A New Approach to ESG Calibration Target Setting

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Introduction and a Perspective on Historical Data

The setting of calibration targets is one of the most important components of the application of an economic scenario generator (ESG) to risk management. The calibration of an ESG determines its primary view on market risks and informs the baseline assumptions that senior management makes in assessing business performance. The two most important inputs to the setting of calibration targets are historical data and expert judgement. The global historical record is rich with patterns embedded within periods of relative calm and turmoil. Mark Twain is reputed to have said "history never repeats itself but it often rhymes," and this is an apt analogy for how the historical record informs the target-setting process under the guiding hand of expert judgement.

Within the historical record, one may often find many instances of two non-overlapping periods of time during which the behavior of a specific financial variable for a given economy is similar. However, the state of an economy is governed by many fundamental variables, and the reasons for the dynamics that were experienced in one particular period could differ significantly from the reasons for the dynamics that were experienced in another period, even when the behavior of a financial variable of interest is the same in both periods. For example, there were two periods in US interest rate history during which the 3-month rate remained close to zero for a prolonged period of time: 1932–1937 and 2008–2016, as seen in Figure 1 below. During both of these periods there was weak economic growth, but the economic collapse experienced during 1932–1937 is not comparable to the recessionary experience of the 2008–2016 financial crisis era. For example, the inflationary environment in the US was quite different during these two periods, as we see in Figure 2.

The 1932–1937 period experienced chronic deflation and significant volatility in inflation rates. In contrast, the 2008–2016 financial crisis era experienced a small deflation shock and returned to a stable and low-inflation environment. Similarly, the response of the unemployment rate to the two crises was very different: in the post-1932 period, unemployment jumped to over 20% and remained above 10% for nearly a decade; in 2008, the shock to unemployment was

Figure 1: US Three-month Treasury Bill Rate

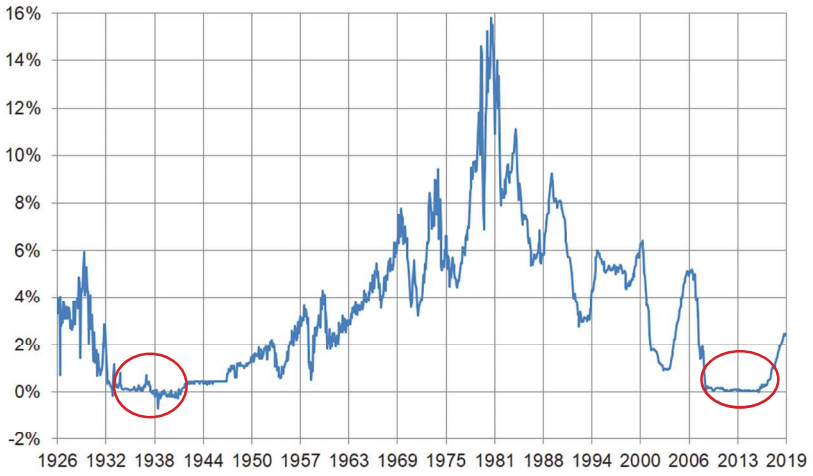

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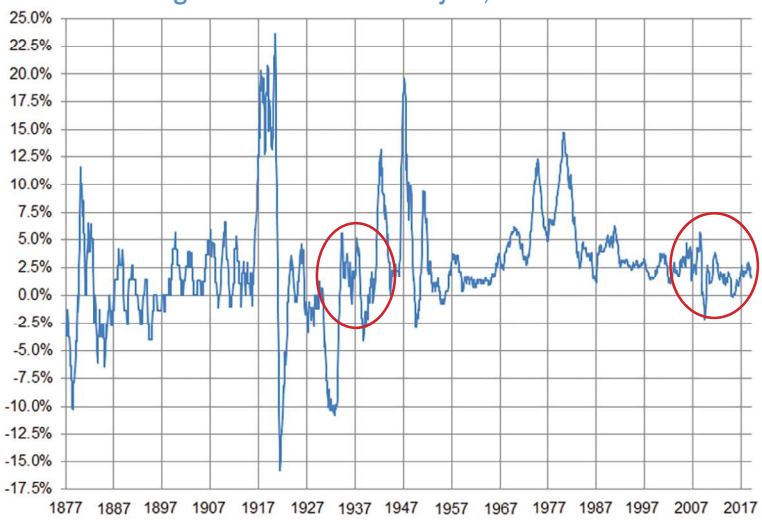
Figure 2: US CPI Year-over-year, 1877–2019



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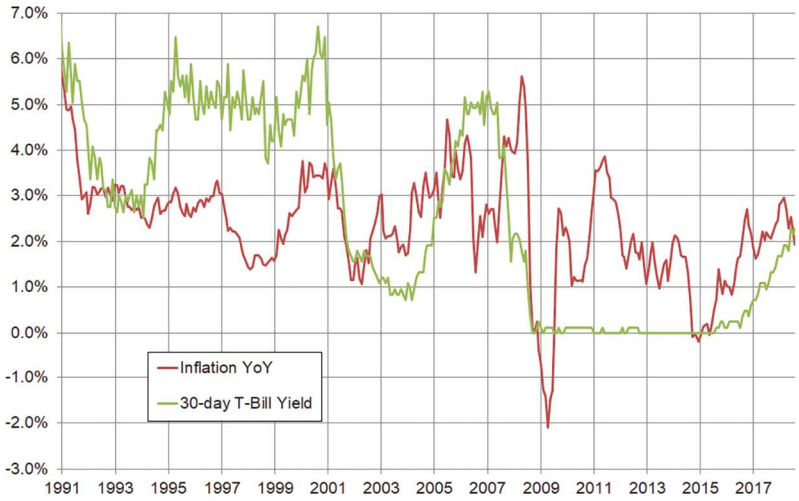
significantly smaller (slightly below 10%), and it normalized much more rapidly. Thus, we see that, despite the apparent similarity between interest rate behavior during these two periods, there were fundamental differences in other key aspects of the economy that make a direct comparison between the two periods of limited value. This is a common issue if one tries to compare experiences during different historical periods. Consequently, it is often problematic to apply previous historical experience in setting targets or expectations for the future evolution of financial variables.

Another general approach in which historical data can be applied to target setting is to select a historical period and use the statistics for that period to establish calibration targets. One of the challenges with this approach is that interest rates have been far from stable for most global economies. If one chooses a historical period for the data in Figure 1 and computes the average level and volatility of the treasury rate, one finds that these statistics are quite sensitive to the length and historical window of the chosen period. Alternatively, if one were to use a process based on the most recent twenty years of data, then the targets based on these statistics will evolve as the historical window rolls forward. This will imply changes in calibration targets that are possibly the result of short-term fluctuations in data rather than fundamental changes in economic outlook.

To overcome this difficulty, Conning has developed a new approach that combines economic information, historical analysis, and expert judgment to establish credible and transparent calibration targets for an ESG. One of the most important developments in global financial markets in the last thirty years has been the near-universal adoption of inflation targets by the world's central banks. This began in the early 1990s, and we can see in Figure 2 that relative to the longer history inflation rate volatility in the US has been lower ever since. The data in Figure 3 shows recent inflation and short-term interest rate behavior for the US. Compared to the longer historical record, this data is quite tame and demonstrates a significant change in the stability of inflation and interest rates in part as a result of central bank credibility. The qualitative features of the data in both Figure 2 and Figure 3 are similar across other developed economies that have adopted inflation targeting.

Figure 3: US Inflation and Short-term Interest Rate



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Our understanding of the success of the inflation-targeting approach to central banking can serve as a theoretical basis for setting robust calibration targets. The general approach begins with understanding the individual inflation targeting approach for an economy and analyzing the relative success of inflation targeting based on the historical record of inflation levels after the targeting policy was adopted. Calibration targets for inflation are derived from this information, and the relationship between inflation and short-term interest rates is then examined. When calibration targets for short-term interest rates are established, target setting for the rest of the treasury yield curve is accomplished by looking at historical term premia using an econometric model.

Target-setting Considerations

There is no definitive strategy for setting targets, and considerations beyond the purely technical may be important in designing an appropriate methodology. There are also many practical considerations, in terms of the ability to calibrate models on a regular and timely basis and the need for parameter stability through time. Therefore, before defining a specific target-setting methodology for interest rates, it is worth considering what general characteristics an idealized process might have, and to use this as a guide.

It is our belief that certain principles should be adhered to:

1. The methodology should enable the setting of long-term or steady-state targets of key variables.
2. The methodology should lead to targets which remain stable through time and do not require regular updating.
3. The methodology should be consistent across economies and, by extension, be applicable irrespective of geographic, economic, or other differences.
4. The methodology should not be overly impeded by the lack of availability of data.
5. The methodology should be justifiable based on the available data and the latest thinking in the academic literature.
6. The methodology should lead to targets which are appropriate and meet the expectations of the many markets the ESG product serves.
7. The methodology should be as prescriptive as possible, allowing targets to be set by following a well-defined procedure.

While it may not always be possible to satisfy these requirements, they serve as useful guidance when differentiating between different target setting methodologies.

Inflation and Interest Rate Target Setting

In setting targets for nominal interest rates based on central bank inflation targets, there are several steps which must be carried out:

1. Use data to assess the reasonability of the central bank inflation target as a measure upon which to base an inflation target.
2. Apply a correction, if necessary, to form long-term targets for the inflation rate.
3. Prescribe a methodology for mapping the steady-state inflation target onto a short-term interest rate target (e.g. 3-month yield).
4. Prescribe a methodology for setting targets for higher tenors (e.g., 5-year and 10-year) given the short-term interest rate target.

Conning uses central bank or representative target inflation rates as a starting point for setting the steady-state mean inflation rate for each economy. However, a correction is applied which is determined from an analysis of data from the mid-1990s, where available; this period is chosen because it covers the period during which many economies began adopting inflation targeting in monetary policy decisions, and so is a period where we might reasonably expect that, for developed economies, those targets had an effect. This inflation data is compared to the available monetary policy target and analyzed to determine the appropriate correction factor based on how well a central bank has achieved its stated target inflation rate. For example, Figure 4 shows historical values for the inflation rates minus the US inflation target. Table 1 shows a sample of the resulting corrected inflation targets including representative targets for the volatility based on an historical analysis.

Figure 4: Historical Inflation Rates Versus the US Inflation Target

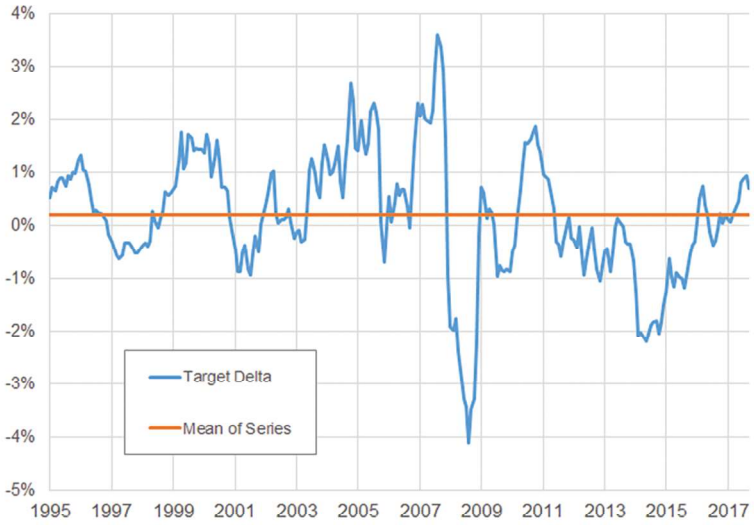

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Table 1: Conning Corrected Inflation Targets

Economy	Year-over-year Inflation Target Mean	Year-over-year Inflation Target Standard Deviation
United States	2.25%	2.56%
Eurozone	2.00%	2.00%
United Kingdom	2.25% (CPI) 3.25% (RPI)	3.61%
Japan	1.50%	3.07%
Canada	2.00%	2.81%

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Figure 5: The US Three-month Yield and the Yield Adjusted by Inflation Rate

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The next step is to map these steady-state inflation targets into a steady-state interest rate target for a short-term interest rate. We choose as our short-term instrument the three-month government bond. This is chosen because long histories of data are typically available and bonds with three-month maturity are mostly liquid. The objective of this analysis is to determine an implicit "risk premia" that the short-term interest rate carries to reflect real interest rates in the inflation targeting era. This process proceeds by considering data such as that in figure 5, which shows the inflation-adjusted 3-month interest rate through time (calculated as the yield minus the prevailing interest rate).

We note a marked difference in the inflation-adjusted short-term interest rate following the 2008 financial crisis, with a persistent period of negative adjusted rates. This feature is mirrored in many economies globally and is the subject of some discussion within academic and financial industry circles. We also note that, towards the end of the historical window shown, the rate has returned to positive values, as interest rates have risen in the US. In practice, a weighted average is used to extract appropriate additive correction factors to the inflation targets to arrive at a short-term interest rate target.

The resulting correction factors, along with the short-term interest rate targets, are shown in Table 2.

Table 2: Final Inflation Targets and Three-month Interest Rate Targets

Economy	GEMS Steady State Mean Inflation Target	Correction Factor (C)	Steady State 3-month Yield Target
United States	2.25%	0.618%	2.87%
Eurozone	2.00%	1.003%	3.00%
United Kingdom	2.25% (CPI) 3.25% (RPI)	2.188%	4.44%
Japan	1.50%	0.073%	1.57%
Canada	2.00%	1.157%	3.16%

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Term Spread Estimation

With the 3-month yield target in place, targets for longer maturity yields (e.g., 1-, 5-, 10-, and 30-year) are determined by adding a term spread to the 3-month yield specific to each economy. The term spread is determined using the Dynamic Nelson-Siegel model (DNS). This model has been shown to have good forecasting properties, and has several useful features when considering the estimation of the term spread targets, including:

1. It is a three-factor model which is capable of producing shift, twist and curvature in the yield curve.
2. It is easy to estimate from available data.
3. It provides an algorithmic way of determining the targets, removing much of the need for expert judgment and removing "observer bias" (i.e., that one analyst can arrive at a significantly different target than another).
4. The Dynamic Nelson-Siegel model is widely used across capital markets, including by many central banks.

The model incorporates three factors: level, slope, and curvature. A decay rate is applied to extrapolate the yield curve to longer maturities of bonds, and a stochastic disturbance term captures any discrepancy between the model's yield predictions and actual historical yields. To use the model for estimating the term spread, we fit the factors to the historical yield data; by fixing the decay rate, this can be done by using ordinary least square estimation. Autoregressive models are then estimated for each factor and projected forward until a steady state is reached for the mean—typically one hundred years. This could be considered a long-term forecast of the yield curve, but here it is only used for determining term premia to the 3-month rate. Based on this forecast, term spreads to the 3-month yield are then calculated for the 1-, 5-, 10- and 30-year tenors, which are added to the targets for the 3-month yields to form final yield curve targets. Prior to finalizing targets, the term spreads and yield targets are compared to raw historical data to ensure that they are reasonable. Final target values for the mean yield curve in several economies are shown in Table 3.

Table 3: Term Structure Targets

Economy	3 months	1 year	5 years	10 years	30 years
United States	2.87%	2.95%	3.98%	4.72%	5.36%
Eurozone	3.00%	2.98%	3.75%	4.39%	4.96%
United Kingdom	4.44%	4.65%	5.53%	6.00%	6.39%
Japan	1.57%	1.34%	1.73%	2.32%	2.87%
Canada	3.16%	3.30%	4.08%	4.55%	4.95%

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Conclusion

The setting of calibration targets in a multi-economy economic scenario generator is a vital yet challenging element in the implementation of a stochastic model for the purposes of risk management. Trying to define a methodology which is consistent across currency regions which often have significant structural, political and economic differences, as well as variability in data quality and availability, requires finding a common global basis upon which to build a target. In this document we have identified the setting and implementation of inflation targets by central banks as one such basis for setting long-term interest rate targets. This is perhaps a natural starting point, since we know a structural relationship exists between interest rates and inflation rates, and many economies either have an official inflation target or publish an indicative range of inflation values which they use as guidance when setting interest rates. It is also observed that inflation targets are generally stable over relatively long periods, making them a good practical choice. While it is acknowledged that central banks may move away from inflation targeting in its current form at some point in the future, there is good reason to believe that inflation will remain one of the important considerations in monetary policy decisions for a long time to come.

We have shown that by combining an understanding of central bank monetary policy, historical data, and expert judgment, one can arrive at coherent calibration targets that reflect the realities of the current market environment. The methodology presented has significant advantages over pure historical analysis or historical analysis combined with expert judgment, particularly because the methodology arrives at reasonable and justifiable targets in a largely algorithmic and process-driven fashion. This approach removes many of the potential sources of observer bias and makes target setting for new economies a much faster and more transparent process. The incorporation of a robust econometric model into the target-setting process is also a unique and important development which further ensures that interest rate targets are robustly estimated and likely to validate well against recent and future data.

Global calibrations of the GEMS® Economic Scenario Generator based on this methodology are soon to be made available. Contact your Conning representative for more information.

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