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# Towards a skewness index for the Italian stock market

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**Abstract**

The present paper is a first attempt of computing a skewness index for the Italian stock market. We compare and contrast different measures of asymmetry of the distribution: an index computed with the $CBOE\ SKEW$ index formula and two other asymmetry indexes, the $SIX$ indexes, as proposed in Faff and Liu (2014). We analyze the properties of the skewness indexes, by investigating their relationship with model-free implied volatility and the returns on the underlying stock index. Moreover, we assess the profitability of skewness trades and disentangle the contribution of the left and the right part of the risk neutral distribution to the profitability of the latter strategies. The data set consists of FTSE MIB index options data and covers the years 2011-2014, allowing us to address the behavior of skewness measures both in bullish and bearish market periods.

We find that the Italian $SKEW$ index presents many advantages with respect to other asymmetry measures: it has a significant contemporaneous relation with both returns, model-free implied volatility and has explanatory power on returns, after controlling for volatility. We find a negative relation between volatility changes and changes in the Italian $SKEW$ index: an increase in model-free implied volatility is associated with a decrease in the Italian $SKEW$ index. Moreover, the $SKEW$ index acts as a measure of market greed, since returns react more negatively to a decrease in the $SKEW$ index (increase in risk neutral skewness) than they react positively to an increase of the latter (decrease in risk neutral skewness).

The results of the paper point to the existence of a skewness risk premium in the Italian market. This emerges both from the fact that implied skewness is more negative than physical one in the sample period and from the profitability of skewness trading strategies. In addition, the higher performance of the portfolio composed by only put options indicates that the mispricing of options is mainly focused on the left part of the distribution.

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## 1. Introduction

Measuring the asymmetry of a distribution has gained an increasingly important role in finance in the recent decades. A symmetric volatility specification, precludes the disentanglement of positive and negative extreme stock price movements. The third order moment of a distribution (skewness) captures the asymmetry of the distribution. Hence, accounting for skewness allows one to model risk-neutral probability distributions with different shapes (more skewed to the left or to the right). Skewness can be measured with two alternative methods: first, using historical realizations of the underlying asset returns (called physical skewness) or second, by using options traded on the underlying asset (called implied skewness). While the first methodology is backward looking, the latter is forward looking in nature, since option prices reflect the investors' expectations about the underlying asset distribution at the maturity date. Many studies find that the option-implied information is superior to the historical approach (see e.g. Giamouridis and Skiadopoulos (2012) for a literature review) in forecasting future realized moments.

The most important signal of the importance of measuring the skewness of the financial markets is the listing on February 2011 at the Chicago Board Options Exchange (CBOE) of the $CBOE\ SKEW$ index. As explained in the CBOE white paper, $CBOE\ SKEW$ measures the risk-neutral skewness of the distribution of S&P500 log-returns at a 30-day constant maturity date and it complements the $CBOE\ VIX$ volatility index with an additional piece of information. In fact, while the $CBOE\ VIX$ measures the expected standard deviation of 30-day S&P500 log-returns, the $SKEW$ index describes the tail risk of the S&P500 distribution. Both are risk-neutral measures and therefore embed the investors' sentiment about the next-30-days volatility and skewness of the S&P500 log-returns. If the volatility index $VIX$ measures the overall risk in the 30-day S&P500 log-returns, without disentangling the probability attached to positive and negative returns; the skewness index $SKEW$ measures the perceived tail risk, i.e. the probability that investors attach to extreme negative returns (if the $SKEW$ index is high, which points to a negative skewness and a distribution which is skewed to the left, extreme negative returns are more often expected than positive ones). The (negatively) skewed risk-neutral distribution points to the presence of sizable risk premiums in order to be hedged against negative realizations of the underlying asset (tail risk).

The existence of a skewness risk premium charged by the market, i.e. the difference between physical and risk-neutral skewness, is investigated in a few papers and the sign of the latter is debated. Lin et al. (2008) in the English market, find a positive relation between physical and risk-neutral skewness: the discrepancy between the two suggests that the market charges a high risk premium on downside index movements. Kozhan et al. (2013) generalize the notion of variance swap (Carr and Wu, 2009) to higher order moments: the fixed leg is the option-implied moment and the floating leg is the realized moment. The average profit from the strategy can be interpreted as the premium for being exposed to the moment's risk. In the S&P500 equity index options market they find that the average realized skew is negative and substantially smaller, in absolute terms, than the average implied skew. Elyasiani et al. (2014), in the time-period January 2005-December 2009, find that implied risk-neutral skewness is less negative than the subsequently realized one in the Italian index options market.

Another strand of literature investigates the skewness risk premium by using portfolio strategies consisting of positions in options and in the underlying asset. Javaheri (2005), based on the assumption that the option implied distribution is in general more negatively skewed than the historical one, finds mixed evidence on the profitability of skewness trades in the American market. Liu (2007) implements vega and delta neutral strategies by using FTSE 100 index options data and finds that portfolios with long positions in put options and short positions in call options achieve significant negative returns. Bali and Murray (2013) investigate the pricing of risk-neutral skewness by using options on individual stocks in the American market and find results consistent with a negative skewness risk premium and an investor's preference for positive skewness. Similar findings are obtained by Conrad et al. (2013) on a sample of individual stock options in the American market.

The predictive power of risk-neutral skewness on future realized returns is debated in the literature. In fact, if Bali and Murray (2013) and Conrad et al. (2013) find a negative relation, many other papers find a positive relation. Xing et al. (2010) find that stocks with the steepest smirks in the options market underperform stocks with a less pronounced smirk. Yan (2011), finds that low slope portfolios earn higher returns than high slope portfolios. Cremers and Weinbaum (2010) find that stocks with relatively expensive calls outperform stocks with relatively expensive puts. Rehman and Vilkov (2012) find that option-implied ex ante skewness is positively related to future stock returns. Last, Faff and Liu (2014), find that the more negatively skewed is the risk-neutral distribution, the lower the future returns in the SPX market. Stilger et al. (2015) argue that the underperformance of the portfolios with the lowest risk-neutral skewness is driven by those stocks that are perceived as overpriced by investors but hard to sell short.

To sum up, a positive relation between risk-neutral and physical skewness is generally found. The skewness risk premium is generally found to be significant but the evidence on the sign is mixed. The relationship between skewness and subsequently realized returns is debated: some papers find a positive relation, others a negative one. The majority of the papers have investigated the American market, and have used single stocks, very little is the evidence on market indexes, in particular, European ones.

In this setting, the present paper is a first attempt of filling the gap, in order to delineate a skewness index for the Italian stock market. In fact, in the Italian index-options market, while implied volatility is currently measured by the implied volatility index, called the $IVI$ index (which is computed similarly to the $VIX$ index), a measure of the asymmetry and tail risk (such as a skewness index) has yet to be introduced. We compute both an index similar to the $CBOE\ SKEW$ index and investigate also other asymmetry indexes, the $SIX$ indexes, as proposed in Faff and Liu (2014). We analyze the properties of the skewness indexes, by investigating the relationship between the skewness measures, implied volatility and the returns on the underlying stock index. Moreover, we assess the profitability of skewness trades and disentangle the contribution of the left and the right part of the risk neutral distribution to the profitability of the latter strategies. The data set consists of FTSE MIB index options data and covers the years 2011-2014, allowing us to address the behavior of skewness measures both in bullish and bearish market periods.

The results show that in the Italian market, the risk-neutral distribution of the stock market index presents a negative asymmetry which is higher in absolute terms than the one of the physical distribution. This implies that there exist a negative skewness risk premium, which is supported by the empirical evidence that selling out-of-the-money puts and buying out-of-the-money calls is on average profitable. In addition, the higher performance of the portfolio composed by only put options indicates that the mispricing of options is mainly focused on the left part of the distribution. We find a negative relation between volatility changes and changes in the Italian $SKEW$ index: an increase in model-free implied volatility is associated with a decrease in the Italian $SKEW$ index (less negative risk neutral distribution). We do not find any significant relation between model-free implied volatility and the other asymmetry $SIX_{mf}$ indexes.

By investigating the relation between the skewness indexes and market returns, we find that an increase in the $SKEW$ index (i.e. the risk neutral distribution becomes more negatively skewed), is associated with an increase in the returns. We also detect an asymmetric effect: a decrease in the $SKEW$ index is associated with a strong decrease in the returns, while an increase in the $SKEW$ index is associated with a less pronounced increase in the returns. The market reacts more negatively to decreases in the $SKEW$ index than it reacts positively to increases in the $SKEW$ index.

Therefore in this setting the $SKEW$ index acts as a measure of market greed and the opposite of the $SKEW$ index (risk neutral skewness) acts as a measure of market fear, since returns react more negatively to a decrease in the $SKEW$ index (increase in risk neutral skewness) than they react positively to an increase of the latter (decrease in risk neutral skewness). When skewness is proxied by the $SIX_{mf}$ indexes, the slope coefficients are non-significant, pointing to the uselessness of the $SIX_{mf}$ indexes as indicators of current risk. Therefore, we find that the $SKEW$ index presents many advantages with respect the $SIX_{mf}$ indexes: it has a significant contemporaneous relation with both returns, model-free implied volatility and is still significant in the explanation of returns, even after having controlled for volatility. We also find weak evidence that positive changes in the $SKEW$ index are reflected in a negative return the following day, and that a positive return is reflected in an increase of the $SKEW$ index. This is in line with Harvey and Siddique (2000), who find that when past returns have been high, the investors' forecast of skewness becomes more negative, consistently with the so-called "bubble theory": if past returns have been high, this means that the bubble has been inflating and therefore a large drop can be expected when the bubble is going to burst. Given the possibility to use the Italian $SKEW$ index for settling portfolio strategies and to forecast future returns, and the properties of the $SKEW$ index as indicator of market greed, we believe that the results of the paper can be of importance for both investors and regulators.

The plan of the paper is as follows: in Section 2 we review the existing literature about skewness measuring and forecasting, in Section 3 we present the different skewness measures, in Section 4 we describe the data-set and the methodology in order to compute the skewness measures. In Section 5 we analyze the properties of the skewness indexes obtained and finally in Section 6 we investigate the profitability of skewness trades in line with Bali and Murray (2013), where three different portfolios (a $PUTCALL\ asset$, a $PUT\ asset$ and a $CALL\ asset$ are created in order to disentangle the contribution to the profitability of differences in the left or in the right part of the distribution or in both. The last section concludes.

## 2. Literature review

After the October 1987 crash, many authors recognize that the implied volatility of index options varies with a pre-specified pattern: out-of-the-money put options are more expensive than out-of-the-money call options (the so called skew or smirk). This phenomenon has been called (Rubinstein 1994) the "crash-o-phobia", since put options are deemed to be more expensive than call options because they provide protection against stock market crashes. Jackwerth and Rubinstein (1996)

Table 10 - Skewness assets returns for the entire sample period

| | $PUTCALL\ asset$ | $PUT\ asset$ | $CALL\ asset$ |
|---|---|---|---|
| Cumulative return | 56.43% | 49.16% | 10.64% |
| Average daily return | 0.05% | 0.04% | 0.01% |
| t-statistic | 5.49 | 4.05 | 0.95 |
| p-value | 0.000 | 0.000 | 0.343 |
| Average ann. return | 11.44% | 10.28% | 2.73% |
| Annualized volatility | 4.14% | 5.03% | 5.70% |

Note: The table reports the descriptive statistics for the Skewness assets returns used in the study in order to disentangle the contribution to the profitability of differences between the physical and the risk-neutral distribution in the left ($PUT\ asset$) or in the right ($CALL\ asset$) parts of the distribution or in both ($PUTCALL\ asset$) .