

**Nobel Prize of 2013:**

**Trendspotting in asset markets**

**by**

**Eugene Fama, Robert Shiller, and Lars Peter Hansen**

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History of Economic Thought

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## **Introduction**

In 2013, Nobel Memorial Prize in Economics was divided between three scientists: Eugene Fama (1/3), Robert Shiller (1/3), and Lars Peter Hansen (1/3). Main topic of this year economic prize was prediction of asset price movement in stock markets. Each of Laureates made his contribution in studying this problem. They all developed new methods for researching asset prices. In modern world, tools that they invented are widely used in practice. Theoretical basis that these scientists developed moved human knowledge much further. Eugene Fama developed effective-market hypothesis, which was based on random price walking hypothesis. He used theoretical grounding most of all. Robert Shiller criticized Fama's theory and researched the problem using more information that is empirical. That gave unexpected results and benefits for understanding the problem of asset value prediction. Lars Peter Hansen used econometric approach and discovered new algorithm for non-linear high complexity economic models, which could not be evaluated before, using old methods.

## Chapter 1 – Eugene Fama

The largest distribution of Eugene Fama in world economic thought is Efficient-market hypothesis. This theory was based on earlier studies of stock prices changes. Main goal of study was to analyze how prices react on new information and events.

Before Efficient-market hypothesis, random walk hypothesis was popular. French broker Jules Regnant invented the concept it was published in 1863. It is grounded on theory that previous prices do not have correlation with future movements, market prices change randomly. This hypothesis was tested empirically in several student groups, that behaved as market traders, and sport achievements. This studies showed that there is very small predictability in short term, the hypothesis could not be rejected. Economists believed that this hypothesis could be applied to asset markets. Therefore, it is not possible to predict price using historical data.

Eugene Fama also tested random-walk hypothesis in his PhD dissertation in 1963. He used three group of tests: tests of serial correlation, runs tests, and filter tests. This approach was more systematical, than previous works in this field. Fama finished his work in 1965. Results showed that on daily, weekly, and monthly horizon prices can be somewhat predicted using past prices. In addition, they tended to be positively auto-correlated, relationship was weak, however, and the fraction of the return variance explained by the variation in expected returns was less than 1%. In addition, changes from random-walk pricing were so insignificant, that they cannot be used in any trading strategy.

Further studies of stock markets leaded to research in correlation between events and price movements. Main theory was that prices react on publicly available information; significant events have impact on price when happen, but before prices should remain

unpredictable. Eugene Fama and his team was first to use stock market historical data provided by Center for Research in Security Prices. They assumed that there are certain types of corporate information, which are vulnerable for markets such as stock split. In addition, their methodology can be applied to other significant information. For example changes in dividends, director's board, and merges. Nowadays it is called event study.

The idea of study was based on changes in price behavior before particular event and after. They assumed that in free market there would be no systematic positive or negative trend in price movement because prices include all available information. In addition, price reaction will show unbiased change in fundamental asset price, they was caused by particular event.

Empirical side of event study faced new problems. First, many factors may cause effect on price. Second, there is lots of new and relevant information in particular moment, it is almost impossible to isolate price change from one event. Third, effects caused by different events may interfere. At first, they took stock split events, and found that there are no abnormal price changes after these events. It showed that markets fully absorbed information and adjusted prices accordingly. Figure 1 represents information about price changes before and after companies announced paying dividends. Time mark 0 is the date of event. Graph shows price changes 12 days before and after event. There are no additional abnormal deviation before event or after, stocks increased 5% in the exact date of announcement. Such behavior indicates, that there is no predictability for this type of event.

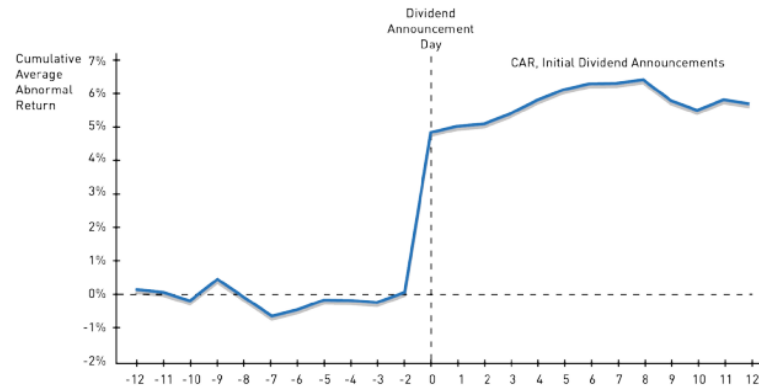


Figure 1: Abnormal stock prices for initial dividend announcements

Practical use of this type of research nowadays is to measure how particular type of event change effect asset value. It is important to get information about direction of changes, which are caused by particular event, whether price is growing or reducing. Most common use of event studies directed to find out the exact value of changes in price. They are often used in macroeconomics, corporate finance and government regulation. Using such simple methodology it is possible to calculate effect of corporate decision, regulatory changes for different periods and assets, in addition it can be used for economic theory testing.

Efficient-market hypothesis is the conclusion, based on previous researches. Main statement is that there is no possibility to earn more than average market returns on a risk-adjusted basis, given the information at the time the investment made. This assumption is made on basis that in short run there are no possibilities to predict market price. There are some additional conditions traders have rational expectations, and they adjust their expectations according to new events. Some traders may react more, some less, but in average this reactions follow normal distribution pattern. That is how this hypothesis looks like in general; also, there are common forms, which can be applied to different markets.

Using above-mentioned information there can be three types of markets allocated: weak-form efficiency, semi-strong form efficiency, and strong-form efficiency. All these forms show how markets work, in terms of adjusting price according to expectations.

When markets have weak-form efficiency investment strategies, which are based on historical data, in the long run cannot provide additional profit. In this case, there are no patterns that may show price future movements. In result, technical analysis techniques cannot provide information, which could produce more profit than average. Fundamental analysis techniques used for weak-efficiency markets may provide additional data. Price movement is determined entirely by data not contained in the price series. In result, prices move randomly.

Markets that have semi-strong form efficiency adjust prices very quickly with the new information published. In addition, investors and traders accept this information on unbiased basis. For semi-strong form efficiency markets technical and fundamental analysis techniques are not able to provide additional data to produce reliably additional profit. To test market for this form researchers take some isolated events that definitely affect market price. Then watch price movements before this event and after. If there are additional adjustments of price except from this particular event, then investors and traders interpret information on biased basis. In result they act in an inefficient manner, it means that this market has no semi-strong effectiveness. To prove that market has semi-strong efficiency form reaction of prices on new events should be reasonable value and instant, without strong adjustments after event.

Strong-form efficiency has several features that differ it from other forms: asset value reflect all relevant information both public and private. Such efficiency form is possible only if

all information is available, and not forbidden by legislation, except the case when these laws do not work and ignored by market participants. Testing for this form of market efficiency is relatively easy. It must be a market, where no trader or investor earn additional profit in long term. In such market high performance funds, that retrieve huge earnings, move downwards later giving place for new one. In result in average, all market participants earn the same risk-adjusted profit.

In general, market-efficiency hypothesis describes how different market types work. Main ideas are this: in average level of profitability of each trader does not exceed market profits on risk-adjusted basis in long term; production function of every trader and investor has normal distribution, it means that all extreme decisions nullified and market price moves because of unbiased new information accounting and rational expectations, all market participants are trying to maximize their profitability. It leads to assumption that asset market have rational behavior.

Critics of theoretical part of market-efficiency hypothesis is based on its main assumptions. Asset markets cannot exist because it is not possible to have all significant information. It happens by the reason of high amount of private or insider relevant information; this changes everything for most assets markets. Next point is how traders and investors react on news and events. Hypothesis says that in average they act adjust expectations in the same way. It is not quite truth because traders and investors are people that have emotions and may act completely different ways depending on mood or other factors that do not effect asset value directly. In addition, one of the main points is unbiased perception of news and events. That is also not possible by almost the same reasons, everyone have biased opinion based on life experience, knowledge etc. Behavioral economists say that

imperfections of asset markets are combinations of different forms of biases like overconfidence, overreaction, representative bias, information bias, and various other predictable human errors in reasoning and information processing.

Empirically efficient-market hypothesis is also disputed. There are no asset markets, which show strong forms of efficiency. Rare times, when markets may act as they have strong-form market efficiency, are treated as anomalies, that may appear eventually but do not have sustainable forms. Researches of profitability of different investors and traders in different markets showed controversial to efficient-market hypothesis information. Some of them can be identified as 'winners', which have high profits and others as 'losers', which have low earnings. Both groups have stable level of profitability in short run, but in the long run, they change groups, so 'losers' become 'winners' and vice versa. Main discrepancy between effective-markets hypothesis and real data is that new 'winners' have to earn much more than it is. Data showed that gap of profitability between these two groups does not disappear through time and may become even greater later.

There are also problems with testing asset markets on efficiency. If one wants to know whether profitability is higher than average or lower, one should make a model of this market that would describe price changes, so it would be possible to calculate all earnings. However, until now these models do not work properly in long term, so it is not possible to find out normal profitability. Consequently, a situation arises where either the asset-pricing model is incorrect or the market is inefficient, but one has no way of knowing which is the case.



## Chapter 2 – Robert Shiller

Robert Shiller is mostly famous for his book *Irrational Exuberance*, where he proved irrational nature of market behavior. This theory was created as critics of market-efficiency hypothesis and it is mostly based on long-term historical data. The main difference between these theories is that first, one is based on theoretical research, and the second is mostly based on empirical information. Irrational market behavior is most well-known and accepted theory in this field at the moment.

Theory was proven by several researches in different ways. At first Shiller studied US stock market data since 1870s. Basic assumption of this research was based on market-efficiency hypothesis that investors and traders act rationally. In this case, it means that market price changes according to future dividend expectations and discount rates. To prove this assumption he made previous actual prices based on real dividends paid in future. Dotted line on Figure 2 shows this calculated price, and if the efficient-market hypothesis was right, it should match actual prices. As we see lines does not match at all. This proves two things: first, efficient-market hypothesis is wrong; second, since there are no real dividends and discounts calculated that could match real price, market behavior is irrational. This data also showed that real asset value do not change much in long-term perspective, and real price will always try to find equilibrium near these levels.

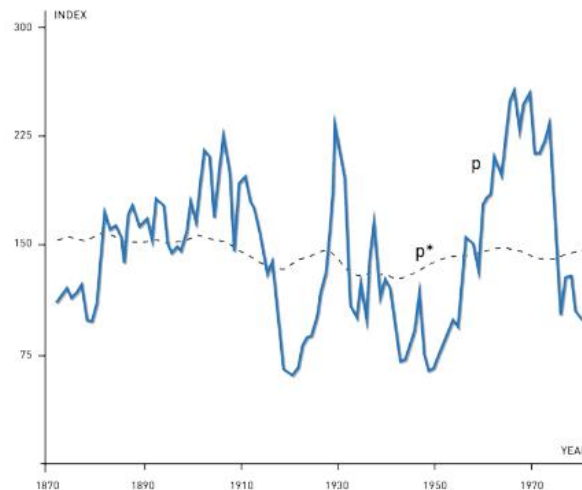


Figure 2: Real S&P Index ( $p$ ) and ex post rational price (dottedline  $p^*$ ), 1871–1979, both detrended by dividing a long-run exponential growth factor. The variable  $p^*$  is the present value of actual subsequent real detrended dividends, subject to an assumption about the present value in 1979 of dividends thereafter.

Market prices show that people act irrationally and finally to prove the assumption Shiller made research from the other side of problem. Since market prices reflect actions and expectations of all market participants, for example, traders, investors, fund's managers, it is most likely that more information can be acquired by questioning them. Therefore, Shiller did it in 1989, after stock market crash in October 1987. Main goal was to find out main motivation that drives traders and investors to trade. Data gathered since then proved that, mostly they do not use rational calculation in decision-making process, instead they act emotionally.

In addition, Robert Shiller is widely famous for Case-Shiller Home Price index. It is used as indicator for real estate market in US. Index is based on calculations of prices for repeat sales of single-family homes since 1890. This index is useful if one is willing to evaluate real estate market condition. More researches of this index show that real price on houses does not correlate with construction costs, interest rate, population.

### Chapter 3 - Lars Peter Hansen

Hansen's contribution in world economic thought is the Generalized Method of Moments that can be used for calculating consumption capital-asset-pricing model. It is a kind of capital asset pricing model, but the meaning of beta coefficient is different. Basic formula of capital asset pricing model has this look:

$$\tilde{r} = r_f + \beta_c(r_m - r_f)$$

Where:

$\tilde{r}$  = expected return on security

$r_f$  = risk free rate

$\beta_c$  = sensitivity of expected excess asset returns to the expected market returns

$r_m$  = return from the market

Capital asset pricing model is used to find out appropriate rate of return of asset, if the asset will be added to portfolio with high level of diversity, given that asset's non-diversifiable risk. Model includes parameter that shows asset's sensitivity to type of risk that is known as systematic or market risk. In formula it is represented by coefficient  $\beta_c$ . This model is widely used in evaluating asset prices and portfolio selection, it is popular because of relative simplicity of usage and because it may be modified to a variety of situations.

The Generalized Method of Moments allow evaluating coefficients of nonlinear models as consumption capital-asset-pricing model. Usual mathematical methods cannot calculate models with high complex structure, because there is no possible way to calculate derivative for some of the coefficients. For example, in formula below derivative of coefficient

u cannot be calculated using usual methods. Main idea of Generalized Method of Moments is to calculate coefficients of model directly, one makes it using different values for each of model's components until it works properly.

$$E \left[ \left( \beta \frac{u'(c_{t+1})}{u'(c_t)} \cdot R_{i,t+1} - 1 \right) \cdot z_{jt} | I_t \right] = 0.$$

## Conclusion

Main field that was object of researching of Laureates in 2013 was asset market behavior. All three scientists showed different approaches to problem, but results are more than useful for modern people.

Eugene Fama invented developed events based market researching. He proved that market price is affected by different news and events. Sometimes it is possible to evaluate the strength of effect using historical data. This new methodology gave an impulse for development a new economic theory. Basic principles of efficiency-market hypothesis show that asset value depends on how market participants adjust their expectations according to new information. He assumed that there are three forms of effectiveness weak, semi-strong, and strong. Market researching using information about news and events widely practiced in modern world. Theory of market effectiveness was a breakthrough in the time it was presented, but disproved later.

Robert Shiller's researches are based on the criticism of efficient-market hypothesis. He showed weak point of this theory, calculated new data, and proposed new point of view. Proving irrational behavior gave impulse for new field of study behavioral economics that is widely used now in analysis. Another impact of this research was that real value of asset does not change much in long period, also real market price will eventually return to this natural level. Last beneficial point of his research was creating the Case-Shiller Home Price index, which is widely used by investors as indicator of real estate market conditions in US.

Lars Peter Hansen has econometric approach in solving asset market predictability problem. His main contribution is the Generalized Method of Moments. This method allows one to evaluate complex non-linear models using relatively simple tools. Hansen used it to

calculate a variation of Capital asset pricing model, which included new beta coefficient. Previously there were no mathematic methods, which could help in solving such economic models. Nowadays Generalized Method of Moments is widely used by investors.

Each of them contributed in solving market predictability problem in different ways, but all together Laureates did a lot in field of prediction asset market movements.

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