

# Investing: Risk and return

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A portfolio will generally include both bonds and shares. The idea is to mix asset classes to tune the return or the volatility, just like you can change the proportions of blue and yellow to tune the resulting green colour. This is called asset allocation.

## A higher return without a higher risk

Risk and return are related: in order to get a higher return one must accept more risk, and conversely one must accept to lower one's return to lower one's risk. But while there is a maximum return that can be had for a certain level of risk, it is quite possible to get in fact much less (the whole asset management industry is about trying to achieve this goal for you). A crucial goal of investors should be to get rewarded for the risks they are taking: do not put your money at risk for free.

Figure 1 shows equity–bond portfolios of all possible proportions, with their volatility (i.e. the tendency of the

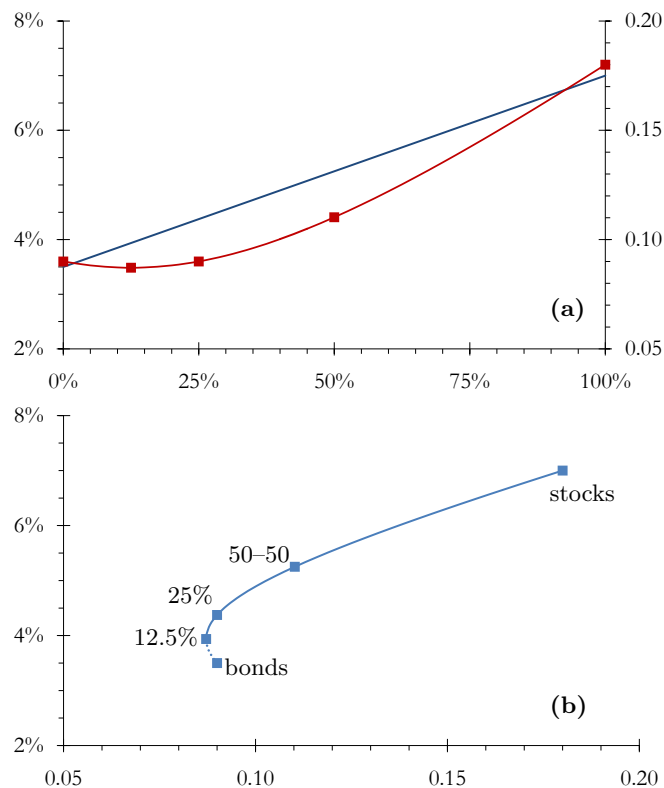


FIG. 1: (a): Average real return (blue straight line, left axis) and volatility (brown curve, right) as functions of the equity allocation of equity–bond portfolios, and (b): the real return as a function of volatility.

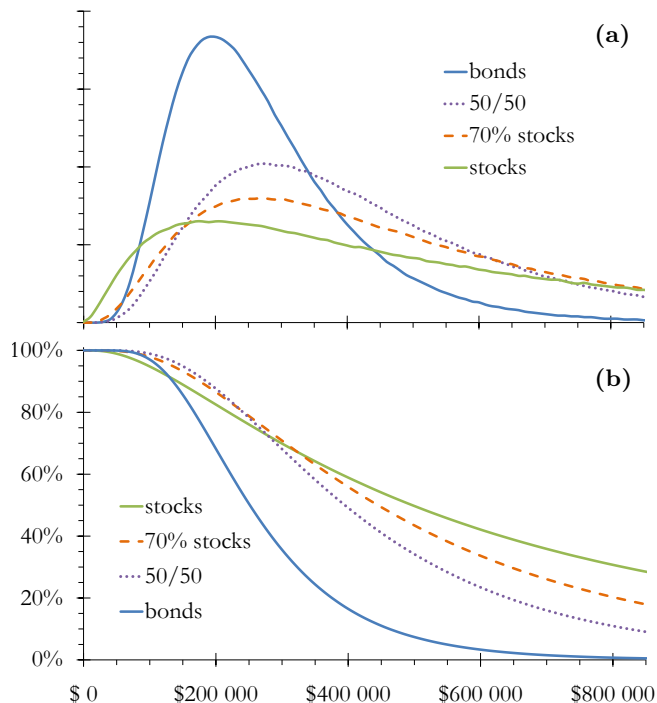


FIG. 2: (a): Distribution of the possible value (in today's money) of \$100 000 invested for thirty years. (b): Cumulative distribution.

value of an investment to swing wildly: going from gains to losses and back again) and their return. One can note that, on average, a portfolio with  $3/4$  bonds and  $1/4$  stocks has the same volatility but a higher return than bonds. And a portfolio with  $87.5\%$  bonds and  $12.5\%$  stocks has a lower volatility and a higher return than a portfolio containing only bonds, i.e. it is superior in all respects. A portfolio with less than  $12.5\%$  in equity (dotted part of the line) is more volatile and returns less, so that even conservative investors should not hold only fixed income. (Note that this uses simplifying assumptions, so that the exact fraction may not be  $12.5\%$ .)

## Comparing asset classes over thirty years

Figure 1 focuses on volatility. But volatility is not a satisfactory measure of risk (see “Investing: Four misconceptions on risk”). Figure 2 shows what may happen to \$100 000 invested for thirty years. The distribution for bonds is rather narrow, with a small  $4.5\%$  probability of either losing money in real terms or of ending with \$550 000. Stocks on the other hand may do much better (probability of reaching \$550 000 of  $45\%$ , and a  $4.5\%$

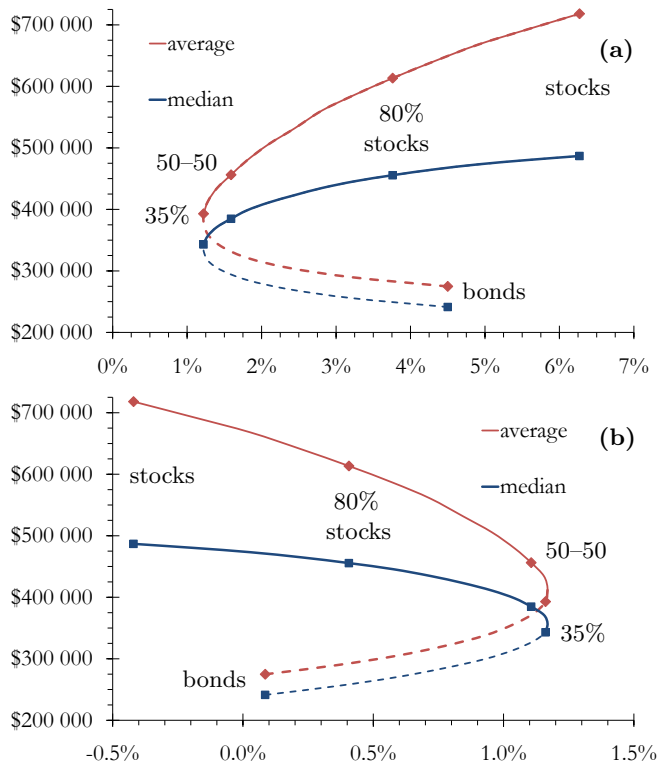


FIG. 3: The median and average final amounts from \$100 000 invested for thirty years, as functions of (a) the risk of losing money in real terms and (b) the annualized return from the bottom vigintile (from Fig. 4).

chance of ending with 2.4 millions) or much worse (6.3% of scenarios lose money in real terms and 1.7% lose 50% in real terms). On average stocks return \$720 000 against \$275 000 for bonds (medians are \$485 000 and \$240 000).

### Even conservative portfolios need stocks

Figure 2(b) is the probability of having at least some given amount after thirty years (e.g. the probability of ending with over \$850 000 is 28.5% with stocks). It shows that, for any amount of money one picks, a portfolio with 35% stocks is more likely to return at least this much over thirty years than a pure bond portfolio. Figure 3(a) shows that the probability of losing money in real terms drops from 4.5% to 1.2% when one adds 35% equity to a bond portfolio (and the chance of tripling one’s money increases by three quarters, from 33% to 60%). (However, deeper falls in value are also possible in the short term.)

The dashed parts of the lines in Fig. 3 correspond to allocations that are suboptimal since there are other portfolios which return more without a greater risk. (The exact minimum equity allocation depends on the definition of risk one chooses: a third with loss of money in real terms, but about 40% based on the bottom vigintile.) Even conservative investors with over 30 years

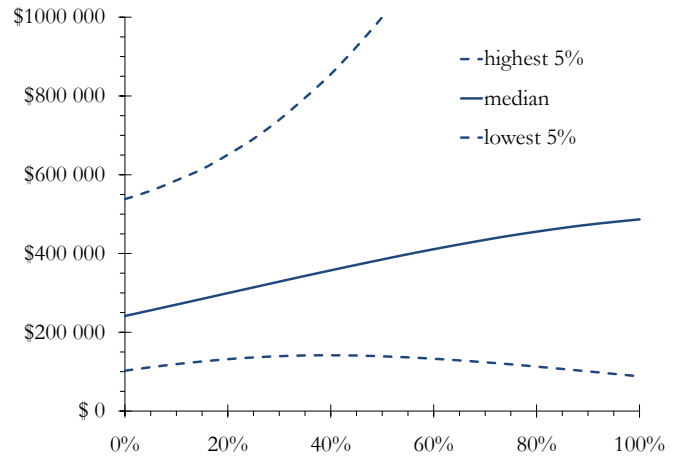


FIG. 4: The median, top and bottom vigintiles for \$100 000 invested for thirty years, as functions of the equity allocation.

ahead of them should consider having about a third to a half of equity in their portfolios — not just to increase return but to lower risk.

At the equity end, Figs. 3 and 4 show that adding 20% bonds to a stock portfolio decreases the median by merely 5% but increases the value of the bottom vigintile by 30% and decreases the probability of losing money by 40%, i.e. it reduces the likelihood of bad events.

Figure 3(a) is similar to Fig. 1(b): the lower part of the curves is suboptimal because it does not maximize returns for a given level of risk, so one should never have such allocations. Where one wants to be on the upper part of the curve is a matter of choice, circumstances, personality, etc. The tipping point depends on time — the longer one has the more equity there should be, even in a conservative portfolio. (Also see “Investing: For the short term”.)

### Methodology

This is based on Monte Carlo simulations using normally distributed returns. The average real returns are 7% p.a. for stocks and 3.5% for bonds, standard deviations are 0.18 and 0.09 p.a. [Source: J. C. Bogle: *Common Sense on Mutual Funds* (Wiley, 1999)]. The correlation between them is taken to be 0.25. (This model introduces two important inaccuracies: it underestimates the probability of extreme events and it does not account for volatility clustering.)

In plainer English, this means that I treat the market as random in the short term but not in the long term. Similarly, with dice you do not know at all what the next roll will be but you do know that each result has a probability of 1 out of 6. Rolling dice many times (or writing a computer program to mimic these rolls), it is possible to determine the probability of certain events.