RADAR LOGIC
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THE RADAR LOGIC INDEX METHODOLOGY

The Demand for Knowledge

There is great demand to know what is happening with real estate prices. For example, homeowners want to know the value of their biggest asset; builders want to project the profitability of their construction plans; lenders want to understand their underlying risk; property investors want to understand how to balance their portfolios of properties; and financial investors want to participate in the available returns. But even in the face of such pervasive demand for knowledge and visibility, efforts to analyze information on real estate prices have been plagued by limitations:

- Data is available infrequently, tending to be published monthly, quarterly or semi-annually;
- The value of market transactions in aggregate is substantial, but the number of transactions varies greatly from city to city and within individual cities themselves;
- Each property is unique, making it difficult to compare individual properties within a market and even harder to compare from one geographic area to another; and
- The nature of the transaction tracking systems is such that the data is effectively out of date by the time it is visible.

The Existing Problem

As a result of these limitations, real estate information is extremely difficult to translate into indices. Nonetheless, indices are being created, but we believe the methods available until now suffer from some basic and significant drawbacks:

- As with the data itself, the indices currently available are published infrequently, making them less like commodity spot prices than they might be;
- Most of the current indices are based either intentionally, or as a result of their methodology, on subsets of the data as opposed to the full data from the marketplace; and
- Often the actual calculation methods are not described and thus impossible for traders and investors to fully understand. Understanding, of course, becomes vitally important in the development of correlations and the ability to manage positions and position risk.

Radar Logic's Approach

To overcome these difficulties Radar Logic set out to understand the nature of real estate transaction pricing and how best to translate the total activity in an area on a given day into an index that reliably represents changes in the marketplace that day. This study led us to what we term the Triple Power Law™ characterization of real estate transactions, which is explained in greater detail in the technical paper available on our website.

To characterize the real estate transactions occurring in an area, we need a measure that will allow us to compare small and large homes. Simply looking at the prices at which an existing house changes hands is limited by the information it ignores. Further, the uniformity of the asset value is not guaranteed as renovations may have occurred; the length of time between transactions is variable; and there is no possibility of including new home sales.

Rather than looking at the price of a house, we look at the price of a house *per square foot* as a means to make transactions comparable. (This is the accepted practice in commercial real estate, is also used by most builders, and, less formally, by those in the market for a new home.) From a trading perspective this makes the transactions more similar, but unlike a more fungible commodity such as oil, there are still significant differences between houses.

Therefore for real estate, we need to characterize a distribution of transactions. To again use oil as an example, if the price of a barrel of oil is $75, then that is the price at which you can sell it. There might be small variations reflecting convenience, transportation, quality or other issues, but the price is really the price. When, on the other hand, we look at the real estate transactions occurring on a given day we see a distribution of prices, even when measured per square foot. This is because there are many attributes besides square footage that determine the value of a house. Thus, in deriving an index for real estate, we must use a composition of prices from all the different properties for which transactions are recorded. Creating that composition must be done with care, as many simple measures are not likely to accurately reflect true market value.

To find a good summary measure of daily real estate prices, we have explored many alternative measures and examined many aspects of real estate data. As a result, we have succeeded in finding important patterns in the distribution of prices. These pattern characteristics can be used in the creation of an index that reflects the maximum amount of information on daily closing prices. Since we have been able to create a good representation of the observed data, we can use the resulting distribution as a means of generating the index. Since this distribution is continuous, our index will avoid any granularity that might be introduced by the data. For example, suppose the median value of the distribution were $100 per square foot but there were no transactions in the range from $95 to $105. Then, using the data, it is likely you would get a value either just below $95 or just above $105, but not $100. Also, the distribution proves to be less sensitive to outliers than any simple median of the data. Furthermore, it is extremely difficult to manipulate the index by introducing fraudulent transactions or timing closings for a particular day.

Getting the distribution that can be used as a basis for the index does require some work. There are a variety of factors that have influenced the development of our technique for computing the index, but the most important consideration is that *the index reflects, as*

accurately as possible, the true value of transactions recorded on a given day. This means that any sort of time averaging of actual transaction values must be avoided. A corollary of this is that any index that accurately reflects the actual market data will have a significant amount of movement from day to day, especially when the number of recorded transactions is relatively small. We strongly believe it is critical that investors and market participants be awarded the opportunity to observe this movement.

Avoiding time averaging does not, however, mean that we cannot use the broader set of days to determine the best distribution. In fact, we consider not only many days, but many cities in determining the overall characterization. Similarly, we use a full year's worth of data in order to characterize the distribution for a day, and then the current day's data to position that distribution and ultimately determine that day's index value. In other words, in order to compute the index we separate the distribution use into shape and position. The shape is computed using data from many days, while the position is computed using the data for the current day.

Another important characteristic of our index is that we will not ignore transactions just because they appear to be outliers. This would be analogous to leaving a stock price at $120 because $200 was outside the range of reasonable values. To prevent this from occurring, we make use of all transactions that have been validly recorded and that are available to us through public sources. Since there may still be errors in the recording process, it is important that the index not be sensitive to these, as we will discuss later.

The actual technique for computing the shape, though logically quite straightforward, is complex. Once we have characterized the underlying distribution we know the theoretical probability density function for the data. This function can then be used to determine what is referred to in statistics as "the likelihood of the data." This means exactly what it says: how likely is it that the data was generated by the specified distribution? The important thing about likelihoods is that we can change the parameters and again compute the likelihood. By finding the underlying distribution set that maximized this phenomenon, we get what is called the maximum likelihood estimate of the distribution. The maximum likelihood estimate of today's distribution is determined by computing all together the shape parameters and the positions for 365 consecutive days, including the current day.

Using 365 days guarantees that there are no seasonal effects that might distort the shape parameters while still allowing them to evolve over time as overall market conditions change. Because the shape's location is different for every day, there are no delays in the response of the current index to changes in prices. This means that the index will correctly reflect all trends and patterns in the data, including seasonal and other behavior, and will change exactly when the data do.

The Radar Logic Real Estate Index offers its users five important advantages:

1) The Radar Logic Index will reflect the true daily activity of the market, without the delays and distortion inherent in monthly or quarterly averages and those created by filtered data.

2) The Radar Logic Index will capture all trends and patterns in the market without smoothing or delaying the realities of the market. Seasonal patterns will be shown without delay or dilution. Sudden changes in the market will be

reflected accurately as sudden changes in the index. Real variation in transaction prices from day to day will be fully revealed in the index.

3) For days with few transactions, traditional methods can exaggerate the variation in the market because of granularity in the data. The Radar Logic Index gives a value truly reflective of the day's transactions, even if no individual transaction occurred at exactly the representative price per square foot.

4) The Radar Logic Index is a "full information" index. We strongly believe that excluding any valid transaction, including condominium sales, new-house sales, "outliers", house flips or prices that changed "too much" tends to understate change and hide the realities of the market. The Radar Logic Index takes into account all legitimate transaction data available to us.

5) Because it contains multiple computational layers capable of detecting anomalous or damaged transaction data, the Radar Logic Index is resistant to fraud and data error.