Predicting trending days: an analysis of the ES mini futures market Luca Polledro, CEU Business School 2017/2018



PREDICTING TRENDING DAYS: AN ANALYIS OF THE ES MINI FUTURES MARKET

Master Thesis

Luca Polledro

CEU Business School

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Supervisor:

Ferenc Meszaros, Visiting Lecturer

Central European University

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1 Executive Summary

One of the greatest challenges of investors since the inception of financial markets has been predicting future price movements. This research, based on data from the past one year, aims to identify patterns – with a positive edge on the ES-mini futures market – that can be used to predict trending days¹ and trade them profitably.

Between September 2016 and September 2017, 41 trending days were identified on the ES, 13 in 2016 and 28 in 2017. The research consisted of two parts:

- a) first, we looked for any patterns *on the RTH* session² preceding the trending *day* that may have a predictive value
- b) secondly, we looked for patterns with a predictive edge during the electronic trading hours (ETH, 6pm to 9.30am) during the same period of one year.

Neither research found patterns that have a positive expectancy when used to trade subsequent trending days. These results may prove particularly important for intraday traders, and underlines the fact that edges³ – especially on the intraday timeframe – are, due to the near-complete efficiency of the market, hard to find.

We must add that this research was carried out on a limited sample size of 41 trending days over a one-year period. Research on such limited sample sizes cannot produce statistically definitive conclusions, therefore further research should be carried out on a larger sample size on the ES-mini contract, looking at many years of data: this, to establish if there are any "warning signs" (i.e. patterns of predictive value that precede the potentially highly profitable trending days), and which could be used as the basis for trading strategies aimed to trade such trending days with a positive expectancy.

¹ trending days: days with a strong unidirectional movement on the ES-mini futures market, when price opens at the daily low and closes near the daily high.

² a trading session (RTH, regular trading hours) is defined as 9.30am to 4.15pm Eastern Time.

Electronic trading hours (ETH) are defined as 6pm to 9.30am Eastern Time.

³ edge: a trading opportunity with a positive expectancy.

2 Introduction: Purpose of the Project

This paper has two main purposes:

- 1. To discover whether *trending days*⁴ can be somehow predicted by analyzing price movements on *preceding trading day's Regular Trading Hours (RTH)*.
- 2. To discover whether any patterns exist in the pre-market hours (ETH) that may help to predict developing *trending days* in the RTHs.

Ultimately, our goal is to build a strategy around an edge that would allow *trending days* to be successfully tradable. The research looks for quantitative evidence, if any, of these correlations.

Given that this research was made for academic interest, it's not meant to be investment advice, but rather a thorough look at how market forces generate price movements. It is interesting to understand how price fluctuations create patterns that can be categorized and analyzed for any predictive characteristics.

It should be pointed out that this research is based on a one-year sample and 41 data points. The number of the total observations is, statistically, not enough to provide definitive answers. To get that, the research should be repeated, using the same methodology, on a much larger dataset (3 to 5 years' worth of data) in a subsequent project.

⁴ Throughout this paper 'trending days' means unidirectional trading sessions on the ES-mini futures contract.

2.1 Definitions

Trending days are those days in which the market moves unidirectionally, opening near the day's low and closing near the day's high (for upward sloping days), and vice versa (for downward sloping days). On such days, many traders looking to trade the extremes may get trapped on the wrong side of the market, subsequently adding fuel to the fire as they are forced to abandon their positions. Pullbacks, if any, are unconvincing, making entries for latecomers difficult. The unidirectional pressure tends not to let up during the regular session.

Pre-market action is the period of trading activity that occurs before the regular trading hours (RTH). For the purposes of this project, we will regard as pre-market action the time between midnight and 9:30am of the current trading day, with regular trading hours (RTH) defined as the time between 9:30am and 4:15pm.

3 Trending Days

3.1 Research Methodology

The research started in September 2017, using the NinjaTrader7 trading platform and live futures market data. A one-year period was analyzed between September 2016 and September 2017, and 41 trending days were identified on the ES. The research was organized as follows:

- Chart screening from September 2016 to September 2017
- Categorization of trending days and preceding trading days and sessions
- Excel data classification and calculations

3.2 Chart screening

This first part of the work consisted of a day-by-day visual screening of the ES futures chart. Trending days and preceding days were grouped into subcategories based on their characteristics.



Figure 1 Trending day (day in the middle)

3.3 Categorization of Trending Days

A fundamental part of the research was to identify trending days based on a consistent criteria, as well as grouping preceding market action into categories for further analysis.

3.3.1 Type "A" trending days

These indicate a day in which price either follows a unidirectional trend or makes one pullback before starting the unidirectional trend. (A *pullback* is defined as a counter-trend movement, followed by a recovery in the direction of the trend). See examples below:



Figure 2 Type "A" trending day – example





3.3.2 Type "B" trending days

These indicate a day in which the market retests, once or several times, the same price area on the chart. This pattern may be an indication of accumulation (in the case of a bullish move) or distribution (in the case of a bearish move) before the trending movement actually starts.



Figure 4 Accumulation (marked with horizontal yellow arrow)



Figure 5 Distribution (marked with yellow arrows)

3.3.3 Type "C" trending days

Indicates a day in which no clear price pattern is identified.



Figure 6 Uptrend with various price action patterns

3.3.4 Classification of Preceding Days

This group indicates a preceding trading day that shows sideways market action, and a potential accumulation/distribution pattern. Price drops are bought, resulting in low daily range less than 8 points⁵.

3.3.5 Type 1: Compressed Volatility Preceding Days

Low volatility or compression often leads to volatility expansion as can be seen on



the following chart:

Figure 7 Volatility expansion on the ES

⁵ The calculations will be explained in the paragraph 3.4.

3.3.6 Type 2: V-shaped Preceding Days

This pattern indicates a preceding trading day that has a V-shape with a daily range of larger than 8 points.



Figure 8 V-shaped preceding day on the ES

3.3.7 Type 3: Preceding Days with Upward Pressure

This pattern on a preceding day shows a clear upward pressure.



Figure 9 Upward pressure on a preceding day

3.4 Excel Data Classification and Calculations

After grouping Trending Days and Preceding Days into categories, the data was analyzed in Excel to uncover any correlations. The Excel spreadsheet included the following data:

Date

Indicates the date on which the trend occurred.

S/R Test

Indicates whether price reversed on support/resistance.

S/R

Indicates the indicator (apart from price) that was used to identify support/resistance area.

PD Range-bound Market

Indicates whether the previous trading day was a range-bound market with a range of less than 8 points.

Gap

Indicates whether the trending day opened on a gap with the previous day close. If yes, it tells when the gap was up, down, filled or not filled.

Occurrence

Indicates how many times a specific indicator acted as a support/resistance out of the total number of observations.

8 Range						
Date	S/R Test	S/R Type	PD Range-bound Mkt.	Gap	Occurrence	
			2016			
Sept 15	Support	ADXVMA	No	No	ADXVMA 13/13	
Sept 22	Support	ADXVMA	No	No	PDC 3/13	
Sept 23	Resistance	ADXVMA/PDC	No	No		
Sept 26	Resistance	ADXVMA	No	No		
Oct 11	Resistance	ADXVMA	Yes	No		
No 1	Resistance	ADXVMA	Yes	No		
No 7	Support	ADXVMA	Yes (11/4)	Up (not filled)		
No 15	Support	ADXVMA	Yes	No		

3.5 The Volatility Calculator

This tool was designed to find correlation in the data. The calculator combines open/close prices as follows:

Daily Variation (%) - the percentage change between open/close on a given day

Daily Variation (Absolute) – the difference between the open and the close on a given day

Mean - the simple average of the daily variation on a yearly basis

SD Daily Variation - the standard deviation of the absolute daily variation in each

day and the yearly mean

Volatility Calculator								
Date	Open	Close	Daily Variation (%)	Daily Variation (Absolute)	SD Daily Variation	Mean		
			2016					
Sept 15	2102	2123,75	1,03473	21,75	2,570061185	18,11538		
Sept 22	2143,25	2155,75	0,58323	12,5	3,970676541			
Sept 23	2155,25	2144,5	-0,49878	10,75	5,208113408			
Sept 26	2143,25	2126,75	-0,76986	16,5	1,142249416			
Oct 11	2146,5	2120,5	-1,21127	26	5,575265006			
No 1	2110,5	2089	-1,01872	21,5	2,39328449			
No 7	2093	2117,25	1,15862	24,25	4,337828138			
No 15	2148	2166	0,83799	18	0,081589244			
No 17	2159,5	2172	0,57884	12,5	3,970676541			
No 21	2166,5	2180,75	0,65774	14,25	2,733239673			
Dec 7	2198,25	2223,5	1,14864	25,25	5,04493492			
Dec 9	2234	2248,5	0,64906	14,5	2,556462978			
Dec 13	2242,5	2260,25	0,79153	17,75	0,258365939			
			2017					
Jan 4	2245,25	2257	0,52333	11,75	5,303300859	19,25		
Jan 24	2253,25	2268,25	0,66571	15	3,00520382			
Jan 25	2268,25	2286,25	0,79356	18	0,883883476			
Febr 3	2266,5	2284,25	0,78315	17,75	1,060660172			
Febr 9	2283	2296,75	0,60228	13,75	3,889087297			
Febr 13	2306,75	2319,25	0,54189	12,5	4,772970773			
March 1	2357	2385	1,18795	28	6,187184335			
March 2	2384,5	2373,25	-0,47180	11,25	5,656854249			
March 15	2359	2374,75	0,66766	15,75	2,474873734			
March 21	2364,5	2336,5	-1,18418	28	6,187184335			
Ap 17	2319,5	2340,75	0,91615	21,25	1,414213562			
Ap 20	2328,75	2347,5	0,80515	18,75	0,353553391			
Ap 25	2365,5	2379,25	0,58127	13,75	3,889087297			
May 15	2384,25	2395,5	0,47185	11,25	5,656854249			
May 17	2392	2351,75	-1,68269	40,25	14,8492424			
May 19	2359,5	2377,5	0,76287	18	0,883883476			
Jun 19	2431,25	2445,25	0,57584	14	3,712310601			
Jun 20	2445,5	2434,25	-0,46003	11,25	5,656854249			
Jun 28	2414,75	2440,5	1,06636	25,75	4,596194078			
Jun 29	2439,75	2419,25	-0,84025	20,5	0,883883476			
Jul 6	2425,75	2406,5	-0,79357	19,25	0			
Jul 7	2407	2421	0,58164	14	3,712310601			
Jul 12	2422,5	2438,5	0,66047	16	2,298097039			
Aug 14	2439,25	2462,75	0,96341	23,5	3,00520382			
Aug 17	2464,5	2425	-1,60276	39,5	14,31891232			
Aug 22	2425,75	2451,75	1,07183	26	4,772970773			
Aug 31	2453	2468,25	0,62169	15,25	2,828427125			
Sept 11	2467,75	2486,75	0,76993	19	0,176776695			

3.6 Research Focus

Research focused on the following areas:

- Calculation of the price range of a range-bound day, to obtain information about the mean daily variation before a trending day
- Correlation analysis between range-bound days and total trending days
- Proof of the validity of the correlation the other way around
- Pre-market patterns analysis to get hints on the RTH price behavior

3.6.1 The Importance of the ADXVMA Indicator

The ADXVMA indicator (Average Directional Index Variable Moving Average) is a type of moving average that uses volatility. This indicator revealed its fundamental function as a support/resistance through the whole research: out of 41 total observations, support on or around ADXVMA lines occurred 27 times (68%). This finding may prove particularly important when defining trading risk management strategies: setting up of stop loss⁶ levels a certain distance above or below the ADXVMA is likely to be a good method to control trading risk, while providing a positive expectancy.

3.6.2 The Importance of Previous Day Close (PDC)

The previous day's close has relevance to the current day's trading session: in a bullish environment, price tends to stay above the previous close during the overnight session and vice versa. Nevertheless, this is a very useful tool for understanding price patterns. In fact, PDC acted as a support/resistance in many occasions during the research: when price goes back to this level, it can either break it or – as usually happens – bounce back. In tandem with the ADXVMA, it is extremely useful for risk management as well.

⁶ A "stop loss" is a pending order used to protect a position from excessive losses. It closes open positions.

3.7 Findings

Eventually, let's look at which outcomes the research produced.

Calculation of the price range of a range-bound day, to obtain information about the mean daily variation before a trending day

The range was calculated using the formula:

|Daily Open Price – Daily Close Price|

It returned the absolute difference in points and was applied to all the range-bound days preceding a trending day. It ranges from min = 0 and max = 7.5. (A range-bound day was defined as a day with a range of less than 8 points).

Volatility Calculator - Previous Trading Days								
Date	Open	Close	Daily Variation (%)	Daily Variation (Absolute)	SD Daily Variation	Mean		
			2016					
Oct 10	2139	2146,5	0,35063	7,5	1,856155301	4,875		
Oct 31	2107	2110,5	0,16611	3,5	0,972271824			
No 4	2071	2068,5	-0,12071	2,5	1,679378605			
No 14	2151,5	2147,75	-0,17430	3,75	0,795495129			
No 16	2159,25	2166	0,31261	6,75	1,325825215			
No 18	2171	2167,25	-0,17273	3,75	0,795495129			
Dec 6	2192	2198,5	0,29653	6,5	1,149048519			
Dec 12	2247,75	2243	-0,21132	4,75	0,088388348			
			2017					
Jan 23	2258,5	2253,75	-0,21032	4,75	1,08145743	3,221		
Febr 2	2267,5	2266,75	-0,03308	0,75	1,746969695			
Febr 8	2278,25	2283	0,20849	4,75	1,08145743			
Febr 28	2358,25	2357,25	-0,04240	1	1,570192999			
March 14	2366,25	2359	-0,30639	7,25	2,849224383			
March 20	2369,25	2365	-0,17938	4,25	0,727904039			
Ap 19	2333	2327,25	-0,24646	5,75	1,788564211			
Ap 24	2361,25	2365,5	0,17999	4,25	0,727904039			
May 12	2385,75	2384,5	-0,05239	1,25	1,393416304			
May 16	2395,25	2393	-0,09394	2,25	0,686309523			
Jun 16	2429	2432,25	0,13380	3,25	0,020797258			
Jul 5	2422,5	2426,25	0,15480	3,75	0,374350649			
Jul 11	2421,5	2422,75	0,05162	1,25	1,393416304			
Aug 11	2434	2438,5	0,18488	4,5	0,904680735			
Aug 16	2462,25	2464,25	0,08123	2	0,863086218			
Aug 21	2426,5	2426,5	0,00000	0	2,277299781			
Sept 8	2464,75	2461	-0,15215	3,75	0,374350649			

Correlation analysis between range-bound days and total trending days

From my observations, out of 41 total trending days, 25 were preceded by previous range-bound days. Thus, 25/41 or 61% of total trending days in the 1-year sample were anticipated by a previous day with a volatility lower than 8 points.

Proof of the validity of the correlation the other way around

Despite the results above, the correlation is relevant only whether it is true the other way around also. That means, it is fundamental compounding the weight of previous trading days with a volatility lower than 8 points on the overall sample. To do that, I counted the number of preceding trading days with volatility > 8 points in a year, and compared them to the number I had in my dataset. The result is 25/148 - or 17%.

Hence, even though we can say that the volatility expansion of trending days is likely to be anticipated by a volatility contraction (61%), we cannot say that – taken a random day with volatility > 8 points – this will precede a trending day. In fact, given a random day with this volatility feature, only one or two times out of ten it will give us any hint on the following day's price behavior. This is the main finding of this chapter, and does not allow us to build a live trading based on it.

3.8 Pre-Market and Regular Trading Hours (RTH)

The other important research made on trending days was aimed to find whether existing patterns occurring in pre-market, carried any predictive value on RTH price movements. I analyzed the trading session between midnight and 9:30 AM, additionally paying attention to any specific price behavior between 9:30 and 10:00 AM. I made a visual chart screening of the 1-year sample, and categorized the pre-markets in three groups:

3.8.1 Pullback

Indicates a pre-market action in which price bounces back after touching specific price levels.

3.8.2 Unidirectional

Indicates a pre-market in which price follows a unidirectional movement.

3.8.3 Accumulation/Distribution

Indicates a pre-market action in which price action indicates potential accumulation or distribution.

The overall sample counted 234 trading days, divided as follows: 101 for pullback pre-market, 74 for unidirectional pre-market and 59 for accumulation/distribution pre-market. Here as well, any relevant outcome can be found only by weighting the 41 trending days already screened. Hence, I divided 41/234, finding a correlation of 17%⁷. Again, no edge was found, and no live trading strategy can be built on these findings. Nevertheless, this research outlines once again how important support/resistance levels are for the trend holding.

⁷ If we concentrate on the sole pullback pre-market degree of correlation, the result is 33/101 = 0.3267 - or 33%. In fact, 33/41 were the trending days clearly characterized by one or more pullbacks in the pre-market session. Still, this is not an edge.

4 Conclusion

The first important finding of my research is that no significant correlation exists between trending days and previous trading days.

 Even though 61% of the trending days were preceded by a day with a range of less than 8 points, the probability that a less than 8 point range day is followed by a trending day is only 17%.

Still, the answer to the question:

can a trading strategy be designed for trending days on the ES that would have a positive expectancy?

is, possibly, a yes. Let's how that could be achieved:

Based on this information (and bearing in mind that the 17% is based on only 41 data points, so a study of a larger sample size would have needed for such a system to be firmly grounded in data), we can use the following Expectancy Formula:

Expectancy = (probability of wins x average win) - (probability of losses x average loss)

to devise a trading system with a positive expectancy.

The following chart contains a few possible scenarios: by changing the variables in the expectancy formula, we can establish what metrics are required for a trading system to be profitable⁸. We have to bear in mind that to do that we need more data and expanding the research to, say, 5 years of data is likely to be necessary for the results to be statistically meaningful.

⁸ Designing the trading system, including defining contract size, risk profiles, targets and stop losses, while a fascinating challenge, is beyond the scope of this study.



Figure 10 Devising a profitable trading system

As can be seen above, by changing the variables in the chart, the metrics of a winning trading system can be easily established. The more difficult task then becomes to actually design such a system, with the appropriate money and risk management rules, contract sizes, targets and stop losses, entry and exit rules and the appropriate trailing stops. However, although highly interesting and challenging, this is beyond the scope of this study, and shall be the topic of a future endeavor.