

Escalation: How Much is Enough?

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Determining the escalation percentage to an estimate is often the subject of fierce debate. Cost increases are determined by dynamic relationships between many factors, including acts of nature, interest rates, oil prices, global commodity markets, wars, wage rates, and the overall health of the economy, as well as supply and demand for the required goods or services.

How much escalation is enough? Are the recent price increases temporary aberrations, or will they continue to plague us? This paper examines historical escalation rates, as well as indications of trends. Various analysis methods—Monte Carlo simulations, neural networks, trend impact analysis, and the Delphi method—are examined in an attempt to determine future trends.

Accurately forecasting escalation rates can play a pivotal role in determining job profitability or job viability especially for large multi-year construction and development projects. The estimator must predict the cost of future goods or services that must be purchased in the future, perhaps many years from now. If the prediction is wrong, profitability suffers. Owners are typically less than responsive for requests for equitable adjustment as a result of contractor cost increases.

The most difficult part of any cost estimation process is determining how much escalation to apply to the estimate. The construction industry has recently seen a rapid escalation in pricing, leaving estimators wondering whether this is a trend that will continue or merely a temporary aberration. After a great deal of research, summarized here, the author believes that there are two viable methods available to predict escalation.

The first is limited to short term escalation (periods less than a year) is a 12-month moving average of the rate of change for the cost index that is most applicable to the work being performed. This 12 month moving average may perhaps be extended for as much as another year if interpolation is used to factor in anticipated trends derived from industry applicable leading indicators like, interest rate changes, the Architectural Billings Index (ABI), and the Baltic Dry Index.

The second is to use a Monte Carlo simulation with a distribution derived from historical cost index data, again using the most applicable cost index. An informed management decision is then made as to the amount of risk they are willing to accept. Refer to figure 13 for an example of this concept.

Can Escalation Be Predicted?

Many believe the economy to be cyclical, with identifiable, predictable periods of boom and bust that last 14 to 20 years. Since a 20-year period of low inflation has just ended, they believe that we are due for 14 to 20 years of high inflation.

In contrast to this, in 1973 American economist Burton Malkiel developed a “random walk” hypothesis that implies that such predictions are impossible[5]. The random walk theory proposes that future events are truly random and thus cannot be predicted. Predicting the rate of escalation has been compared to searching for a black cat in a dark room.

But, as the philosopher George Santayana wrote, “Those who cannot remember the past are condemned to repeat it.” Therefore, if the economy is truly cyclical, with identifiable periods of expansion and contraction, trends should be predictable. In this line of thought, the likelihood of extreme variations should also be predictable. Thus, if wild oscillations occurred in the past, they can occur again.

The Problem in Using Cost Indices

Cost indices are frequently used in predicting escalation. The cost index, devised by G.R. Carli in 18th century Italy, compares the change in cost between periods for a fixed quantity of goods or services[6]. The concept of the cost index may be useful in some industries, but of the many cost indices in use today, no single index completely represents the construction industry. These indices have the same problem—they are lagging indicators since they measure cost changes that have already occurred. Also, these indices cannot account for the substitution of one product with another. For example, contractors may buy aluminum wire when the price of copper wire rises dramatically, or when regional shortages cause soaring prices. Since cost indexes track specific goods and services, if others are substituted, the rate of escalation measured by the index will be incorrect.

Market Conditions Are Not Escalation

Escalation or inflation is broadly defined as in change in the cost of a good or service over time. From an owners perspective there is a problem with this definition, since it does not specify whose cost, the owners or the contractors. Since most cost indexes measure the cost to the contractor, over a large geographical area and also fail to account for the difference in cost-

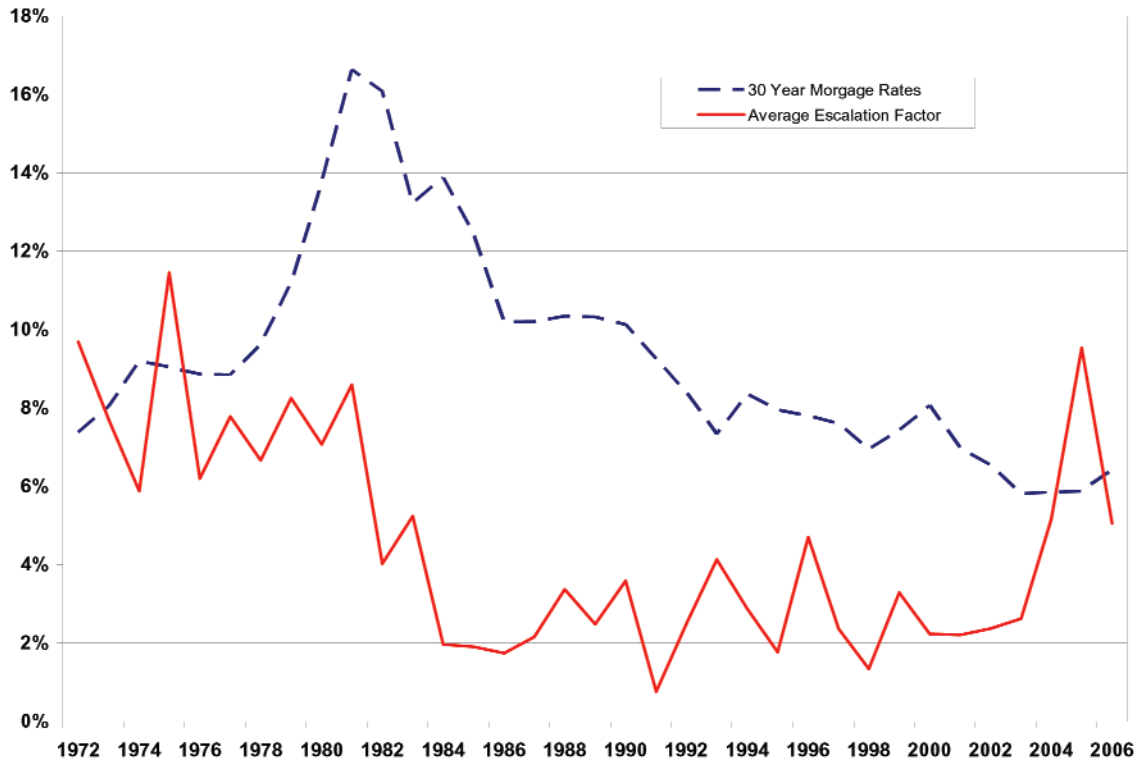


Figure 1—Cost Index Compared to Rates for 30-Year Fixed-Rate Mortgages

ing and pricing. Pricing is broadly defined as the cost the contractor bids for the job[8].

This is why escalation should not be confused with local market conditions, or demand surge as the insurance industry classifies it, although they both affect cost. Market conditions are generally additive to escalation. Categorized by specific local cost drivers like, fear factors or opportunity cost increases, market conditions are usually limited to a local area or region. For example market conditions may substantially increase local costs after a natural disaster, or during regional booms when contractors have more work than they need. The number of bidder concept can help correct for market conditions [3].

Construction Escalation Factors

Many factors influence construction escalation. These include the following.

Global Demand—The global demand for commodities is greater than any prior time in history.

Energy Costs—The costs of oil, natural gas, coal, and electricity are major components of construction cost. They are expected to continue to rise substantially as a result of the following.

- **Utility Deregulation**—Rates, which have been locked at an artificially low level for a number of years, are opening up to market pricing; and large increases are expected.
- **Environmental Regulations**—Fears of global warming fears are driving retrofits of power plants, use of cleaner fuels, and pollution controls on new diesel equipment—all of which are expensive.

Aging Infrastructure—Much of the power distribution system in the US is beyond its life expectancy. Replacement will be very expensive.

Instability in the Middle East—Crude oil and natural gas are used in the mining, production, and transportation of many construction materials.

Security Requirements—New security requirements for background checks limit the available pool of workers. Also, competition for workers who can pass background checks has intensified in the post 9-11 world.

Climatic Changes—The US is entering into a period of increased hurricane activity. A landfall of a large hurricane anywhere within a region will consume that region's available resources. Also, considering the explosive increase in coastline development, hurricanes will have a much greater impact than the data indicates.

Immigration Policies—Illegal immigrants make up a large share of the labor pool in the construction industry. If there is a decrease in the use of illegal labor for construction, the competition for labor from legal sources will drive up costs.

Nuclear Power—The construction of several new nuclear plants is close to approval. This multi-billion-dollar construction effort will draw on a large portion of the regionally available skilled labor and resources, driving up costs.

Escalation Indicators

Both short-term and long-term escalation indicators are used in estimating escalation. Of the many indicators available, some appear to be more predictive than others. However, all indicators are subject to interpretation. This discussion is limited to a few of the more popular indicators.

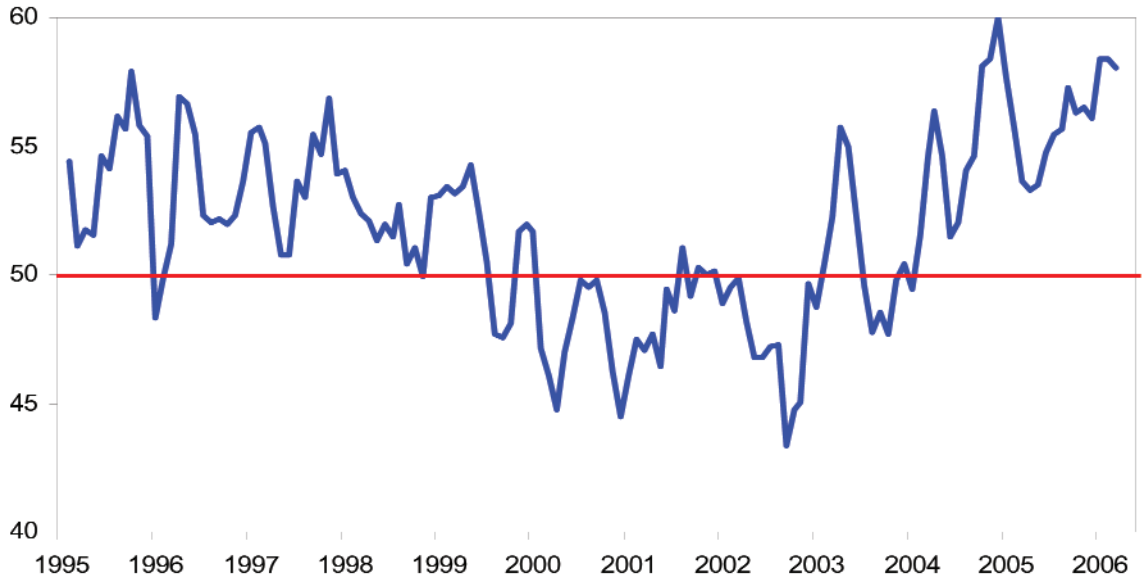


Figure 2—ABI for Commercial and Industrial Projects

Short-Term Escalation Indicators

Short-term escalation indicators include interest rates, the Architecture Billings Index (ABI), and the Baltic Dry Index (BDI).

Interest Rates—Interest rates appear to have an inverse relationship with construction cost increases (see figure 1). When interest rates increase, the cost of financing construction rises, and the number of new projects gradually declines. With less work, there is more competition for the available projects and a reduced demand for raw materials. Increases in interest rates generally precede a slowdown of the general economy, making companies less likely to fund large capital projects. On the other hand, if interest rates are reduced, the cost of financing con-

struction is reduced, and the economy is generally poised for an upswing.

ABI—Since 1995, the American Institute of Architects has generated the **Architecture Billings Index** (ABI) based on results of a monthly survey of approximately 300 US architecture firms. This index, shown in figure 2, is designed so that ratings above 50 indicate an increase in billings. A statistical analysis conducted by Kermit Baker and Diego Saltes indicates that the ABI has a high degree of correlation with construction activity, with lead times up to a year[2].

BDI—The Baltic Dry Index (BDI), shown in figure 3, is issued daily by the London-based Baltic Exchange. The BDI, which is based on the costs of shipping raw materials by sea on

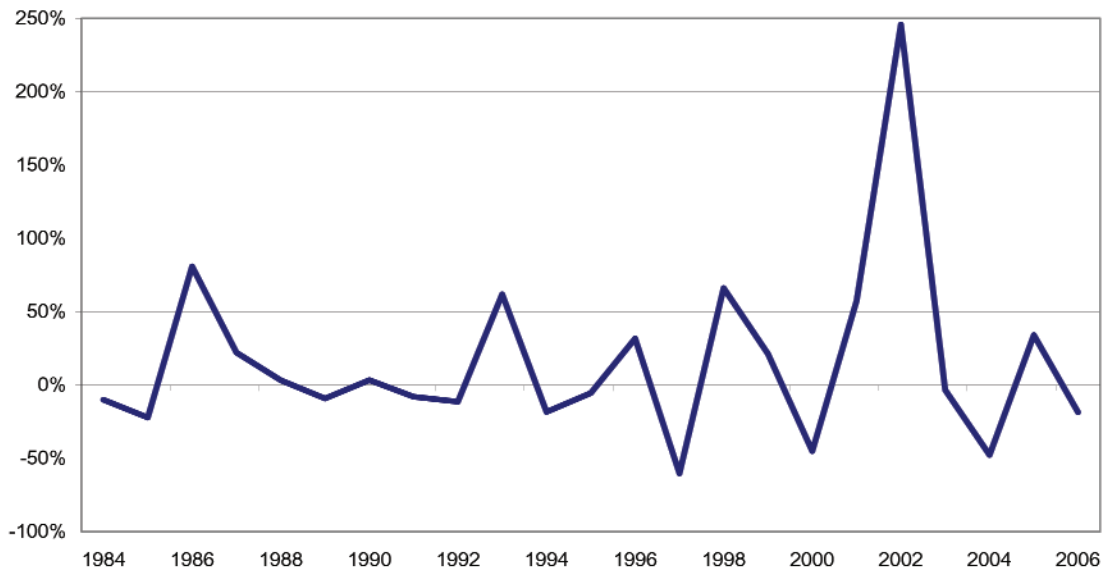


Figure 3—BDI

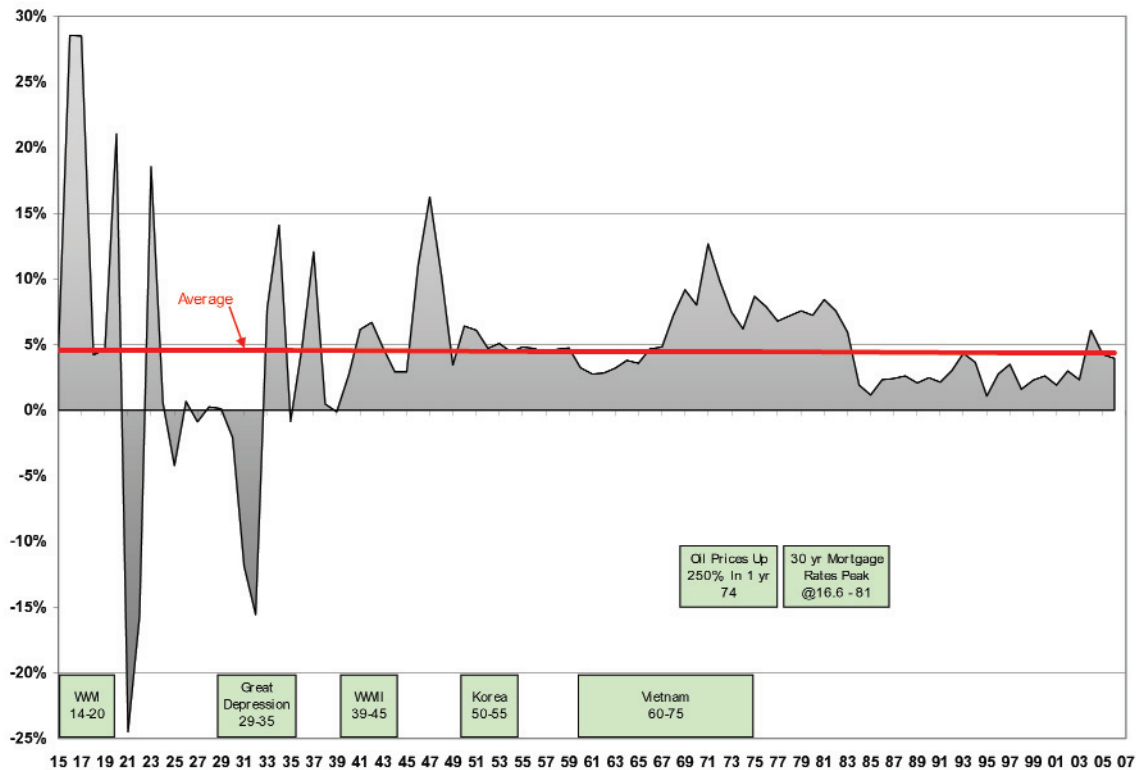


Figure 4—90 Years of CCI Historical Data

various routes, has been in use since 1744, and is still considered an accurate leading indicator of global economic growth.

The BDI tracks the costs of transporting commodities required for production (such as cement, coal, and iron) and excludes the costs of transporting finished goods via container ships. Because the supply of cargo ships is limited (it takes approximately two years to build a new ship), marginal increases in demand can push the index higher quickly. Significant increases in demand can push the index sharply higher.

Long-Term Escalation Indicators

Reputable sources for long-term escalation predictions tailored to the construction industry are sparse. The following three are commonly used.

OMB—The US Office of Management and Budget (OMB) releases free inflation guidance on an annual basis. This data is used for most government programs, but as it bears the weight of political agendas, its validity must be taken into consideration.

CMFS—The McGraw-Hill Construction Market Forecasting Service (CMFS), a fee-based product of McGraw-Hill Analytics, offers an extensive five-year forecast with detailed profiles of construction activity and a comprehensive analysis of key market trends and economic conditions for the US and nine US regions. Projections are developed every quarter by a team of economists who use econometric forecasting techniques and the most current economic, demographic, and building data available.

BCIS—The Building Cost Information Service (BCIS), a division of the Royal Institution of Chartered Surveyors (RICS),

is a fee-based service that offers five-year escalation forecasts tailored to markets in the United Kingdom.

Analysis Methods

Various methods of analysis are useful in determining escalation trends: Monte Carlo simulation, trend impact analysis (TIA), application of factors affecting construction escalation, neural networks analysis, and Delphi studies.

Monte Carlo Simulation

By using the Monte Carlo simulation technique in the predictive process, the estimator can determine the likelihood of a particular escalation rate being accurate. This is done by obtaining as much historical data as possible and determining the best-fit distribution of the data.

In the Monte Carlo simulation, one of the most popular computer simulations, random sample data is generated based on a known distribution. Monte Carlo, when properly applied, is an emulation of reality based on the law of large numbers. If enough samples are generated, eventually an approximation of the total distribution (all possible outcomes) will be obtained.

Under this approach, the author originally planned to convert several cost indices into percentage gain or loss per year and average the results of various indices. However, this approach dampened oscillations in the individual averages as a result of the central limit theorem. In simple terms, the central limit theorem states that a small sample expanded to encompass the total population will have a normal distribution. This occurred since individual averages tended to lead, or lag, the others. Therefore, the author elected to use a single index in the Monte Carlo simulation. The **Engineering News Record (ENR) Construction**

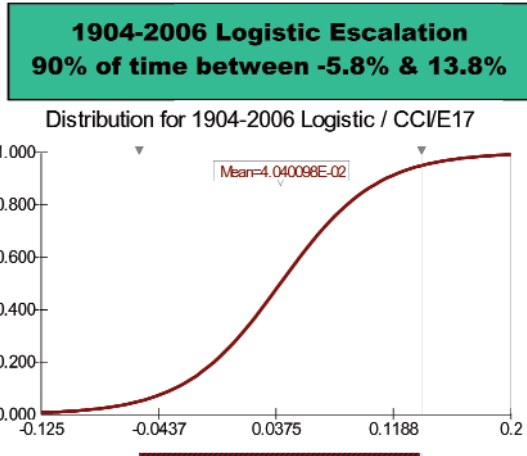


Figure 5—Logistic Distribution for the Entire Period

Cost Index (CCI) was selected because it is a reputable index, providing many years of data for analysis[4].

Figure 4 is a graphical representation of this index from 1914 to 2006.

Palisade Corporation’s @Risk Professional 4.5.5 was the software chosen to run the Monte Carlo simulation for this analysis. Distributions were selected using the best fit feature. The analysis ran for 100,000 iterations (years). For the period from 1904 to 2006, the logistic distribution revealed that 90 percent of the time, escalation fell between -5.8 percent and 13.8 percent, with a mean value of 4 percent (see figure 5).

Because the CCI historical data, shown in figure 4, revealed distinctive periods of high and low escalation, the following two other periods were selected for analysis.

- Running an ExtValue distribution on the period 1968-1983 revealed that 90 percent of the time, escalation fell between 6.1 percent and 10.6 percent, with a mean value of 8 percent (see figure 6).
- Running a Logistic distribution on the period 1984-2003 revealed that 90 percent of the time, escalation fell between

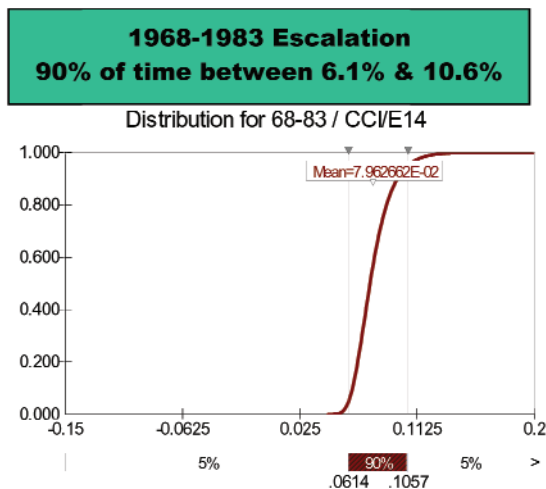


Figure 6—Examination of Distinctive Periods

1 percent and 3.8 percent, with a mean value of 2.5 percent (see figure 7).

In homage to the central limit theorem, a cornerstone of statistics, a normal distribution was selected for another analysis. The normal distribution was the second best fit for the data, as determined by the Anderson-Darling, Komolgorov-Smirnov, and chi-square goodness-of-fit tests. This suggests that the central limit theorem is correct in this instance, and the normal distribution is the correct distribution.

Running a normal distribution for the period 1904-2006 indicated that 90 percent of the time, escalation fell between -7.9 percent and 15.8 percent, with a mean value of 3.9 percent. These results are shown in figure 8.

Monthly escalation rates were then examined in an attempt to add granularity (see figure 9). Unfortunately, only 54 years of CCI monthly data were available for this analysis, from January 1952 to August 2006. This subset of the data excluded many years in which there were substantial oscillations in the data. Therefore, a normal distribution was selected for the analysis. As expected, this analysis closely correlated with the annual analysis, requiring 0.4 percent per month (4.85 percent annually) for a 50 percent probability of overrun-or 0.7 percent per month (8.4 percent annually) for a 70 percent probability of overrun.

Further parsing of available ENR monthly data into skilled labor, common labor, and material categories, depicted in figure 10, reveals that recent price spikes are primarily the result of material price increases. Unfortunately, only a limited quantity of detailed data, from 1977 to 2006, was available for this analysis.

To summarize the findings from the Monte Carlo simulation, the 2.5 percent mean escalation for the 20 years between 1984 and 2003 has been underrunning the four percent mean escalation for the period from 1904 to 2006. According to the reversion to the mean principle, an accepted statistical theory, escalation will eventually move back to the mean value of four percent. However, if we average the escalation for the 1904-1994 period (halfway through the recent period of low escalation), then the mean value rises to 4.2 percent.

The Monte Carlo simulation can allow management to decide how much escalation to use, depending on how much

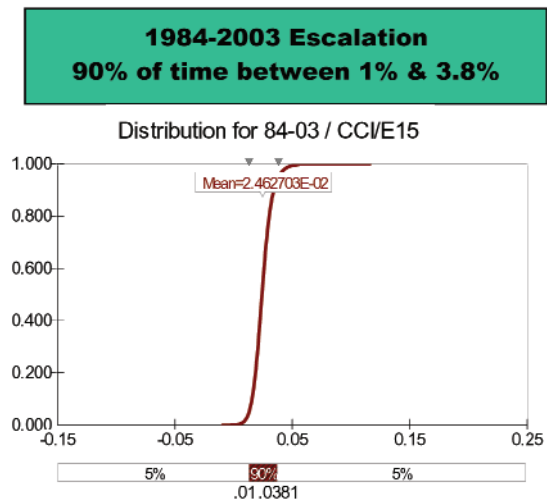


Figure 7—Examination of Distinctive Periods

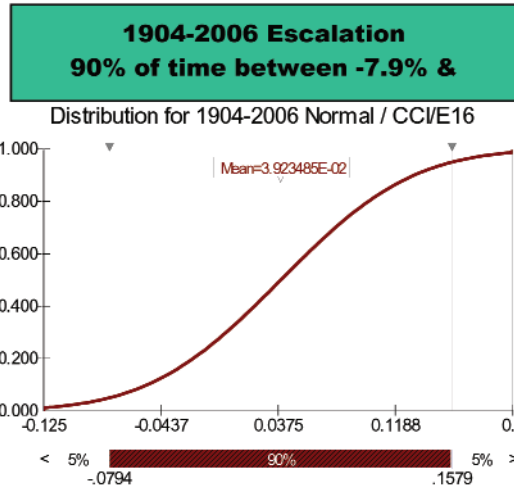


Figure 8—Normal Distribution

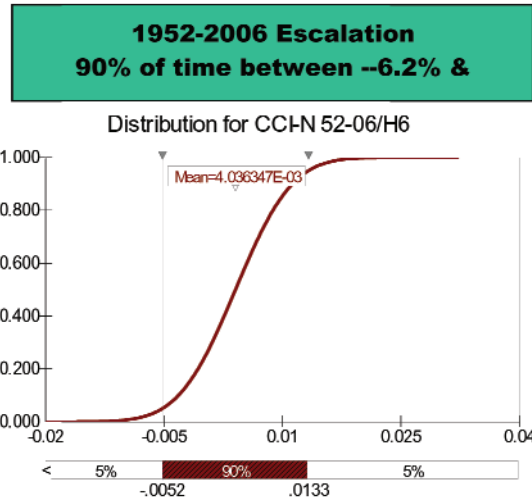


Figure 9—Examination of Monthly Escalation Rates

risk the project is willing to assume. For example, if management decides that a 70 percent probability of success is desired, as indicated by figure 11, a normal distribution will predict an 8.3 percent annual escalation.

Trend Impact Analysis

In trend impact analysis (TIA), a forecasting method developed in the late 1970s, extrapolations of historical trends are modified to allow for the effects of plausible future events. If we use a rudimentary form of TIA and claim parallels from the last period of high escalation (1968 to 1982), then we can project possible escalation rates for the next 14-20 years for which we expect high escalation. This premise is shown in figure 12.

To obtain the results shown in figure 12, an assumption was made that the 1968-1982 distribution would apply to the 2007-

2020 period. By selecting the Monte Carlo option from the @Risk Standard Recalc menu and clicking the F9 button, the user can display a possible scenario based on historical data.

Neural Network Analysis

In a search for alternative escalation forecasting methods neural networks were examined. By mimicking the functions of the human brain, neural networks can discern complex correlations in historical data for use in various predictions. Unfortunately, after billions of iterations with two software packages, no consensus was obtained. Small changes in settings created widely divergent predictions, indicating everything from staggering inflation to colossal deflation.

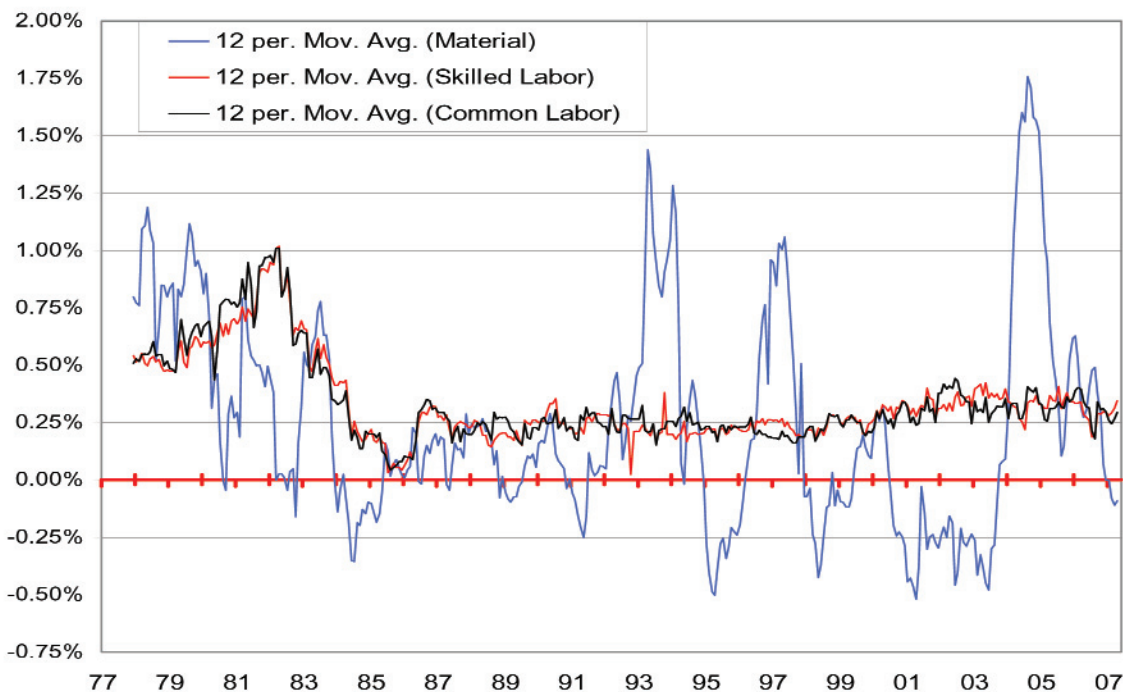


Figure 10—Correlation Between Monthly Labor and Material Price Changes

Other Work

The Society of Actuaries recently completed a 142-page Delphi study that forecast long-range values of four economic variables (see figure 13). While this study did not examine construction escalation specifically, it did examine the expected annual change of the Consumer Price Index (CPI). A compar-

son shows that the CPI generally tracks with the CCI, but underruns the CCI 68 percent of the time.

This analysis polled 24 industry experts, primarily economists and actuaries, and the consensus was that, “In the case of the curve fit baseline, (CPI) inflation grows to nine percent or so shortly after 2010 and then begins to diminish; for the linear baseline, inflation grows throughout the period reaching about seven percent in 2024”[7].

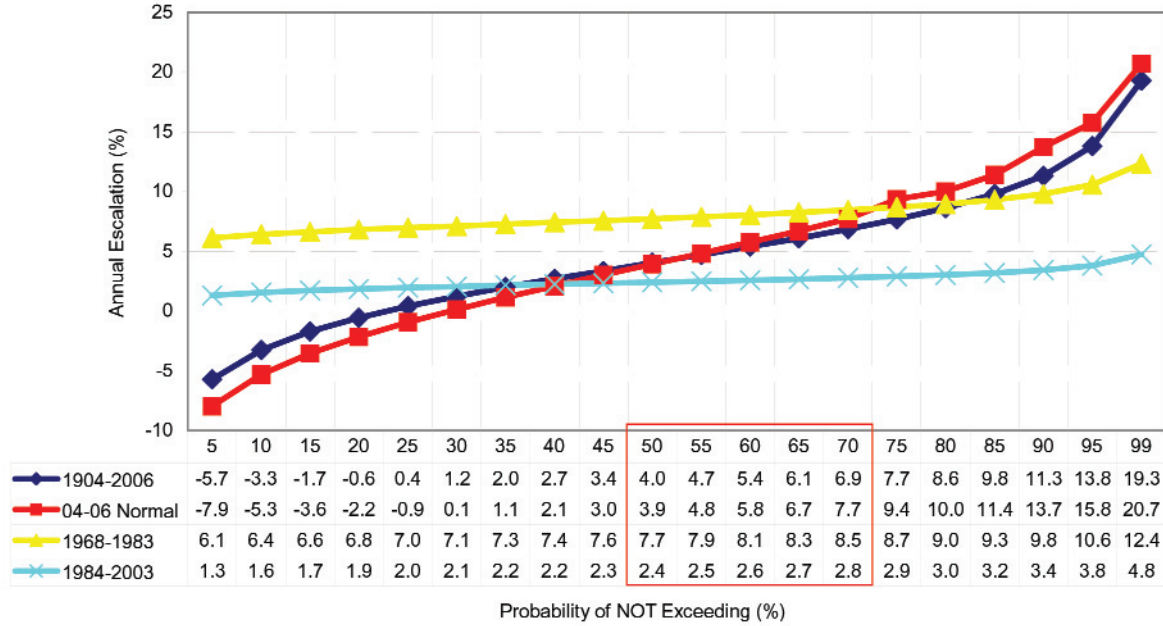


Figure 11 – Escalation Based on Acceptable Risk

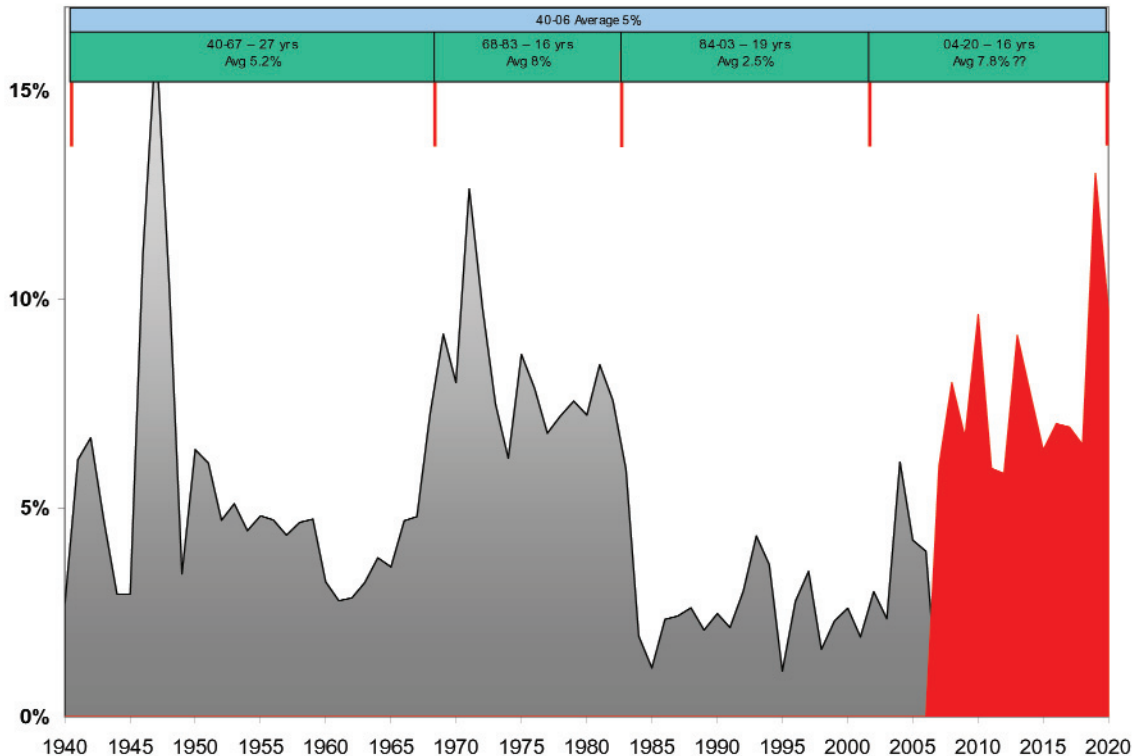


Figure 12 – Trend Impact Analysis

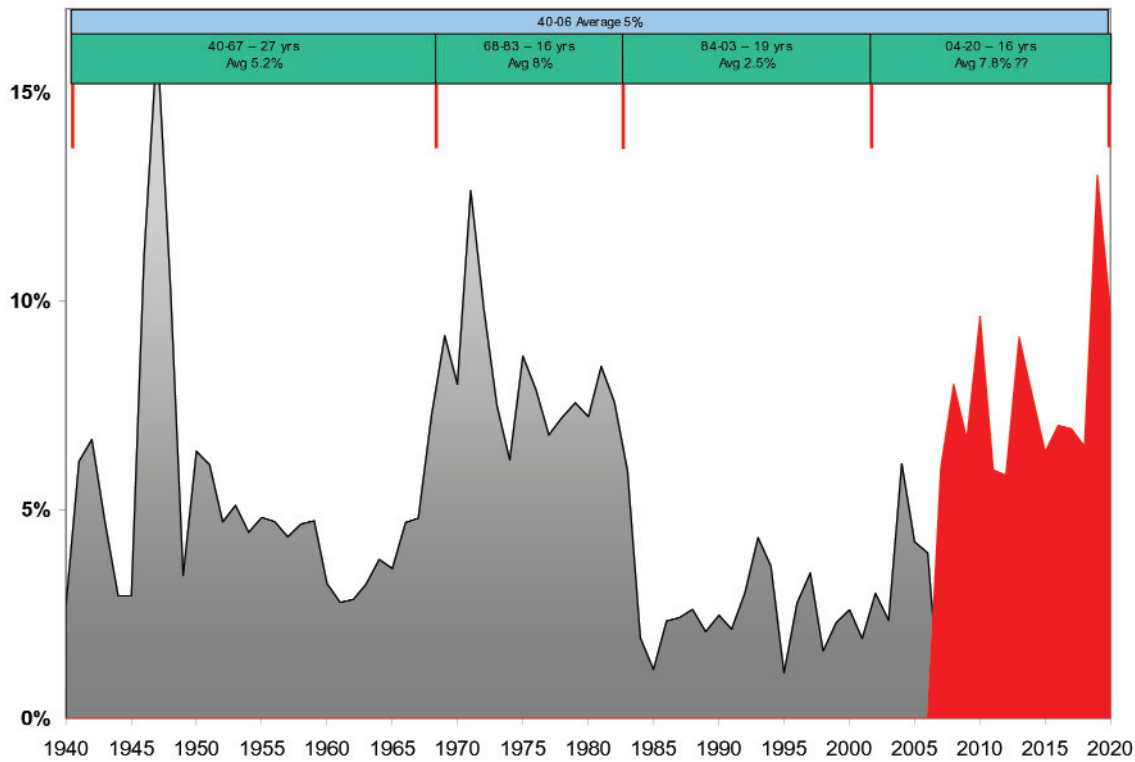


Figure 13—Delphi Examination of CPI

According to the experts polled, the following 10 events can be used to foretell whether rates of inflation will increase or decrease:

- Oil prices rise over \$60/barrel for at least five years.
- The value of the US dollar collapses in comparison to the Euro.
- The CPI reflects pressures from growing budget deficits, rising demand for services (e.g., health-care costs), a stable or declining labor force, and concomitant growth in retirements.
- New technologies cause the costs of production of most products to drop by 10 percent or more.
- There are significant corporate defaults (three times over the current rates).
- Investor confidence in the US economy drops; direct foreign investment falls to 50 percent of current levels.
- Global political instability, Iraq-like wars, and terrorist activities and threats become the norm.
- New technologies improve productivity in services by more than 10 percent.
- The climate for investment in US proves attractive.
- Globalization lowers labor costs by an average of 10 percent.

A 2001 study published by the US Federal Reserve Bank of Minneapolis examined the usefulness of Phillips curve-based models in forecasting inflation[1]. These models are based on the non-accelerating inflation rate of unemployment (NAIRU). It compares the accuracy of three sets of inflation forecasts from NAIRU models to the assumption that at any date, inflation will be the same next year as it was last year. It asserts that none of

the NAIRU forecasts are more accurate than the assumption and states: “The likelihood of accurately predicting a change in the inflation rate from these three NAIRU forecasts is no better than the likelihood of accurately predicting a change based on a coin flip. . . . We find that for the last 15 years, economists have not produced a version of the Phillips curve that makes more accurate inflation forecasts than those from a naive model that presumes inflation over the next four quarters will be equal to inflation over the last four quarters.”

Predicting the exact annual escalation expected is admittedly difficult, if not impossible. However, in the 20 years between 1983 and 2003, escalation has been abnormally mild, averaging 2.5 percent (within a one percent to 3.8 percent range) 90 percent of the time. Annual escalation has exceeded 4 percent 42 times over the past 90 years, and exceeded 10 percent 12 times. This excludes market factor increases that occurred after natural disasters or during boom periods.

Material prices have been the primary driver in recent cost increases, as shown in figure 11. However, escalation has been underrunning the long term historical averages. The reversion to the mean theory predicted a correction in prices, which has now occurred. Anecdotal evidence is indicating substantial pressure on wages. This suggests that the current trend of high costs and low wages will not continue. Either material costs will decline or labor costs will increase.

If short-term escalation predictions are required, then the 2001 US Federal Reserve study offers compelling evidence that on average, the next year’s inflation rate will be the same as last year’s inflation rate. Perhaps a 12-month moving average of the rate of change for the estimator’s favorite index will prove a valid indicator of the current trend.

Year	CCI	BCI
1915-2006	=RiskLogistic(0.04421, 0.031153)	=RiskLogistic(0.0371, 0.030702)
1940-2006	=RiskGamma(2.0559, 0.020279, RiskShift(0.0086651))	=RiskInvgauss(0.055277, 0.153698, RiskShift(-0.010448))
1968-1983	=RiskExtvalue(0.073327, 0.010914)	=RiskLogistic(0.075144, 0.016628)
1984-2003	=RiskLoglogistic(-0.028251, 0.052313, 12.387)	=RiskLognorm(0.034878, 0.013847, RiskShift(-0.012949))
1904-2006 Normal	=RiskNormal(0.039235, 0.07215)	No Data
1904-2006 Logistic	=RiskLogistic(0.040401, 0.033168)	No Data

Figure 14—Best Fit Distributions

The available information indicates that we are entering a period of increased volatility in the construction industry. The world economy is changing, and emerging markets are increasingly affecting commodity prices. The estimator is increasingly challenged in trying to determine trends in construction escalation and, ideally, the escalation range.

Figure 14 contains the @Risk best fit distributions for the ENR Building Cost Index, and the Construction Cost Index that were used for this paper.

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