

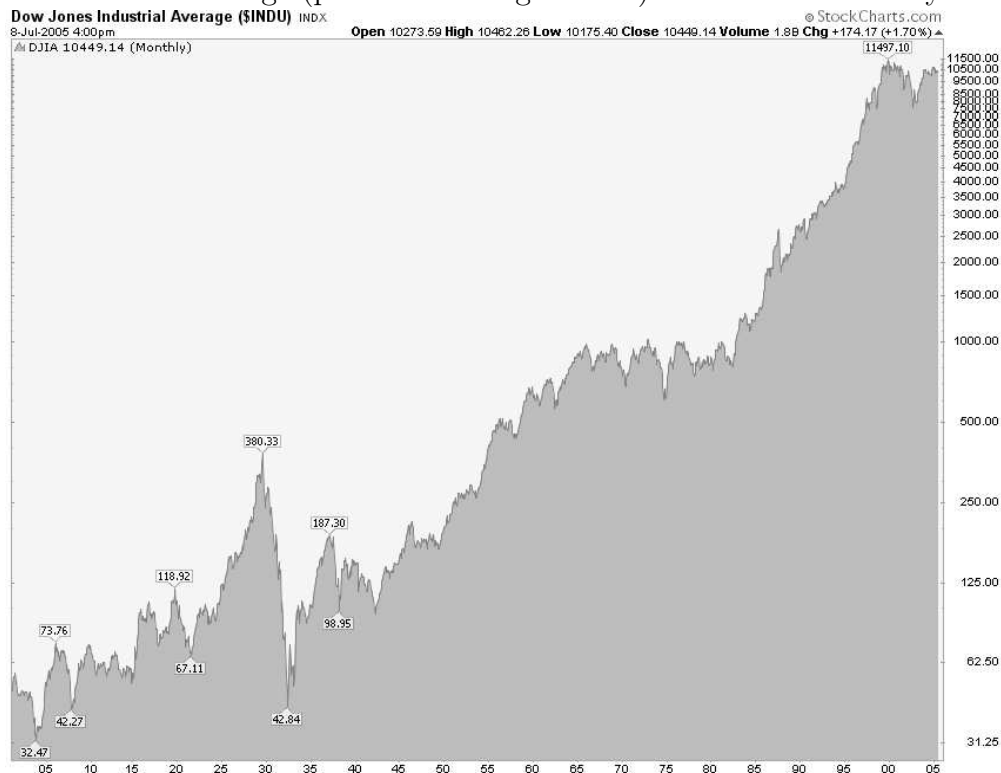
The Efficient Market and Random Walks

Today we're going to discuss randomness in the context of buying and selling stocks. If you've never played the market, don't worry. All you need to know to start is that the price of something (say, a stock) is set by being the maximum price people who don't own it are willing to pay to buy it, and the minimum price people who do own it are willing to sell it for.

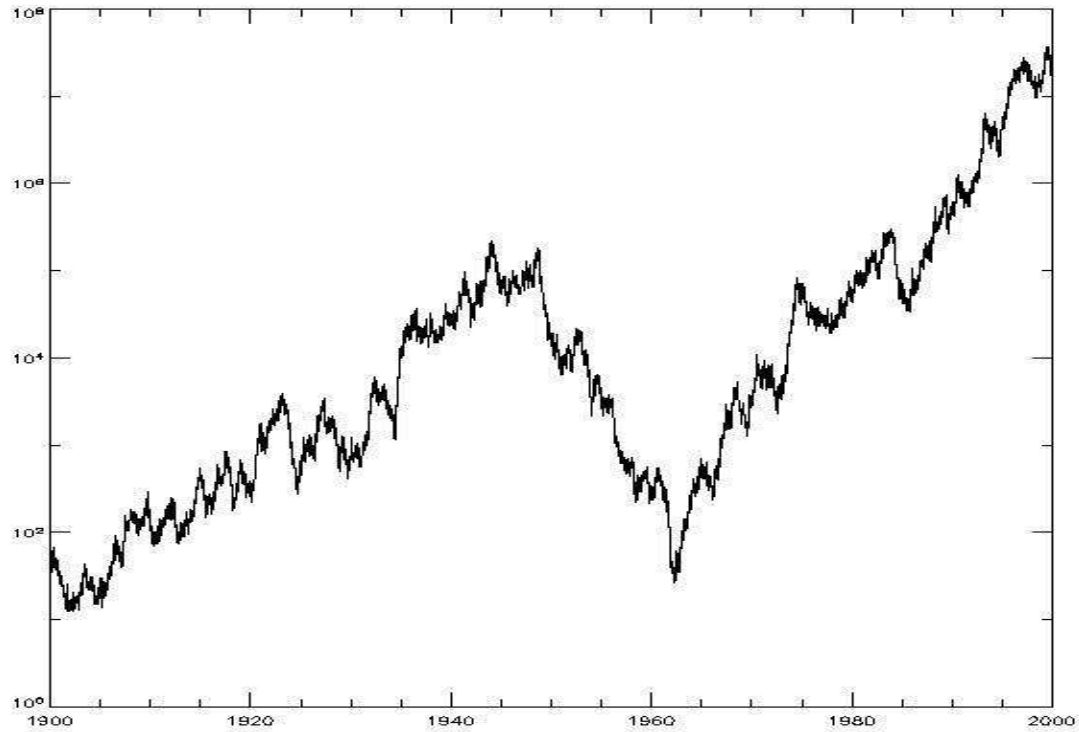
One of the big assumptions in the modern marketplace is that the market is *efficient*. That is, information flows through all the buyers and sellers, and thus, the current price of the stock accurately reflects all the information available.

In principle, this is at least approximately testable. We could look at the price of a stock over time, and if the market weren't efficient, we could tell. A rise in one day, for example, would more often than otherwise predict a rise the next day, and so on.

While we're not going to do a rigorous statistical analysis consider the following plot of the Dow Jones Industrial Average (prices of 30 large stocks) over the last century or so.



It certainly looks like there are clear trends, and that a drop in one day (or year) predicts a drop the next year, and vice-versa. But in fact, this is a very good example of how your brain can sometimes fool you and detect patterns where there is really noise. Consider, by contrast the following plot:



This plot was created by doing a *random walk*.¹ Each day, I flipped a coin (well, I actually had a computer choose a random number, but the effect is the same). Since the market tends to go up, I made the coin weighted slightly. If it was heads, I increased the “price” by a few percent. If it was tails, I decreased the “price” by a few percent.

Even though in my model every day is completely independent from the last, you still see all sorts of regular trends – long bull markets, a great depression, and lots of 5 year “business cycles.”

Risk and Return

So if the market is random, why should we invest at all? Why not simply take it to the casino? Well, for one thing, you’ll notice that the average *return* of both the Dow Jones, and my model (and many stocks, by the way), are positive over time. In fact, if you look at the Dow Jones over the last 100 years or so, you’ll find that the average return is about 6% per year. This is much better than you would normally do by putting your money in the bank. However, there is a tradeoff. What would you do if you’d found you’d invested your money in 1929 and needed it for your retirement 5 years later? It’s no good telling yourself that the market will eventually go up. The scatter in the market – known as risk (and equivalent to the “width” of our probability distribution, σ) means that occasionally you’ll be down over the short term. The more risk, the longer the period of time when you might be down.

Economists realize that despite the differences between the tastes of individual investors, they share a number of traits in common. One of these is that the more risk involved in an investment, the more return investors will demand. A startup company is very risky, and

¹A random walk is named by the model wherein you flip a coin, and with a heads, you walk to the right, and a tails you walk to the left.

thus it should have a high expected return. “Expected” is the keyword, though, because even though occasionally you get a stock which increases by a factor of 50 (like Amazon), you’ll very often get companies (like pets.com) which go out of business and where you’ll lose all of your money.

Some useful reading

- “A Random Walk down Wall Street,” Burton Malkiel
- “A Mathematician Plays the Stock Market,” John Allen Paulos