

Outline

1 Uncertainty and asset prices

2 Informational efficiency – rational expectations, random walks

3 Asymmetric information – lemons, moral hazard

UNCERTAINTY

Economics of uncertainty might seem a bit abstract, so useful here to review what are the important things you should take away:

i) RISK AVERSION

We derived risk aversion with the concept of expected utility, but we won't be testing you on this, so its most important that you simply understand the idea – **PEOPLE PREFER CERTAIN SITUATIONS TO RISKY SITUATIONS** – This means that economic value is created by taking undesirable risk off people's hands. Another way of saying this is that people who choose to take on risk, for example by buying stocks, will be economically rewarded for doing so – **RISK HAS A PRICE**. All the economics of uncertainty is concerned in one way or another with determining how risk is priced.

By introspection, this is how most people behave:

If I offered you a choice:

- a) \$1m for sure
- b) toss a coin – heads you get nothing, tails you get \$2m

which do you prefer? Most people would choose a) – they have the same outcome on average, but b) is more risky – if you dislike b) it is only because of the risk.

Example with expected utility theory

We formalize the intuitive idea with **EXPECTED UTILITY THEORY**. The idea is that you don't compare situations just according to the expected monetary value of the

payoffs, but instead according to the UTILITY that can be obtained with that money. The EXPECTED UTILITY IS THE AVERAGE UTILITY THAT YOU WILL ACHIEVE WHEN FACED WITH A RISKY SITUATION.

EXPECTED UTILITY IS THE METRIC USED WHEN COMPARING RISKY CHOICES.

Expected utility formalizes RISK AVERSION because of DIMINISHING MARGINAL UTILITY. The value of a dollar, in terms of what you can do with it, declines with increasing wealth. This implies that when faced with risk you are more concerned about a \$1 loss than a \$1 gain. This asymmetry leads immediately to risk aversion – a gamble which is neutral in terms of expected wealth (e.g. 50% chance of winning or losing a \$1) is not neutral in terms of utility since the possible loss of utility outweighs the possible gain.

Example:

Suppose agent has a utility function $U(w) = W^{1/2}$.

Consider the following situation – the agent has \$100 and faces a 50% chance of losing \$36. What is the expected utility of the agent bearing this risk? How much would the agent be willing to pay to avoid the risk?

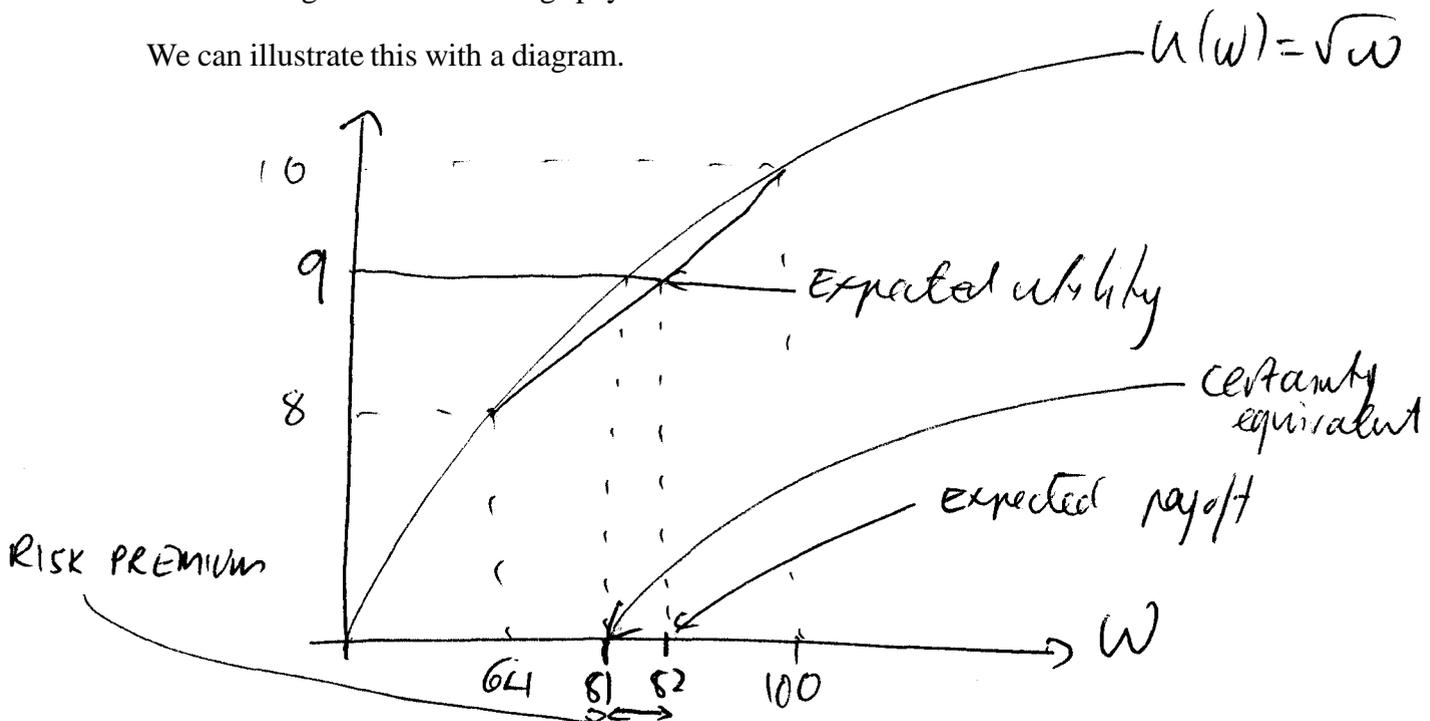
$$U(100) = 10, U(64) = 8.$$

$$EU = 1/2(10 + 8) = 9 = U(81)$$

$$E(w) = 1/2(100 + 64) = 82.$$

Thus the expected payoff of the risky situation exceeds the value that the agent effectively attains. The agent would pay \$1 to avoid the risk as \$81 for sure is worth the same as the gamble with average payoff \$82.

We can illustrate this with a diagram.



This illustrates the general principle that AGENT TRADES OF EXPECTED PAYOFF FOR RISK BECAUSE OF RISK AVERSION.

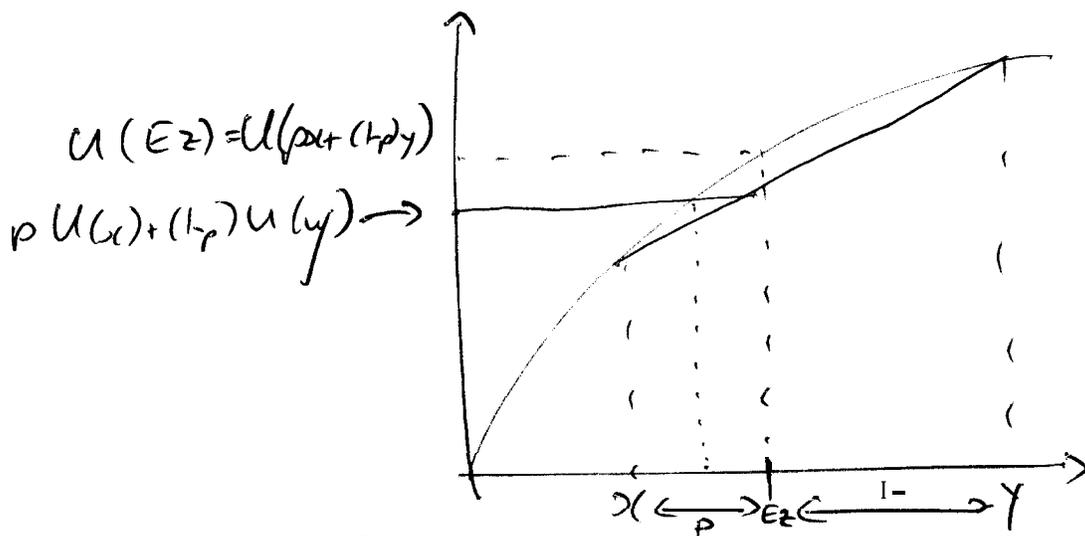
More general statement of this principle:

If agent gets x with probability p and y with probability $1-p$ then:

$Z=x$ with prob p , $Z=y$ with prob $1-p$

$$pU(x)+(1-p)U(y) < U(px+(1-p)y)$$

First term is the expected utility bearing the risk and second term is the value of the average payoff with the risk removed. Risk aversion just states that the average payoff with the risk removed is better than the same average payoff with risk added. The mathematical reason for this inequality is because the utility function is CONCAVE.



Another way of thinking about this is that people voluntarily purchase insurance.

ii) MEAN-VARIANCE

A crude way to think about risk aversion is to suppose that people like things which are better on average (\$2m better than \$1m) but they dislike things which are more risky (\$1m better than the gamble above)

This is particularly useful when we think about asset pricing. We want to answer the question of how a stock price gets determined. A stock is risky, in that its price has

variance. An asset pricing model tells us how that risk is priced – i.e. what compensation, in the form of average return is required for an asset with a more risky return.

The only question we have to answer is what is how to measure risk:

iii) DIVERSIFIABLE RISK

We measure the risk of a stock by the variance of its returns, but there is a subtlety. DIVERSIFIABLE RISK IS NOT PRICED. In other words, it is always possible to offset the risk of holding a stock by holding it in a portfolio with other stocks. Often there are idiosyncratic reasons why one goes up and the other goes down. In a DIVERSIFIED PORTFOLIO many of these shocks will cancel out, so there is less risk left. Since it is free to diversify – just buy a mutual fund – this risk has no economic value – it can be costlessly avoided so no one gets compensated for bearing it. Instead what is left is the common component – the amount by which all assets go up and down together. THIS IS THE ONLY RISK THAT IS PRICED.

iv) CAPITAL ASSET PRICING MODEL

This idea is expressed in the CAPM – it tells us the price of risk for any security (the average return investors demand) depends on the extent to which it is exposed to this common component – MARKET RISK. We measure market risk with BETA – Beta is the covariance between the asset and the market. The more market risk an asset has the higher its beta and the better return investors will demand for holding it.

We can make this precise in the SECURITY MARKET LINE:

$$E(R_A) = R_F + \beta_A(R_M - R_F)$$

R_M is the RETURN ON THE MARKET

R_F is the RETURN ON THE RISK FREE ASSET (E.G. TREASURIES)

$R_M - R_F$ is the PRICE OF RISK or RISK PREMIUM

β_A is the AMOUNT OF MARKET RISK IN THE ASSET A.

i.e R_M and R_F are properties of the market as a whole

β_A is a property of the particular asset in question – and we would measure it with historical data on the covariance of the returns on the given asset A and the market as a whole.

How should we think about CAPM? It is basically about the CROSS-SECTION of stock returns. It allows us to compare how risk across different assets at a given point in time (the beta) and how that risk will be reflected in the price (the expected return) – with the

caveat that it only measures the risk of an asset, **WHEN IT IS HELD IN THE CONTEXT OF A DIVERSIFIED PORTFOLIO**. An implication of the CAPM is that you would never want to have undiversified stock holdings – then beta would not be giving you a good measure of the risk you are actually facing as you would also be holding unnecessary idiosyncratic risk which you could have avoided by spreading your portfolio more widely – assuming everyone else is diversifying that risk will not be priced and so your portfolio will be inefficient in the sense of holding more risk than necessary to achieve a given expected return.

Information and Financial markets

While the CAPM describes the cross-section properties of asset markets and the expected returns at a particular point in time the evolution of asset prices over time has much to do with information. New information about a stock represents the idiosyncratic component of returns that cross-sectional diversification attempts to minimize.

In financial markets we have a new notion of efficiency related to information. We say a market is **INFORMATIONALLY EFFICIENT** if prices **FULLY REFLECT ALL AVAILABLE INFORMATION**. There are powerful incentives for agents to acquire information that will allow them to profit. For that reason we think that information quickly gets reflected in prices

A corollary of this statement is the **RANDOM WALK HYPOTHESIS**. Stock prices follow a random walk if the change in the stock price is unpredictable – if it could be predicted then that information would already be incorporated into the price. This is closely related to the idea of **RATIONAL EXPECTATIONS** – that agents make the "best guess" about the future and thus there should be no systematic predictable element to the changes in prices.

$P_{t+1} = P_{t+1}^e + \epsilon_t$ – this incorporates **RATIONAL EXPECTATIONS**

$P_{t+1}^e = P_t$ – on average (short time period) we don't expect the price to move – if we did it would have moved already.

Putting these ingredients together

$$P_{t+1} = P_t + \epsilon_t$$

This describes a **RANDOM WALK** – stock prices move up or down each period according to a random shock – on average we don't expect them to move.

Asymmetric Information

Once we start to think about information as an economic commodity many interesting applications arise. There are many situations in which information is held asymmetrically by particular market participants and this often constrains us from reaching fully efficient outcomes.

We will study two particularly important classes of asymmetric information situations:

- i) adverse selection
- ii) moral hazard

Adverse selection occurs when one participant knows more about what he is buying or selling than the other. The classic example is the "lemons" problem in the used car market. Without some way to get around this, the market might just collapse. If I can't tell which is which then when the market establishes a price for a car this will be too high for a lemon and too low for a good car. As a result the good cars will not be sold and only the lemons will be on the market. As a buyer I am aware of this, so I cut the price I'm willing to pay even further – this creates a vicious circle where the quality of cars in the market gets worse and worse. This is inefficient because if you could verify the quality of a car, all cars could be sold at their real value. Of course the market finds some solutions – Carfax allows you to find out about the car – the fact that you are willing to pay for this demonstrates the value of information in this market.

Example – health insurance

Here we will examine another situation in which adverse selection can be a problem – insurance companies if they can't identify the risks might end up with a market of high risk clients:

The second major class of information problems is described as MORAL HAZARD. Whereas adverse selection concerns the nature of the market before a transaction takes place, moral hazard concerns information problems that occur after the transaction. In particular it refers to the problem that after signing a contract – e.g. employment, insurance etc. one party often has much more information about the circumstances than the other and can use this information to the detriment of the other party.

In labor contracts the problem is that the worker might not put much effort into the job if it is not possible to observe effort only outcomes. In insurance the homeowner might take less precaution if he knows that the insurer covers any damages.

The key to resolving these problems is to make the employee, insuree more responsible for the consequences of his actions – e.g. make wages contingent on outcomes, make the insuree pay a deductible. The problem with these solutions is that they create a tension – to provide incentives it is usually necessary to make people bear some of the risk of their actions – but we know that risk aversion implies this is costly – so we face a dilemma and won't be able to get to fully efficient outcomes.

In the exercise below we'll examine some of the different contractual designs that can help to get around these problems:

Exercise on moral hazard:

Main points

Need to reward effort . Can only do so by conditioning on the outcome which distinguishes effort -200,000 and non-effort - both the 100,000 and 150,000 outcomes are equally likely to occur under effort and no effort so don't provide any information to the principal – the agent would always shirk so there is no incentive effect.

A variety of different contracts will achieve the efficient outcome, but all of them have to satisfy 2 constraints:

- i) incentive compatibility – the agent must find it PRIVATELY optimal to exert effort since cannot contract on effort level
- ii) participation constraint – you can't force the agent to work, so there is a minimum salary level which is needed for the agent to participate at all – and the incentives will imply that the agent receives more than this minimum in certain circumstances.