

Market Dynamics: Modeling Security Price Movements and Support Levelsⁱ

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Abstract

Market Dynamics presents a method for measuring and forecasting target price, support level, and price movement indicators of traded securities. The method receives historical and optionally projected data such as price, trade volume, earnings, and number of outstanding shares. It then develops a security pricing model that takes into account the received data and generates target price and price movement indicators including expected price change, investment rate, money flow, support ratio, and event time horizon. The security pricing model applies a time derivative approach to the price equation and relies on a conservation of capital principal in its formulation.

Market Dynamics has the wherewithal to be applied to a number of fields including investment management through measurement of security price appreciation potential, as well as technical analysis in determining support or resistance price levels and understanding the underlying mechanism behind these levels and the security price movements.

Introduction

The price of a security may vary pursuant to a number of events, including: an earnings surprise, change in growth rate, change in attractiveness of an industry or asset class, shift in market liquidity and availability of buyers and sellers, change in macroeconomic factors such as inflation and interest rate, or other significant security or market development. Existing security pricing models typically use fundamental analysis or technical analysis in setting a target price or anticipating a price movement.

Fundamental analysts often measure

price by using a discounted cash flow model of future expected earnings. This approach relies on research into basic financial information to forecast profits, supply and demand, industry strength, management ability, and other intrinsic matters affecting a security's market value and growth potentialⁱⁱ. Thus, price evaluation is based on business performance and assumes that a forecast target price eventually will be reached. However, fundamental analysis often results in differing projections based on growth rate and annuity model assumptions, and suffers from subjective weighting and application of multiple factors affecting price.

Technical analysis relies on chart pattern recognition and the theory that historically these patterns repeat themselves, giving a guide to the likely future direction of a price movement. This approach assumes that security prices are determined solely by the interaction of market demand and supply and that prices tend to move in trends, and shifts in demand and supply cause trend reversalsⁱⁱⁱ. Technical analysis uses various indicators which typically consist of price and trade volume transformations in order to identify a trend and forecast future price movements. In contrast, fundamental analysis aims at determining the long-term price target and does not concern itself with a study of price action^{iv} and movement patterns.

Technical analysis can result in differing conclusions depending on the specific indicators or approach that is utilized, and while widely studied and practiced is still surrounded by some controversy. For example, the concept of a support level is extensively utilized in technical analysis as a price level at which a downward price movement tends to stop and reverse. However,

no underlying mechanism has been previously identified for the formation of a support level and whether it will successfully hold.

Therefore, it would be desirable to develop a security pricing method that combines the strengths of fundamental analysis and its use of historical and projected data about a security together with the strengths of technical analysis in the form of charts and indicators. Such a method would use historical security data and optionally projected data as input into a security pricing model, which in turn would generate target price, support level, and price movement indicators for a security. In doing so this method can evaluate current security prices and anticipate future price movements while yielding further insight into the underlying mechanisms that may be responsible for the observed price movements and chart patterns.

Dynamics of Price Movement

The expected price movement and target price for a security pursuant to an event can be estimated by applying a time derivative to the price equation^v, as follows:

$$(01) \quad P = EPS * PE$$

$$(02) \quad \Delta P = \Delta EPS * PE_0 + EPS_0 * \Delta PE$$

$$(03) \quad P_T = P_0 + \Delta P$$

where ΔP represents the expected change in price resultant from a change in EPS or PE ratio at time t; P_0 and EPS_0 and PE_0 represent starting values for Price, EPS, and PE at a stable price point immediately preceding the event; and P_T is the target price.

The time derivative approach can be extended into a more general method by applying a conservation of capital principal. Market Capitalization (MC) represents the intrinsic capital or investment value of a security as a product of the total number of outstanding shares (S) and the share price, that is:

$$(04) \quad MC = S * P$$

In this manner, the share price acts as a unit of capital investment in the security. A positive event, such as a rise in earnings, results in an infusion of new investment into the security as buyers purchase shares of the security at a higher price level. The amount of new investment (I) generated by the onset of an event is equal to the change in market capitalization of the security, that is:

$$(05) \quad I = \Delta MC = S * \Delta P$$

A conservation principal may be defined stating that the change in market capitalization of a security must equal the amount of new investment flowing into the security. Such investment occurs when buyers purchase shares of a security at a higher price than the seller's cost basis, (the original purchase price paid by the seller to acquire the shares). Assuming a stable initial price and a single event, the seller's cost basis would equal the security's trading price prior to the onset of the event, whereas the buyer's cost basis would be the purchase price at a point past the onset of the event. The amount of new investment can be measured by adding individual contributions from each trade transaction completed in the aftermath of the event. Assuming N transactions have been completed at time t measured from the onset of an event, each involving s(n) shares, the amount of new investment can be measured by adding the incremental new investment from each transaction, as follows:

$$(06) \quad I(t) = \sum_{n=1}^N [s(n) * \Delta P_n]$$

where

$$(07) \quad \Delta P_n = P_{\text{buyer cost}} - P_{\text{seller cost}}$$

is the difference between the buyer and the seller's per share cost basis, and s(n) * ΔP_n is the incremental new investment for transaction n.

A support ratio indicator can be defined and measured by dividing the amount of new investment at time t by the expected change in market capitalization, as follows:

$$(08) \quad \text{Support Ratio (t)} = \frac{\sum_{n=1}^N [s(n) * \Delta P_n]}{S_{T+1} * \Delta P}$$

As the support ratio reaches one the amount of new investment equals the change in market capitalization, satisfying the conservation principal, and a fully supported price level is established for the target price. A low support ratio indicates a lack of adequate new investment, while support ratios exceeding one indicate over-investment.

A divergence indicator can be defined and measured as the ratio of remaining price spread (ΔP_T) over price at time t, as follows:

$$(09) \quad \text{Divergence (t)} = \frac{\Delta P_T}{P} = \frac{P_T - P}{P} = \frac{P_T}{P} - 1$$

where price spread is measured as the difference between the target price and observed price. Divergence moves towards zero as price approaches the target price, and a fully supported price level is established. Divergence is an indicator of the price appreciation potential of a security.

The time elapsed from an event's onset until a fully supported price level is reached is referred to as the event time horizon (ΔT). For the special case of a linear price movement and constant trade volume, the event time horizon may be estimated as a ratio of the elapsed time over the measured support ratio, as follows:

$$(10) \quad \Delta T = \frac{t}{\text{Support Ratio (t)}}$$

with the value refined after each successive observation. The expected price at time t may also be estimated for this special case by multiplying the expected price change (ΔP) for the event by the measured support ratio, and adding the result to the starting price, as follows:

$$(11) \quad \text{Expected Price (t)} = P_0 + \Delta P * \text{Support Ratio (t)}$$

where the expected price reaches the target price as the support ratio reaches one. Together, the target price and the expected price form a price channel or an acceptable price range for the security.

Using the conservation principal the remaining investment required at time t in order to reach a fully supported price level may be measured, as follows:

$$(12) \quad I(t) = S * \Delta P_T$$

and an investment ratio may be defined as the remaining investment required per share as a multiple of the current share price, as follows:

$$(13) \quad \text{Investment Ratio (t)} = \frac{\Delta P_T}{P}$$

where the investment ratio is an indicator of the expected rate of investment in a security. A comparison to equation [09] reveals that Divergence is in effect the investment ratio of the security.

Treatment of Consecutive Events

The aforementioned approach may be further extended to cover multiple consecutive events for both isolated and overlapping event time horizons. For a single isolated event, as the support ratio reaches one, the event's life cycle completes with the expected price change dropping to zero and a new support level materializing at the projected target price. This support level forms a stable starting price (P₀) for a subsequent event and all indicators are reset to their starting values as a new cycle repeats. As such, an additive

method may be used for combining multiple consecutive and isolated events and determining target prices.

For the case of multiple events with overlapping event time horizons, a similar aggregation method may be used. A common treatment is to calculate the expected price change for a new event in isolation using the aforementioned process. The expected price change is then added to the preceding event's target price. Since the target price is reset in the midst of the preceding event's life cycle, the expected price change and investment indicators now include contributions from multiple events.

A money flow indicator (MF) may be defined as an extension of the investment indicator with the money flow indicator spanning multiple events, as follows:

(14)

$$MF(t) = \sum_{n} [s(n) \cdot \Delta P_n]$$

While the investment indicator is reset to zero at the completion of each event's life cycle, the money flow indicator operates continuously and captures the incremental investment flow from a select starting time. Sudden shifts in the direction and size of money flow represent changes in investor sentiment and require careful consideration by a prospective investor as they may signal a change in momentum.

Market Dynamics in Action

The Market Dynamics method has been applied to securities listed on the New York Stock Exchange and NASDAQ. The implementation requires application of several estimation techniques to measure the required input data elements such as PE values, new investment amounts, and event time horizons.

Figure 1 depicts the price channel chart for shares of Google for the period between June 2006 through to March 2010. The price channel indicator overlays the time series charts for target price, expected price, and the market price of a security. Point markers are also used to note fully supported price levels.

price channel, a potential disparity exists between the current security price and its anticipated capitalization support. This may represent either an over-evaluation, as is the case with higher observed market prices above the channel, or otherwise an under-evaluation of the security below the channel.

The period between April 2009 and December 2009 represents an ascending channel for Google. It immediately follows a strongly supported price level, established and validated during the period from January 2009 through March 2009, as

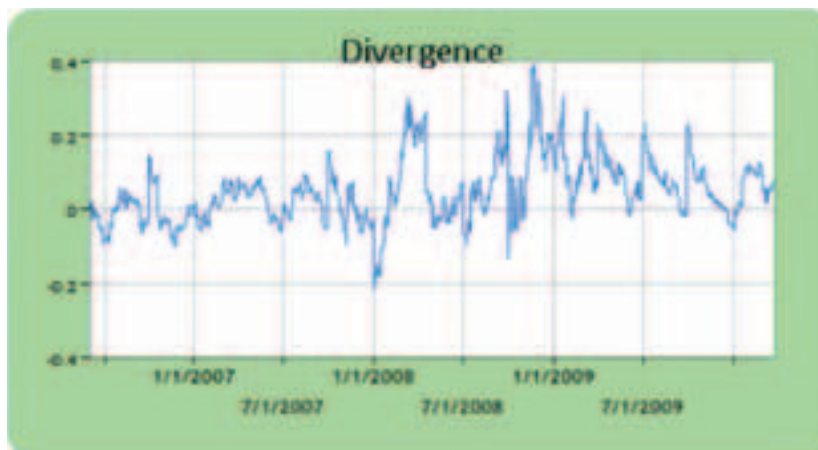
indicated by the presence of multiple support markers on the chart near the \$370 price level. The ascending channel spans three consecutive earnings events represented by a stepped movement of the target price line on the chart. At the same time, the expected price moves gradually towards the target price as new investments continue to stream in. The price reaches the target price line in January 2010 and a new supported price level is established and later validated in March as observed by the subsequent price support markers on the chart. During December 2009, the security

Figure 1
Price Channel for Google, June 1, 2006 to March 25, 2010



Source: Market Dynamix

Figure 2
Divergence for Google, June 1, 2006 to March 25, 2010



Source: Market Dynamix

price moved away from the expected price line and eventually exited the price channel leading to a subsequent price correction in the first part of 2010.

Figures 2 and 3 present the corresponding divergence and investment charts for the same time period. The divergence indicator displays the potential appreciation opportunity for the security and fluctuates with the level of investment flow, changes in target price, and market price for the security.

Figure 4 represents the money flow chart for Google. It shows a perceptible

drop starting around January 1, 2008 due to the severe economic downturn. The money flow indicator represents investor sentiment and may be used to anticipate trend changes. A rising money flow trend may be observed from December 2008 through December 2009 preceding and overlapping the previously highlighted ascending channel.

The Potential for Market Dynamics

Market Dynamics presents a new approach to measuring and forecasting the price movement for traded

securities and identifying their support levels, with the potential to leverage and partially bridge the divide between fundamental and technical analysis methods. The method can be applied to individual securities as well as related aggregates such as industry, sector, exchange traded indices or funds. When combined with a decision support system, Market Dynamics can be used as an investment strategy tool that lists securities with the greatest price appreciation opportunity for a selected investment style.

The application of Market Dynamics to the study of chart patterns can provide sought after insight into the underlying price movement mechanisms. Additional refinements and extensions of Market Dynamics are possible and desirable. For example, while the approach appears to work well with most securities further refinements are required for treating start-up and non-profitable companies as well as wide PE swings that may result in larger than anticipated price movements. **IFTA**

Figure 3
New Investment for Google, June 1, 2006 to March 25, 2010



Source: Market Dynamix

Figure 4
Money Flow for Google, June 1, 2006 to March 25, 2010



Source: Market Dynamix

References

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