Profit and Loss Explanation

Risk measurement will create a strong linkage between pricing models used for profit and loss (P&L) and pricing models used for risk measurement. All market inputs are available for incorporation to risk management systems though some require alternative historical data for calibration procedures. Consistent valuation models will facilitate the identification of market factors driving valuation.

A revamped Front Office and Middle Office trade and P&L validation process (new "End of Day") will result in the ability to report T+0 P&L measurement and risk measurement via the Transit Valuator application and accompanying Middle Office reports. This process will provide a linkage between the Actual P&L, Explained P&L, pricing models, and market data. It will also facilitate the identification of trade capture errors and reduce the requirement of VaR proxies.

Market data accuracy will also improve significantly with the common set of pricing models which allows for direct re-use of official valuation market data (sourcing from the Front Office and Global Middle Office databases, and Valuation Product Control group). This will significantly reduce the complexity of managing multiple market data sources. All market data required for daily valuation is to be saved in databases which are accessible to the relevant Market Risk teams. Data used to compute P&L, PAA, BT and shocks used in VaR should be the same.

The identification and selection of market risk factors to be captured in a risk model, such as VaR, are critical to building strong risk measurement platform. The Risk Management Completeness Review Stream will be responsible for regular validation of the risk factors. Risk factors are market variables which are expected to impact valuation P&L. In VaR, "risk factors" also define the returns which are simulated and subsequently mapped to market instruments. Generally, risk factors should:

- Be related to the market instruments resulting in P&L
- Provide strong explanatory power for P&L
- Offer an effective method for profit attribution

Risk factors in the VaR model define the parameters which are simulated in the Monte Carlo engine. The starting point for defining risk factors in the Nextgen framework is reviewing the pricing models market parameters. These market factors and inputs are candidates to be included as risk factors to VaR. The inclusion of risk factors will be chosen to minimize the Unexplained P&L (see Unexplained P&L section below). The inclusion of risk factors also requires the generation of sensitivities (to which simulated returns are to be applied) and market data for calibration.

Risk factor granularity includes the selection of points along a curve or surface that are simulated in VaR. In many cases, the selection of these points will be dependent on the tradable instruments that desks have been authorized to trade. For example, a desk authorized to trade bond instruments with a final maturity of 10y will have interest rate sensitivity to various tenor points up to 10years. Thus, the selection of risk factors should include instruments having up to 10years in maturity.

The selection of factors may require an evaluation of the simulation modelling under various definitions (such as simulating relative or absolute returns). To the extent that not all market inputs for valuation are represented in the VaR risk factor simulation set, this should be investigated and the justification documented. Often market inputs are rendered more coarse as they are translated to risk factors (i.e. a 27 point yield curve for valuation may be translated to a 5 point yield curve for VaR simulation).   Such translations should also be reviewed and documented as to evidence that the underlying characterization of the market risk is preserved.

With a semi-annual frequency, factors used to decompose P&L for PAA purposes should be compared to risk factors simulated in VaR. PAA involves either 1) a greek-based approach which incorporates changes in PAA market inputs and PAA Greeks or 2) a full revaluation, sequential perturbation of PAA market inputs. In Nextgen, this comparison will be facilitated through common pricing model.

For PAA approach #1, the collection of PAA Greeks should be compared against the VaR Greeks. For example, PAA for an equity derivatives desk may employ an equity 'delta' or risk sensitivity to equity price changes. The suite of VaR Greeks should also contain this term. Similarly, PAA market inputs should be compared with VaR Risk Factors. For example, if equity price changes are part of the PAA process, they should also be simulated in VaR. To the extent that these comparisons yield differences, an investigation should be launched.

For PAA approach #2, the PAA Market Inputs should be compared with the VaR Risk Factors. For example, for a given LOB, the monthly PAA should be reviewed and material contributors should be investigated to ascertain key PAA Market Input drivers. These items should then be confirmed as part of the VaR simulation. To the extent that these comparisons yield differences, an investigation should be launched.

The list of risk factors will evolve over time depending on the relevant market data, portfolio holdings or other parameters. For new products, a review of the required risk factors against existing risk factors will occur as part of the IAAP process. Risk factors that are not simulated in VaR will need to be added to the risks not in VaR list as part of the <u>Risk Measurement Completeness Review</u>.

There are multiple assumptions that are made when modelling risk factors. These choices need to be selected and reviewed to allow for an accurate representation of returns from the simulation engine. The <u>Risk Measurement Performance Review Stream</u> will be responsible for maintaining and signing of on the representation of risk factors and results of the risk simulation. For example, bond spread factors could be simulated as a bond yield or zero yield. Bond yields could also be simulated as a spread to another curve or an all-in rate. The results of the calibration and simulation engine are highly dependent on these assumptions.

A review of modelling assumptions has been incorporated in the Nextgen work. For example, in the work leading up to the Nextgen project, the simulation of base metal commodity futures was changed from an all-in representation to a spread against commodity forwards. The revised modelling assumption helped to improve the accuracy of the basis between futures and forwards, which previously exhibited nearly unbelievable scenarios that were far outside the realm of a 99% confidence level. As part of the commodities, equities and fixed income portions of Nextgen, joint efforts between VPC, RO, and Risk Models have reviewed the basic premises in the risk factor definitions including the use of constant maturity risk factors in commodities and zero interest rate yields for simulation.

A distribution analysis of historical returns against simulated returns will be performed in cases where material adverse effects are observed. This includes the evaluation of important spreads (such as libor-OIS) as well as outright prices (such as libor futures and swap instruments) using statistical tests for model validation (such as the Kolmogorov-Smirnov test). The simulated scenarios should be able to effectively reproduce the original correlation and volatility matrices used as inputs while considering VaR as a forward looking measure.

The target objective for a risk model is equivalency between the hypothetical full revaluation P&L (clean P&L) and hypothetical VaR P&L (model P&L). Clean P&L represents the full revaluation P&L driven by market factors (thus excludes the impact of new trades, date roll and fees/commissions). Model P&L represents the P&L computed using the market factors and valuation approach captured in the risk model (sensitivity based or full revaluation). Unexplained P&L represents the difference between Clean P&L and Model P&L.

When the unexplained P&L reaches above a minimum threshold of P&L (10%/$50K) and VaR (5%/$50K), a review needs to be initiated to understand the drivers. The Risk Measurement Performance Review Stream is tasked with reviewing and outlining any differences. For Nextgen, the single valuation model framework between sensitivity based profit attribution and actual P&L will facilitate the identification of unexplained P&L.

A daily review of trade capture, market data, and model inputs will be required to confirm differences between these two P&L metrics. Confirmed differences between model P&L and clean P&L will often be the result of RNIV. These measures will be evaluated and tracked for each limit letter and legal entity roll-ups. Summary metrics tracking these thresholds along with drivers for the differences are to be presented to the Risk Measurement and Data Review Group by the Risk Measurement Completeness Review Stream. Material gaps identified as RNIV will need to be reviewed for inclusion of additional sensitivities to VaR or changes to risk factors.

To more effectively identify the root issue, the unexplained P&L can be split into the impact of a sensitivity approach and impact of risk factor selection using two additional P&L measures (risk based PAA P&L and full revaluation model P&L).

The impact of the sensitivity approach indicates a gap between full revaluation P&L and sensitivity based P&L. Reducing this difference requires the addition of new sensitivities to the model. A move to a full revaluation would completely remove this error in the model P&L. This difference will be tracked over time at the limit letter level and can be used to evaluate the potential improvement from changing the valuation approach in the model.

The impact of risk factor selection indicates the gap between a direct market instrument representation in valuation compared to mapping market data to risk factors and back to market instruments. As risk factors represent a selective choice of market instruments, differences attributed to risk factor selection will require a review of the risk factors and risk factor modelling assumptions. This difference will be tracked at the limit letter level.

Gaps identified by these two impacts should be investigated to understand drivers. The daily full revaluation backtest should be compared to the Greek-based backtest to identify risks potentially not in VaR.

The unexplained component of PAA should also be separately reviewed to understand key drivers. To the extent that this is >10% of the total P&L, a PAA methodology review should be initiated to understand the drivers behind the unattributed P&L. The comparisons between backtest measures and PAA will be the responsibility of the Risk Measurement Completeness

Review Stream. Investigations may lead to the identification of important new factors that should be included in PAA and/or VaR and recommended for implementation.

Reference:

https://finpricing.com/lib/IrCurve.html