HV on a certain business day falls on the average level, the index is to show 1.)

We will publish on our website the aggregated index of the above three indices as IIMA -GMVI (Average value of the index equals to 3). In addition to the composite index of IIMA-GMVI, we will also publish its subcategory HV series for stock market, bond market and foreign exchange market as well the aforementioned VIX index of the CBOE and yield differentials (Baa-Aaa) derived from the interest rates published by the US FRB as Moody's seasoned Aaa and Baa[6] [7].

Chart 1   Data Source of the INDEX

	Weight	Market Indicators
Data	Nominal GDP (in current US dollar) × 22 countries + HK	Stock price index × 22 countries + HK
		10 year government bond yield × 22 countries
		Foreign exchange rate against US$ × 18 currencies
Frequency	Yearly	Daily
Start	1994.01 ~ today	

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[5] As for bonds, we calculate the volatility of bond yields, not bond prices to avoid the complications in calculations. That's because we don't have to consider about the changes of maturity, picking bonds if we use bond yield to calculate volatility of bonds.
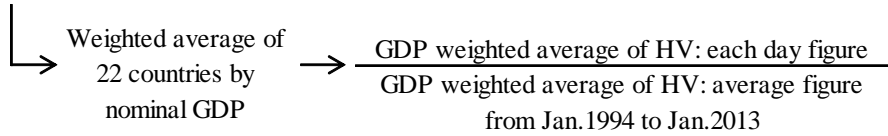
[6] Needless to say, yield differentials between Baa bonds and Aaa bonds published by the FRB represent risk premiums in the US bond market, thus have a high correlativity with the change in VIX.

[7] The IIMA-GMVI can be used freely but we would appreciate your reference to our institute as an originator and the name of "IIMA Global Market Volatility Index" (IIMA-GMVI for short) when you use it in any of your publications.

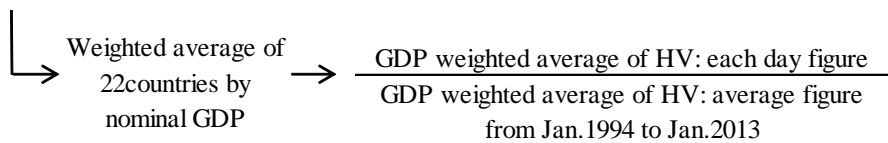**Chart 2   How to Calculate IIMA Global Market Volatility Index**

Stock market

Historical volatility (HV) of stock price index in each country for the latest 20 business days
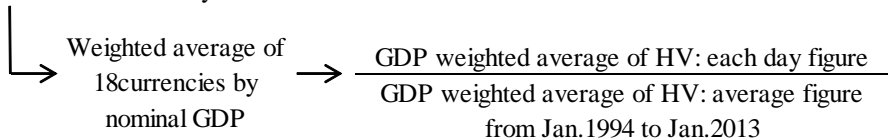
Weighted average of 22 countries by nominal GDP → GDP weighted average of HV: each day figure / GDP weighted average of HV: average figure from Jan.1994 to Jan.2013

Bond market

Historical volatility (HV) of 10 year gov't bond yield in each country for the latest 20 business days

Weighted average of 22countries by nominal GDP → GDP weighted average of HV: each day figure / GDP weighted average of HV: average figure from Jan.1994 to Jan.2013

Foreign exchange market

Historical volatility (HV) of foreign exchange rate of each currency against US dollar for the latest 20 business days

Weighted average of 18currencies by nominal GDP → GDP weighted average of HV: each day figure / GDP weighted average of HV: average figure from Jan.1994 to Jan.2013

add all three => IIMA-GMVI

Units: times
If the each day figure becomes the same as the average of the whole period, the index becomes 1 + 1 + 1 = 3.

We will publish the IIMA-GMVI in two ways of original data and graphs. For graphs, we will show two kinds of graphs, one for the composite IIMA-GMVI as compared to VIX and yield spreads of the bonds published by the FRB (Chart 3). The other shows the developments of HV for subcategory of stocks, bonds, and foreign exchanges that constitute the IIMA-GMVI composite (Chart 4).

As for the original data, we will carry in an excel format the daily figures for six indices shown in the graphs (Chart 5). Daily figures should formally be divided each day by the average of the whole data, but since the average changes day by day and application of such average will affect the continuity of the indices, we will use the average calculated for January 1994 to January 2013 as the initial figure and review the average once in 5 years to incorporate the nearest data for extension.

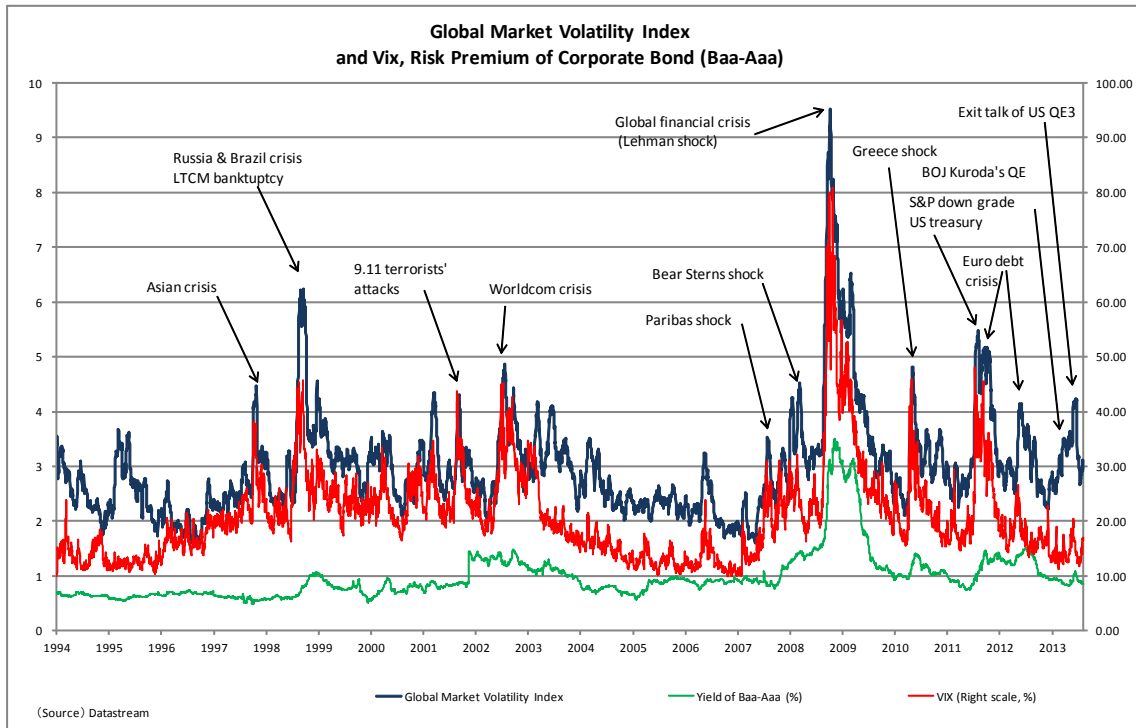## Chart 3　IIMA-GMVI and VIX, Risk premium of Corporate Bond (Baa-Aaa)

**Global Market Volatility Index
and Vix, Risk Premium of Corporate Bond (Baa-Aaa)**

Asian crisis

Russia & Brazil crisis
LTCM banktuptcy

9.11 terrorists'
attacks

Worldcom crisis

Paribas shock

Bear Sterns shock

Global financial crisis
(Lehman shock)

Greece shock

BOJ Kuroda's QE

S&P down grade
US treasury

Euro debt
crisis

Exit talk of US QE3

（Source）Datastream

Global Market Volatility Index　　Yield of Baa-Aaa (%)　　VIX (Right scaa, %)

Chart 4　Each Component of IIMA-GMVI (Stock, Bond, Currency)

Global Market Volatility Index (Stock, Bond, Currency)

（出所）Datastreamデータより国際通貨研究所作成

Stock Market Volatility Index　　Bond Market Volatility Index　　Currency Market Volatility Index
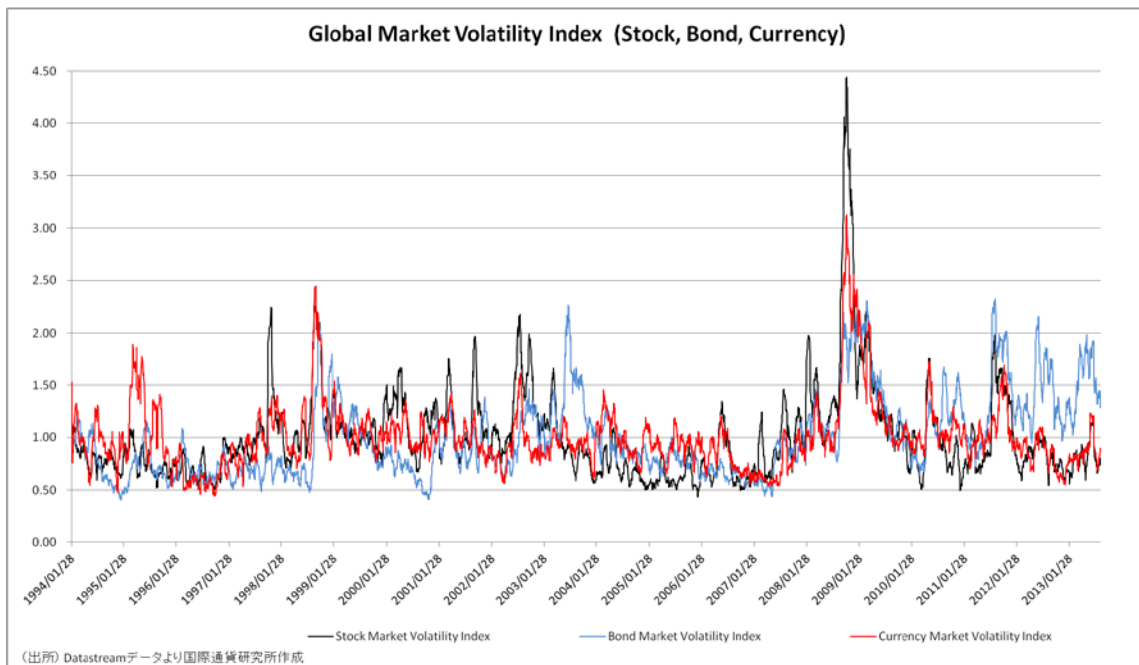
Chart 5 Original Data Series

（平均HV期間：1994年1月～2013年1月）　　　　　　　　(Data Source) Chicago Board Options Exchange, FRB, Datastream

Date	IIMA Global Market Volatility Index	IIMA Global Market Volatility Index (Stock)	IIMA Global Market Volatility Index (Bond)	IIMA Global Market Volatility Index (Currency)	VIX (Right scale, %)	Yield of Baa-Aaa (%)
1994/1/28	3.44	0.86	1.08	1.50	9.94	0.69
1994/1/31	3.51	0.98	1.02	1.50	10.63	0.70
1994/2/1	3.58	1.00	1.03	1.55	10.65	0.69
1994/2/2	2.85	1.01	1.02	0.83	10.61	0.68
1994/2/3	2.87	1.02	1.01	0.83	10.75	0.68
1994/2/4	2.88	1.08	0.97	0.83	15.25	0.68
1994/2/7	2.98	1.08	0.98	0.92	13.96	0.68
1994/2/8	2.98	1.08	0.98	0.92	13.66	0.69
1994/2/9	3.00	1.07	0.99	0.93	13.30	0.70
1994/2/10	2.99	1.08	0.97	0.94	14.24	0.69
1994/2/11	2.95	1.06	0.96	0.93	14.46	0.69
1994/2/14	3.30	1.07	1.07	1.16	14.28	0.69
1994/2/15	3.27	1.08	1.01	1.18	13.40	0.70
1994/2/16	3.24	1.06	1.00	1.17	13.13	0.70
1994/2/17	3.20	1.06	0.98	1.16	13.79	0.70
1994/2/18	3.24	1.07	1.00	1.17	14.70	0.70
1994/2/21	3.24	1.03	0.97	1.24	14.70	0.70
1994/2/22	3.26	1.04	0.99	1.23	13.52	0.70
1994/2/23	3.20	1.03	0.95	1.22	13.91	0.69
1994/2/24	3.30	1.06	0.98	1.26	15.96	0.68
1994/2/25	3.32	1.06	0.97	1.29	14.80	0.67
1994/2/28	3.17	0.90	0.99	1.27	14.87	0.67

4. Examples for Use of IIMA-GMVI and Their Implications

As was stated at the beginning, the purpose of IIMA-GMVI is the provision of an objective indicator on global financial and capital market that will help investors (1) to analyze the movements of the markets in the short and medium run, (2) to gauge the investment risks, (3) to assess the timing of transition of the markets between normal and crisis phase.

As for the point (1), we hope IIMA-GMVI can be used to analyze the factors behind the changes in financial and asset prices (including foreign exchanges). As stated earlier, when the degree of risk expressed in the volatility increases, the investors will lower the share in their portfolios of risk assets centered in stocks, which tends to depress the price of risk assets. Reversely, when the risk appetite of investors declines for some reasons (such as a big loss in a different market) , the investors will lower the ratio of holding stocks or other risk assets, and as a result the market rates tend to fall, which in turn destabilizes the markets.

With the deepening of globalization of financial and investment activities, stock markets have globally experienced a strengthened relationship with such incidents as the expansion/shrinkage of international credits, increase of cross-border movements of investment funds, fluctuations of foreign exchange rates, etc. Let us show you an example. Chart 6 shows a scatter graph of the

relationships between the IIMA-GMVI and the year-over-year change of MSCI ACWI[8] (denominated in dollars), an index of stock prices composed of weighted averages of the major 45 countries (advanced and emerging) in the world. We show the similar relationships between VIX and IIMA-GMVI in Chart 7. The MSCI's relationships with both are statistically significant with the correlation coefficient of 0.72, and determination coefficient of 0.52 with IIMA-GMVI, and the correlation coefficient of 0.69 and determination coefficient of 0.48 with VIX, showing a bit higher relationship with the IIMA-GMVI.

There is no almighty indicator that shows for any period a high degree of explanation for the volatility of all kinds of financial assets. You will need to choose appropriate index depending on the need for explanation. In the case of IIMA-GMVI, it is an expedient decision to have composed the three elements (HV of stocks, bonds, and currencies) on an equal weight. Depending on the target for explanation, there will be the case where there is a higher relationship with a certain element of the three and low with the others. There will be a case where it is necessary to change the weights of the three elements. This is the reason why we also publish the data for each element.

The same thing will apply to the use of the index for the purpose (2) of gauging the investment risks and there will be a room to adjust the weights depending on the assets for intended investment.

As to the function as an objective indicator to assess the timing of market transition between normal and crisis phase, it can be summed up that as far as we look at the chart 3, the levels on or below the historical average of 3 shows a stable market environment, indicating a "risk on" phase for investment. On the other hand, the levels between 3.0 and 4.0 indicate somewhat disturbing market, and levels between 4.0 and 5.0 more serious market conditions, and over 5.0 will indicate a crisis phase where a currency and financial crisis will spread on a global scale.

Currently the level of IIMA-GMVI shows around 3.0, remaining around the long term average. The index rose to around 4.0, caused by a higher volatility in the bond yields, but the index confirms that the turmoil of the market was shortly dissipated.

The IIMA is planning to continue to make and publish further researches using the IIMA-GMVI. Active use of the IIMA-GMVI and opinions regarding the index by many researchers and economists are most welcome.

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[8] As for MSCI ACWI, refer to following website.
http://www.msci.com/products/indices/tools/index.html#WORLD

Chart 6 Relation between changes of MSCI ACWI (YoY) and IIMA-GMVI

MSCI ACWIの変化とIIMA-GMVI指数
（2005年1月－2013年7月）

縦軸：MSCI対前
年同月比

y = -0.1219x + 0.4513
R² = 0.5188
R=0.7203

横軸：IIMA-GMVI

データ：Datastream

Chart 7 Relation between changes of MSCI ACWI (YoY) and VIX

MSCI ACWIの変化とVIX指数
（2005年1月－2013年7月）

縦軸：MSCI対前
年同月比

y = -0.0138x + 0.3536
R² = 0.4777
R=0.6912

横軸：VIX指数

データ：Datastream

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