

## How to Estimate Volatility

### Methodology under SAB 107

As the principle driver of option value, volatility is one of the most scrutinized inputs to ESOP valuation models. Many firms are pushing to come up with lower option values through aggressive volatility estimates, often times driven through the strict use of implied volatility. This short-term focus can lead to undesirable results in future periods as market sentiment, which is theoretically captured in implied volatility, can shift without a moments notice.

Given that FAS 123r requires that the methodology behind obtaining assumptions as inputs to a valuation model should remain constant from period to period, companies should consider the impact of their methodology in more than the current period. Instead, a larger amount of time should be spent analyzing trends in volatility, with the goal of determining the potential fluctuation in a volatility estimation approach from period to period. This is smart from a valuation and expensing standpoint, but also from a forecasting standpoint. Most companies find some comfort in being able to reasonably forecast expenses in future periods, and this requires relative stability in the underlying numbers.

This paper will touch on what we believe is the “best practice” approach to estimating future volatility. This is by no means a holistic view into the methodology underlying our approach, but instead a high-level glimpse into some of the thought process involved.

### Implied Volatility

The heavy reliance on implied volatility has come in light of the SEC's guidance (SAB 107). In their response to FAS 123r, they state, "The staff believes companies that have appropriate traded financial instruments from which they can derive implied volatility should generally consider this measure."

In determining whether or not the financial instruments are "appropriate," one must consider the following factors:

1. *The volume of activity of the underlying shares and traded options*

Determining the level of volume that justifies the use of a particular financial instrument, call options in most cases, for the calculation of implied volatility is more complex than it might seem. This is complicated by the fact that what constitutes adequate volume for one company is likely to be deemed insufficient

volume for another. Auditors from the Big 4 firms have pushed on this issue, and rightfully so, but they have offered little tangible feedback related to a standard approach for determining adequate volume. Instead, auditors have generally examined the volume issue in a somewhat subjective manner from engagement to engagement.

#### *Proposed Solution*

If the goal is to capture market sentiment about future volatility, then it is important to ensure that the underlying options are actually being traded. This means that we should at least exclude instruments that have not been traded from the analysis, but again we are left with little guidance from the SEC, Big 4, or the FASB as to the appropriate way to handle other instruments.

In the end, there is no 'best' solution to this problem, but we propose some very reasonable and theoretically sound approaches to arriving at an implied volatility estimate.

These approaches include the following procedures:

- Only instruments that have been traded are used in the analysis
- We examine prior periods to determine the stability and average level of volume historically. This allows us to determine what “normal” trading volume is and gain insight into how the present differs from the past on this point.
- Test the sensitivity of implied volatility estimates by excluding options greater than 2 standard deviations from the mean trading volume. The goal is to see whether or not heavily traded instruments contain different information than instruments that have been traded less frequently.
- Include all call options, if those are the instrument being used, with a term greater than or equal to 12 months. This will often lead to a dramatic increase in overall volume because the longest “leaps” are generally traded the least.

If there is a marked decline in trading volume in the current period or if volume is very erratic over the history, then a heavy reliance on implied volatility is not the best approach. There still is information to be gained from these instruments, but a full reliance, or even 50% weighting, is generally not warranted.

#### 2. *The ability to synchronize the variables used to derive implied volatility*

The synchronizing of variables such as the strike prices of both instruments is important, but not as important as many believe. Strict adherence to this rule can

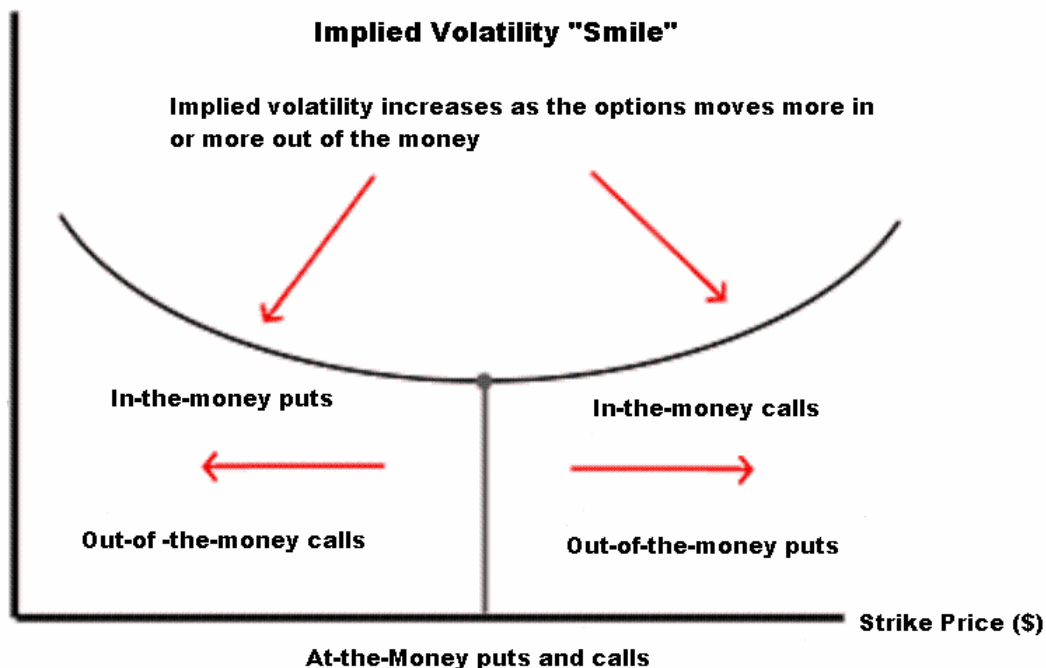
result in the loss of valuable market information because generally there are very few trades on the day of an option grant.

### *Proposed Solution*

We choose to include all options that are traded in the month of the grant being valued, with some exceptions to come later on. This is a trade-off that must be made in order to ensure that the adequate volume constraint is met. In the end, the differences in strike prices of the instrument are small and do not have a material impact on the underlying implied volatility.

### 3. Similarity of Exercise Prices

The SEC’s ruling states that an important factor for consideration when calculating implied volatility is the alignment of the strike prices of both instruments. Because of the nature of the implied volatility “smile”, or distribution of Black-Scholes calculated values, the failure to eliminate options that are in or out-of-the-money results in a higher volatility calculation. The chart below shows this.



Because the only result of including an option that is not at-the-money is a higher volatility estimate, auditors should not be concerned this constraint. However, firms will find it to their advantage to ensure that the appropriate options are coming into the final estimate, and make sure that their 123r consultant has

addressed this issue appropriately. This is why we only include options where the difference between the current stock price and the strike price is not greater than 15% of the original strike price.

4. *Similarity of the length of the term of the traded and employee share options*

With most ESOP's having a contractual term of 7-years or greater and the longest “leap” on tradable options being in the range of 2.5 years, it is not possible to directly line up the terms of the two instruments. SAB 107 states that if there are no terms that directly match the instrument being valued, then you should use the instrument with the term that most closely matches that of the ESO. However, they do place a constraint on the use of implied volatility alone. Implied volatility can be the sole data point for estimating future volatility only if the contractual terms of the options being included in the calculation have term of at least 12 months

The term lengths are not only important if the desire is to use implied volatility as the sole estimate of future volatility, but also if heavy reliance on implied volatility is to be given at all, i.e. weighting of at least 50% with a historical measure. The inclusion of shorter option maturities along with longer maturities can result in a downwardly biased estimate, and should not be overlooked.

*Proposed Solution*

We prefer to adhere to the belief that if heavy reliance on implied volatility is desired, then options with maturities of at least 12 months can only be used. The use of options with shorter maturities should relegate the use of implied volatility in a diminished capacity, i.e. less than 50% weighting.

*Conclusion*

What does all of this mean in the end? In our opinion, option trading volume should be considered over the history of the firm, and not some subjective measure based on an outside company. The strike prices of the instruments should be lined up whenever possible, but does not affect the viability of the estimate in the end. The inability to synchronize the exercise prices of both instruments will not downwardly bias an implied volatility estimate, but strict adherence to this constraint will negatively impact the volume of the instruments being used. If implied volatility is to be used exclusively, or heavily relied upon, then options with at least 12 month terms must be used.

### *Final Implied Volatility Estimate*

The final implied volatility estimate should be a volume weighted average of all appropriate options. This is done in order to incorporate the theory that more heavily traded options contain more “market sentiment” and thus should be given more weight in the estimate.

### *Unique Instruments*

Most of the implied volatility literature focuses on the use of call options, but SAB 107 does touch on the use of other instruments, such as convertible debt, in deriving implied volatility.

Convertible debt is debt that is convertible into shares at some point in the future. These instruments can be thought of as consisting of two separate pieces, a bond and a warrant. This does complicate the valuation of these instruments, but it is possible.

The valuation of these instruments consists of discounting the future principal and interest payments by the cost of borrowing, credit spread, in order to derive the value of the bond. The warrant value is then derived by taking the market trading price and subtracting the bond portions from it. This value is then divided by the conversion factor, or shares received for dollar of value, with the result being the value of the call option portion of the convertible debt. Calculating the implied volatility is then the result of back-solving the Black-Scholes formula for the volatility that will produce the current traded price in the typical manner.

### *Our View*

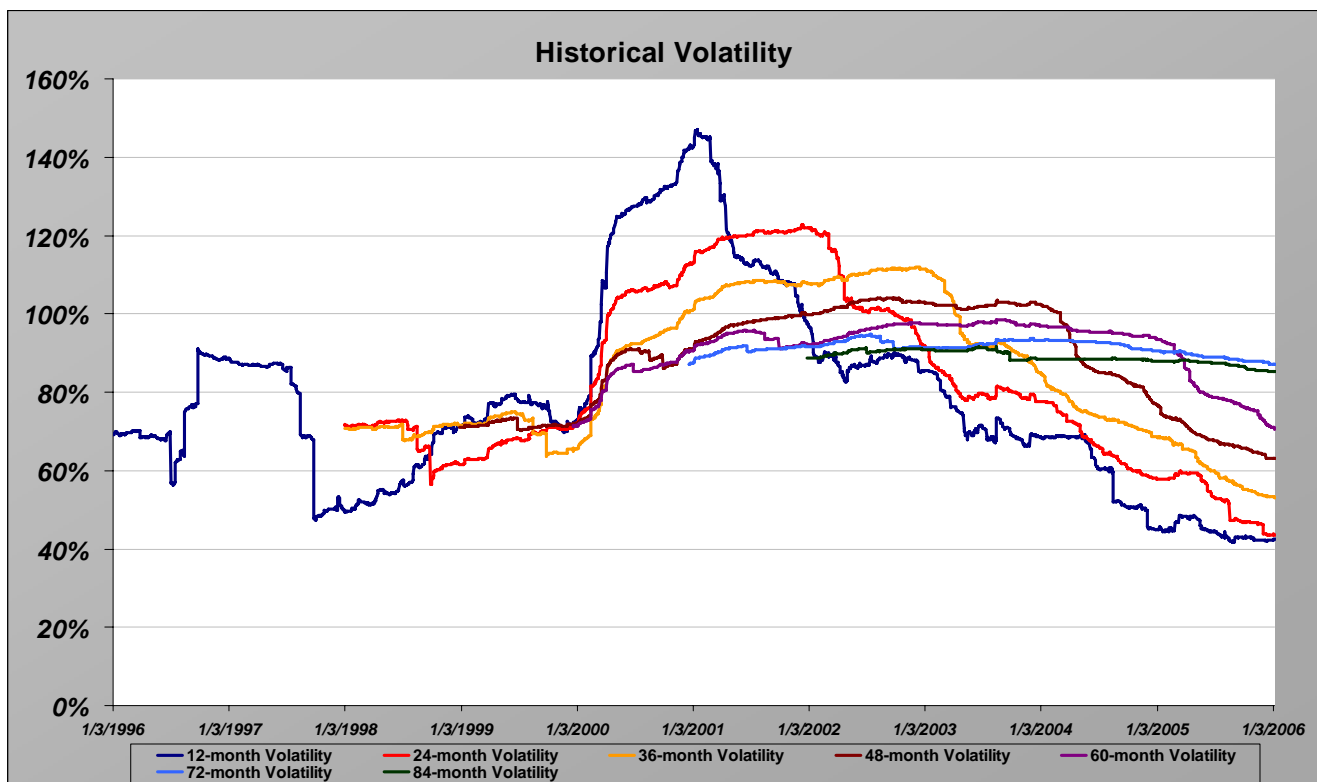
There are several factors that make convertible debt unsuitable for use in our view. These include feature such as issuer calls, investor puts, and conversion rate resets. These features are often difficult to identify without the ability to obtain the contract, and if identified require a more complex model to incorporate them into the valuation process. This is why we recommend that they are not used in the calculation of implied volatility.

## **Historical Volatility**

The basic process for calculating volatility, the standard deviation of the log of returns, is something that anyone can pick up at the local library, but the skill necessary to forecast future volatility requires much more experience and thought. We must understand that estimating volatility is a forecast, and as a result we are likely to be wrong, but there are still many steps, if followed that can lead to a more robust estimate of the future.

Our approach to estimating volatility differs greatly from that of the industry. We believe that an in-depth knowledge of the firm and the underlying health of the industry are vital in the estimation of future volatility. This means that before any attempt to arrive at a final estimate can be made, analysis of how the business or leverage may change, how the firm's growth strategy might differ from history, and how the firm and industry itself may be evolving, are just a few of the areas that must be accounted for in any estimate. Much of the industry does not examine these vital issues, and it is unfortunate that auditors at the Big 4 don't push back more on these points.

Only after a solid grasp of the company and the environment that it is subject to are gained can the process of analyzing the path of future volatility. This process involves looking at historical lookbacks, or volatility lengths, by plotting them over time. This process allows for a visual examination of the path that the firm's volatility has tracked. A sample volatility chart is shown below.



Many people might be asking themselves, “How am I supposed to gain any information from this chart?” Well, there is a large amount of information present in this chart if we know what we are looking for and where to begin.

The most important thing to look for when deriving the most representative lookback period to use as a baseline for estimating future volatility is an “inflection point” in the chart. An inflection point can be thought of as a specific point in the chart at which the mean of the volatility system has shifted and the underlying trend in the data has changed. The difference between short-term variance and an inflection point is that an inflection point results in the underlying trend in the data changing for all subsequent periods. In the chart shown above there is an inflection point occurring at the end of 2002 or the beginning of 2003. The volatility trend since this time has consistently been downward signalling that the environment has changed for the firm, thus the inclusion of periods prior to this time are most likely not representative of the current state that the firm is operating under.

What can cause inflection points? Inflection points are the result of much larger structural changes in the industry or firm itself. They are often the result of the natural growth process of the firm, added diversification, growth strategy changes, changes in debt structure, or a number of other firm specific changes. There are however industry wide changes that can result in similar inflections, such as changes in the lifecycle of an industry, macro economic factors, and a host of other changes.

Any sign of an inflection point should result in the immediate question being asked by the consultant, “What was the underlying cause?” Often times it is possible for the consultant to answer this question themselves, such is the case with the stock market “bubble”. However, often it is necessary to confer with the leading source on these changes, management at the firm of analysis, in order to determine the underlying cause. Whatever the approach to determine the cause of the inflection point, it is also important to determine whether or not the cause is a result of a permanent event. That is why management should play a vital role in any volatility estimation process.

Any inflection points have been identified, if they exist, and the necessary questions around their cause have been asked, so what is next? In our experience many firms, and auditors, believe that the lookback period used to estimate volatility should line up with the expected term of the options being valued. At no time do either of the standards, FAS 123r and SAB 107, state that the term and lookback period should align however, and any suggestion that this is necessary is inconsistent for a couple of reasons.

- If groups are present then under this view separate volatility estimates should be used for each of the group. This implies that options being granted on the same day are subject to different conditions in the future.
- This view would imply that the “best” estimate of future volatility over the life of the next batch of options is the one that lines up with the expected term. There is no statistical proof that such an approach is viable, and strict adherence to it eliminates any analysis of how the future may differ from the past.

What is the alternative then? The estimation of volatility is not as simple as following some “one-size fits all” approach, but instead is the result of experience, analysis, and reasonableness. This involves the analysis of the historical chart for periods that stand out as potential periods of exclusion, identifying “inflection points” if they exist, and choosing a lookback period that corresponds with the previous points but is ultimately reasonable.

### **Final Volatility Estimate**

SAB 107 has a strong preference for the inclusion of implied volatility, as stated earlier, and we agree with this belief. The inclusion of implied volatility in the estimation process provides another data point which will hopefully increase the viability of the final estimate. Unlike the SEC, we do not believe that implied volatility should be used as the sole estimate of the future, but instead believe that the estimate should incorporate an appropriate implied volatility estimate, as defined in the previous sections, and a historical measure, again as defined previously.

The weightings of implied volatility and historical volatility in the final estimate should be based on a couple of factors.

- The length of expirations used to derive the implied volatility estimate
  - If options with < 12 months to expire are the longest terms available then the weighting should be at a maximum of 10%.
  - If longer “leaps” are available then up to a 50% weighting should be used.
- The historical fluctuation of implied volatility.
  - If there is a wide variance in implied volatility estimates from period to periods then less reliance should be given to implied volatility if the desire is a stable and easily forecasted estimate.
- The predictive power of implied volatility historically
  - This is a point that is rarely touched on by other consulting firms, but is vital if our desire is to provide the best estimate give all available information.
  - If implied volatility has been a poor estimate of future volatility, as determined by measuring historical estimates versus realized numbers, then our belief is that less emphasis should be given to implied volatility

So where does this leave us? Well, the final estimate should include both implied volatility, if available, and historical volatility with the appropriate weighting determined by the previous factors. Ideally if both measures meet the prior points then a 50:50 weighting should be used, but in many cases the appropriate weighting falls somewhere between a 100% historical measure and the 50:50 weighting of the “trend adjusted” method.

**For additional information on our services or to speak with someone who can assist you in determining your plan of action to IRS Code 409A, please contact us at:**

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