Futures Trading Based on Market Profile Day Timeframe Structures

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Abstract: Use of Market Profile[®], a part of technical analysis, can improve trading. This paper analyzes Market Profile Day Timeframe Structures and the Initial Balance defined in 1980s by J. Peter Steidlmayer on today's US stock market. Quantitative analysis is performed on several years of historical data. Individual Day Timeframe Structures are defined and their occurrence on the current market is calculated. Comparative analysis of the structures and further analysis of potential dependency among them is performed. The paper concludes that the Day Timeframe Structures do not fully cover the current US stock market. Importance of the Initial Balance is confirmed by the paper and a trading advantage using the Initial Balance is explained.

Key-Words: Market Profile, Initial Balance, Day Timeframe Structure, Steidlmayer, CME, Trading, Value Area

1 Introduction

Financial market participants can use many techniques and tools that help them to better understand and predict the markets. Most common methods are fundamental analysis, technical analysis and analysis of market psychology.

Dynamics and difficult predictability of the markets cause losses to majority of the market participants. This is quite often caused by low knowledge and lack of discipline of these participants. The majority of participants are trying to find a perfect trading system or think that have better information than market makers which inevitably leads to their failure.

Chart analysis (also called technical analysis) is the study of market action, using price charts, to forecast future price direction. Technical or chart analysis is based on the study of the market action. While fundamental analysis studies the reasons or causes for prices going up or down, technical analysis studies the effect of the price movement itself [5].

This paper explores one part of technical analysis that is not widely known and used but can help to determine the state of the market, who controls the market and what the probable next step of the market price is. The concept used for the analysis is called Market Profile[®]. Perhaps the most important benefit of Market Profile data is that it vastly simplifies the trading process [1].

Specifically this paper analyzes part of the Market Profile concept called the Day Timeframe Structures (DTS) and its application to the current US stock market.

2 Market Profile Analysis
2.1 Market Profile Overview

More than 25 years ago, J. Peter Steidlmayer and the Chicago Board of Trade (CBOT) developed and popularized the market analysis method known as Market Profile. Market Profile emphasizes price distributions. This is in contrast to most techniques that accentuate price changes and time series of prices themselves [6]. Market Profile was originally intended to give off-the-floor traders some of the advantages available to pit traders [4]. Market Profile was introduced in 1985 as CBOT Market Profile[®] product. Market Profile is a tool rather than a buy/sell system, reading Market Profile data involves grasping principles - not just memorizing rules [1].

It is difficult for markets to grow and be efficient simultaneously – rather the market accomplishes these two processes (growth and efficiency) in a series of stages [8]. Market Profile helps market participants to better understand auction process on the market through a graphical structure. The concept is based on idea that markets are determined by time, price and volume and it is an instrument for their graphical representation.

Steidlmayer has defined this situation by the following equation:

$$Price + Time = Volume \qquad (1)$$

Price serves as an indicator of opportunity, time regulates these opportunities and volume determines successfulness of each auction.

Market Profile uses the evolving market as its data base rather than past market history and is more of a present-tense information source [9].

Buy/sell systems lose their effectiveness when markets change. Market Profile data captures and lets you see the change so that you can adjust accordingly [1].

Volume is a key factor for understanding the Market Profile. Ordinary technical analysis displays volume at a given time. Market Profile, opposite to the technical analysis, displays volume at a given price.

Each day, the market creates range of the day and value area which represents balance with the same amount of buyers and sellers. Price never stays in value area but diverges from it. Market Profile monitors this situation so that the market participants are able to interpret it.

2.2 Market Profile Chart

Market Profile is based on the Normal (Gaussian) distribution that has a bell-shaped probability density function (bell curve). The bell curve can be used to represent an arrangement of behavior around price. The first Standard deviation – the middle of the bell curve, where the majority of activity takes place – would represent value, while the second and third Standard deviations would measure price away from value [9].

If we turn the bell shape 90 degrees anti-clockwise (so time is on horizontal axis and the price is on vertical axis), we get Market Profile chart structure [3]. This illustrates the following figure.

Figure 1: Market Profile Structure
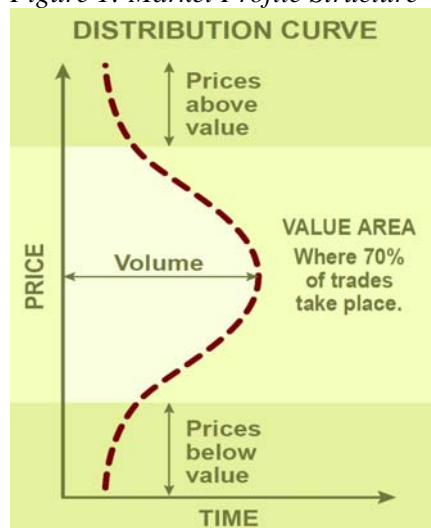
Source: [3]

Thirty minutes of a trading session is represented by one letter of the Market Profile chart. If we merge all the letters representing the 30-minutes sessions together, we get the Market Profile chart. Volume at a given price can be displayed on the right hand side of the Market Profile chart (3 days are shown on the following chart).

Figure 2: Market Profile Chart
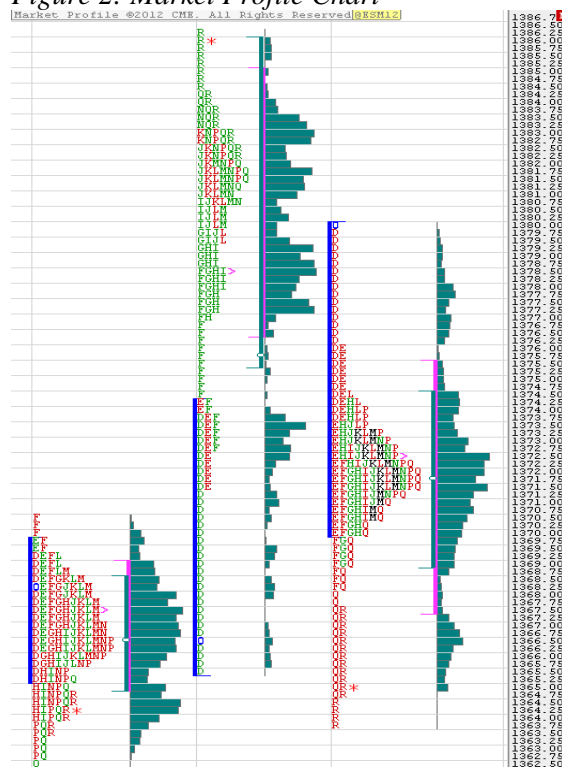
Source: [Investor/RT, Linn Software, Inc.]

Market Profile chart rarely follows the bell curve shape during real trading. The chart is usually a beveled or a distorted curve which allows seeing the price that determined the biggest amount of trades. This curve provides a clue about the price direction – which is a base for understanding Market Profile.

2.3 Day Timeframe Structures

The purpose of the day structure is to find and maintain a fair price. This allows the market to do business because no one intentionally trades at a price they know to be unfair [9].

The day structure study begins with the first hour's price range – the range represented by the first two half-hour segments. This is defined as the first balance area of the day [9]. First balance is currently called Initial Balance (IB). By using the IB as a base, it is possible to project daily ranges based on the measured activity of outside longer-term participants (beyond-the-day trader). The beyond-the-day trader will be buying or selling at different price areas in the market; and we know, from experience, that long-term traders do not make a habit of trading with one another but almost always with the day traders, locals or specialists. The beyond-the-day trader activity can range from extremely low to extremely high. This activity leaves a "footprint" in the market, which we have quantified and categorized as the five types of day structure [10].

2.3.1 Non-trend day

On a non-trend day, long-term traders exert little or no influence on the market. The market exhibits no or almost no extension of its range of prices beyond what is seen in the first hour. Additionally, the day's range is usually small [10].

2.3.2 Normal day

The market gets a slight push from the beyond-the-day traders during normal day, usually resulting in a slight extension beyond IB. On a normal day, outside or long-term activity represents about 10 to 20 % of the trading activity for the day and it produces a directionally biased range extension of about 50 % beyond the first hour's range [10].

2.3.3 Normal variation day

A normal variation day (NVD) takes place when the longer-term trader represents 20 to 40 % of the activity for the day. As a rule, on a normal variation day, the day's expansion is about double the range of the first hour's trade [10].

2.3.4 Trend day

On a trend day, the outside traders represent about 40 to 60 % on the market's activity. The market moves dramatically away from its opening price range. It normally closes within 10 % of the extreme in the direction of its movement during the day. Additionally, IB is typically small. Also note that half-hour ranges are directional. The day should hold directional integrity with successive higher half-hour highs and higher half-hour lows or lower highs and lower lows [10].

2.3.5 Neutral day

Neutral day is a day in which the long-term traders exert opposite or conflicting influences. On the typical neutral day, both upside and downside range extensions occur, netting out to little or no price change for the day. The psychology behind the neutral day is quite interesting. As we know, range extensions are a function of the longer-term trader participation. On neutral days, both longer-term buyer and seller involvement in the same range of prices is an indication of their uncertainty [10].

Almost any trading day will fall into one of these classifications: non-trend day, normal day, normal variation day, trend day, or neutral day. Each involves a different set of likely range parameters, produced by a particular imbalance between short term and long-term traders. If one can make the correct classification as the day develops, one can project how far the market is likely to move and create trading opportunities [10].

3 Research Design

Steidlmayer has defined the five types of days described in the text above. However, there was no further definition about their frequency or any dependency among the days. He claimed that correct identifying of the current trading day can create a better trading opportunity.

This paper analyzes Steidlmayer's concept of DTS on the current US stock market, evaluates how effective trading using this concept is and outlines a simple trading system for a less experienced trader.

Relevant data are essential to perform the analysis. Telvent DTN has been selected as an appropriate data source for this paper. Their IQFeed service provides reliable data. While most quote feeds on the Internet provide a snapshot of real-time data, IQFeed provides a true, tick-by-tick data feed. This feed is completely unfiltered, allowing you to see every trade that occurs in real-time [11]. IQFeed offers 120 calendar days of tick and several years of 1-Minute history (Eminis back to September 2005) retrieval for charting and time & sales data [12].

In the given scope, it is not possible to cover the entire US stock market. Therefore S&P 500 index has been selected as a reasonable representative of the US stock market. The S&P 500® has been widely regarded as the best single gauge of the large cap U.S. equities market [7]. The analysis has been done using CME E-mini S&P 500® futures contracts. E-mini S&P 500 futures are based on the S&P 500 Stock Index, a capitalization-weighted index of 500 large, actively traded U.S. stocks. These stocks are traded on the New York Stock Exchange, the American Stock Exchange and The NASDAQ Stock Market. The primary calculator for the S&P 500 Index is Reuters [2].

The trading data are from September 7, 2005 till June 8, 2012, i.e. 1688 trading days. Several days were removed: either holidays with no trading or days with limited trading hours. Removal of the non-standard trading days allows for more consistent analysis.

This paper asks several questions in its analysis of DTS:

- How do the five DTS defined by Steidlmayer apply to the current market?
- Are DTS still relevant on the current market?
- Do the structures still cover almost any trading day as claimed by Steidlmayer?
- Do DTS help traders with trading decisions?
- Would it simplify trading decisions if any of the structures is eliminated?
- Is there any dependency among DTS that can be effectively used for trading?

This paper performs quantitative analysis of the market historical data to determine frequency of the types of days. Rules for determining each type of the day are the following. Non-trend day's range is usually small. Average range for the analyzed period is 17.87 points (author's calculation using the historical data). Based on the author's trading experience, 7 points range has been selected as the range for non-trend day. Normal day is, for the purpose of this analysis, defined as a day where trading remains within the IB range. Normal variation day is a day where trading breaks out the IB and the extreme doubles the IB range in the direction of IB break. Trend day has smaller IB, directional move and the range is beyond double IB. Neutral day breaks IB in both directions.

Once individual types of days are determined, analysis of dependences among the days follows. Comparative analysis is used to find dependency among the days that should help with the expectation of the market development and support trading decisions. Previous and current trading days are compared and probability of the current day based on the type of previous day is evaluated.

4 Results

Using the rules defined in Research Design to determine DTS during the past 6+ years, the results shown in the following table were obtained.

Table 1: DTS Occurrence

Day Timeframe Structure	Occurence
Non-trend day	6.81%
Normal day	2.43%
Normal variation day	22.39%
Trend day	9.54%
Neutral day	30.21%

Source: IQFeed, author's calculation

As visible from the table, exact following of DTS defined by Steidlmayer on the current market does cover 71.4 % of the days only (which is far from covering almost any type of the trading session). To increase the coverage, let's try to adjust the rules for the days where it makes sense from the concept of the day. For neutral, trend and normal day – the rules are quite clear and do not offer any modification. For the non-trend day, it is very subjective to clearly adjust the rules and also the day definition does not offer much space for such adjustment. NVD appears to be the best candidate for the adjustment since it can be clearly defined by a certain multiple of IB.

The previous table used 2.0 IB as the range to determine NVD. The following table shows how the NVD occurrence changes when various IB range extension is used.

Table 2: Normal variation day occurrence based on IB multiple

IB range	Normal variation day occurrence
2.0	22.39%
1.8	29.15%
1.6	36.97%
1.5	41.75%
1.4	45.62%
1.3	50.53%

Source: IQFeed, author's calculation

As visible from the above table, when IB range gets smaller than 2.0 IB, NVD occurs more often. If the table contained additional rows with IB range 1.2 and smaller, the total sum of all days including NVD would exceed 100 % since these NVD would have also been identified as non-trend days.

For the further analysis IB range 1.5 has been used for NVD determination (i.e. adjusted from 2.0 IB to 1.5 IB). The following table shows the day occurrence when 1.5 IB is used for NVD.

Table 3: Adjusted DTS Occurrence

Day Timeframe Structure	Occurence
Non-trend day	6.81%
Normal day	2.43%
Normal variation day	41.77%
Trend day	9.54%
Neutral day	30.21%

Source: IQFeed, author's calculation

As evident from the table, non-trend and normal days did not occur very often. These days together covered 9.2 % of all trading days. Based on this fact and also usual lower trading activity during these days, it does not make much sense to focus further research on these two timeframe structures.

Trend days occurred in almost 10 % of all days. The market moves quickly in the trend direction during a trend day. If a trader misses the initial move, it might not be easy to catch the trend with a reasonable price. In such situation, it might be better to stay out of the market rather than trying to beat the market and expose the trade to a higher risk of loss.

Neutral day occurred in 30 % of days. If the beginning of trading is not with high level of conviction and later during trading there is a breakout into one side, there is about 30 % chance that the day will end as neutral. It needs some trading experience so that one is able to recognize effectively trade this.

NVD occurred in almost 42 % of all trading days. This is interesting from the fact of most frequent occurrence and should be analyzed further.

As occurrence of the individual types of DTS above is based on several years of historical data, it is still difficult for a less experienced trader to determine what type of day is developing and how to trade it. Potential supporting argument for a less experienced trader can be that during NVD and trend day, i.e. in 51 % of all days, the IB is broken out in just one direction. Moreover, if IB is broken in one direction (this happens during NVD, trend day and during development of neutral day), there is 30 % probability that that day will close as a neutral day.

It would be worth to explore further dependency among the timeframe structures to get more supportive data for trading decisions. One potential dependency can be influence of the previous trading day to the current day.

The dependency can be defined as follows: When there is a certain type of day, what is the probability of a day type of the next trading session? E.g. if yesterday was a trend day, would today be also a trend day or another type of the day? Non-trend and normal days have been excluded from this analysis (as explained above). Therefore, there are three types of days for the analysis: NVD, trend day and neutral day. These three types of days cover more than 81 % of all days. The following table explores occurrence of the next trading session after a certain type of the previous trading session.

Table 4: Dependency between Timeframe Structures

Yesterday \ Today	Normal variation day (today)	Trend day (today)	Neutral day (today)
Normal variation day (yesterday)	39.72%	9.50%	30.50%
Trend day (yesterday)	38.51%	9.94%	34.16%
Neutral day (yesterday)	43.92%	10.39%	31.96%

Source: IQFeed, author's calculation

As visible from the table, the dependency data corresponds with the general DTS occurrence, i.e. there is no strong dependency between any of the DTS. Trend days do not occur often and so do the trend days after a previous trend day. Similar situation is with neutral day. Most frequent is NVD. It is interesting that most normal variation days occur after previous neutral days. This situation can be effectively used during trading: when the previous day was Neutral day, there is almost 44 % probability that the current day will reach 1.5 IB in the direction of the IB breakout. The question is when exactly during a trading session. For such

level of accuracy, it is not possible to be relying just on historical data analysis but certain trading experience is needed.

Let's try to further explore normal variation days. Would we get better results when analyzing them separately as days going up and days going down separately? Normal variation days breaking IB High (up) occurred in 22.69 %, days breaking IB Low (down) occurred in 19.08 % of all trading days (author's calculation based on historical data). The following table shows the results of up and down normal variation day's dependency analysis.

Table 5: Further Normal variation day analysis

Yesterday \ Today	Normal variation day up (today)	Normal variation day down (today)
Normal variation day up (yesterday)	20.37%	19.32%
Normal variation day down (yesterday)	23.29%	16.46%

Source: IQFeed, author's calculation

As visible from the table, normal variation days breaking IB High slightly prevailed. This can help when one is seeking for another supporting argument why to be in a long position during a certain trade based on NVD timeframe.

Let's perform one more analysis: what is the dependency between IB breakout yesterday and today? The following table shows the results.

Table 6: Initial Balance breakout analysis

Yesterday \ Today	No IB break out (today)	IB break out (today)
No IB break out (yesterday)	19.87%	73.72%
IB break out (yesterday)	8.14%	78.34%

Source: IQFeed, author's calculation

Table 6 shows that IB breakout is occurring often on the market (note: the sum on the rows is not 100 % since the Steidlmayer's type of days do not cover all trading days). When the range was reasonable and there was no IB breakout yesterday (i.e. yesterday was a non-trend or a normal day), there is almost 20 % probability of the same situation today, but there is more than 73 % probability that IB breakout will occur on today's market. When there was IB breakout yesterday, the probability of IB breakout (and a reasonable trading range) today is even bigger, more than 78 %. This fact is easy to pick up for even a less experienced trader. When the market is trading around IB High or IB Low once the IB of a day has been formed, there is a high probability that IB will be broken out. Once a trader is utilizing this opportunity and keeping reasonable money management, this should lead towards a successful basic trading.

5 Conclusion

This paper analyzed relative occurrence of DTS defined by Steidlmayer, identified potential trading advantages based on the day definition and analyzed dependences among the days that can be used during trading.

Non-trend and normal days did not occur often and it does not make much sense to rely on those structures in trading. Majority of such trades would be just waiting for the right type of day. The fact that the range is smaller during these days also supports their removal from consideration.

Trend days occurred in 9.54 % of days. If a trader misses the initial trend development there might be another chance to detect the trend on a macroeconomics news announcement. News announcement should be checked while trading since it usually has impact on the market price.

When introducing the DTS, Steidlmayer has defined one important pattern that should not be left out during trading: Initial Balance (IB). The first trading hour is important for the subsequent determination of the potential further development of the trading day. The market is usually able to break the IB (as visible from table 3, it is in more than 81 % of all trading days) which supports Steidlmayer's idea of importance of the IB.

NVD and neutral day can be effectively utilized for the IB breakout trading. A trader should be prepared for the IB breakout and effectively use it during trading. An idea of a trade during the IB development (even very early after the market is opened) should not be rejected as well. It appears to be a good trading opportunity since the market breaks the IB often. If a trader recognizes the market direction correctly then there is a high probability of a successful trade.

Steidlmayer's definition of DTS does not fully cover all trading days at today's market. There is about 29 % of days that do not fit to this definition. But as evident from this paper, the Steidlmayer's DTS can be utilized during trading on today's market. Some of the days do not offer clear and easy trading opportunities (non-trend day, normal day). Opposite to that, if a trader is able to correctly identify developing trading day at the beginning of trading or while IB of that day is being formed, there is a high probability for a successful trade. Since trend days do not occur very often (only about 10 % of days is trend days), NVD and neutral day can be utilized in the remaining trading time.

At the same time, it is evident that there are some limitations caused by the DTS definition. It was necessary to adjust NVD definition to get reasonable results that could be used for trading.

How to deal with this adjustment? Would it be worth to try to define new type(s) of days that would improve the coverage of the trading days and offer better trading opportunities? Would it be worth to evaluate impact of European session trading to the US session? Research on these topics and answers to the questions can be a good material for a further development of this paper.

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