

## Video lecture

<https://youtu.be/y4GYEW1LVeI>

## What?

Financial securities' prices cannot be predicted. This is the long believed financial theory. The main reason is the overall market reaction. If there is any predictive signal some of the traders around the world would notice it and trade on it. So, the market would not allow any predictive signals to survive for long periods of time. The prices of securities then reflect all available information out there.

## Random walk

Daily returns are not predictable. They are random. This is usually referred to as random walk. Some people will try to predict short term returns: price will go up tomorrow. Efficient market hypothesis (EMH) claims that these types of predictions can't come true consistently. S/he could be right a few times. S/he, however, can't be right to the point his/her earnings beat overall market earnings.

## Why persistent prediction fails?

There are enough many individual and institutional investors in the market. These investors try to predict the market all the time. They have access to financial data, trading data and news. They also have access to all the technology that one can have. If there is any predictability in returns, these investors will find it and exploit to the point that it will be noticed in the market. Once a pattern is noticed by others, it will be traded away.

For instance, let's assume that we found a pattern: Monday returns are always negative and Friday returns are always positive. This means, from Thursday to Friday, price goes up. From Friday to Monday, price goes down. So, buy on Monday and sell on Friday.

If enough many people notice this pattern, they will all buy on Monday and sell on Friday. With this increased buy activity on Mondays, the prices will eventually go up. With the increase sell activity on Fridays, the prices will eventually go down. Thus, our rule won't work after people notice it.

## Efficient market hypothesis

Efficient market hypothesis (EMH) claims that no trading rules would work consistently. It is obvious from above example that some trading rules may work for some time but it is bound to disappear. EMH simply argues this point.

## Weak form

You can't look at a graph and predict future prices. This is referred to as weak form EMH. Well, some people are pretty good at this. How is this possible then?

There are technical analysts who do charting for a living. They seem to know what they are talking about. However, EMH claims charting can't produce high enough returns to beat buy and hold market returns. I would argue however that: if we have enough investors in the market who trade based on charting then we could create what the chart predicted **Self Fulfilling Prophecies**. This is actually a testable hypothesis.

## Semistrong form

We look at charts and we also include financial ratio analysis along with all public information (news etc.). So, we do technical and fundamental analysis. Then, we predict the near future price direction. EMH claims that we still can't beat the buy and hold strategy on a consistent basis.

For instance, some people argue that if the price to earnings ratio is relatively low then the stock has an upside potential. This is not a short term prediction. This type of prediction is actually a buy and hold strategy suggestion. However, based on EMH, even this type of strategy will not be able to consistently beat market portfolio buy and hold strategy. Again the key word is **consistently**.

## Strong form

You evaluate all sorts of information including inside information. Then, you believe that the price of the stock you just analyzed will increase. Based on EMH, you still can't beat the market on a consistent basis. It is hard to believe that someone with access to inside information can't make substantial earnings. However, you have to keep in mind that trading on inside information is illegal. SEC proactively goes after traders with suspicious trading

activity. Remember Martha Stewart went to jail because her insider information. More recently, Raj Rajaratnam was sentenced to 11 years in prison and \$10 million in fines.

## Which form of EMH do we have?

Well, the jury is still out on which form of EMH we have in markets. We have tests of market efficiency by academics. We also have people still charting. Institutions have computers constantly looking for trading patterns. It is usually assumed that semistrong form market efficiency is more like what we have today.

There are instances where, because of self fulfilling prophecies, the charting may work. There are instances where fundamental financial ratio analysis may provide insight into which stocks have upside or downside potential. There are also instances where inside information provides significant returns. On average, in the longer term and not focusing on a few outcomes, EMH is testable and confirmed. Its semistrong form that is. However, the strong form is hard to test.

## Testing efficient market hypothesis

We will test a simple yet most argued market anomaly. Anomalies are unexplainable return patterns. If they are really patterns, then their existence puts market efficiency in question. Let's test day-of-the-week anomaly and see if it is true. We will see how to test a trading rule.

Day-of-the-week anomaly claims that Mondays and Fridays have predictable patterns. Depending on the country and time period, it usually refers to negative Monday and positive Friday returns. Let's test it for IBM. Obviously, if we test this for one stocks, we cannot generalize this to all stocks. But, our intention is to see how to test a trading pattern.

We first create a binomial variable. These types of variables are assigned a value of 1 and 0. Some refer to them as dummy variables. In our case, we have two dummy variables, **monday** and **friday**. If any day is a Monday, our Monday dummy variable is assigned a value of 1 and 0 otherwise. Similarly, if any day is a Friday, our Friday dummy variable is assigned a value of 1 and 0 otherwise. With a regression, we will see if Mondays and/or Fridays have any statistically significant positive or negative returns.

So, let's look at our data and regression results.

## Testing EMH: Stata code

```
net install http://researchdata.com/stata/203/fetchyahooquotes.pkg, force
fetchyahooquotes IBM, freq(d) chg(ln) start(01jan2012) end(31dec2012)
gen monday=1 if dow(date)==1
replace monday=0 if monday==.
gen friday=1 if dow(date)==5
replace friday=0 if friday==.
list if _n>10 & _n<20
reg ln_IBM monday friday
```

## Testing EMH: Sample data

	date	adjclo~M	ln_IBM	monday	friday
11.	18jan2012	159.0867	.0059269	0	0
12.	19jan2012	158.6035	-.0030422	0	0
13.	20jan2012	165.6322	.0433625	0	1
14.	23jan2012	166.9149	.0077147	1	0
15.	24jan2012	168.6282	.0102118	0	0
16.	25jan2012	168.4525	-.0010425	0	0
17.	26jan2012	167.7935	-.0039195	0	0
18.	27jan2012	167.3367	-.0027265	0	1
19.	30jan2012	169.129	.010654	1	0

Notice the Monday and Friday binary variables. Also, we are testing the predictability of daily returns that are calculated using daily prices.

## Testing EMH: Regression results

Source	SS	df	MS	Number of obs	=	249
Model	.000143727	2	.000071863	F(2, 246)	=	0.69
Residual	.025462648	246	.000103507	Prob > F	=	0.5004
Total	.025606375	248	.000103252	R-squared	=	0.0056
				Adj R-squared	=	-0.0025
				Root MSE	=	.01017

  

ln_IBM	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
monday	.0007521	.0016993	0.44	0.658	-.002595 .0040992
friday	.0019233	.0016477	1.17	0.244	-.0013222 .0051687
_cons	-.0003572	.0008279	-0.43	0.667	-.001988 .0012735

Both Mondays and Fridays have positive signs. However, their p-values are well above 0.05 (5%) significance. Thus, in effect, our coefficients are not any different than zero. Thus, our test results indicate that there are no statistically significant return patterns based on Monday/Friday day-of-the-week anomaly for IBM for 2012.

