How To Save And Invest
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21st September 2021

1. How to Save
## The Power of Compound Interest

The simplest way to save is with a bank. When you deposit your money, you're "renting" out your money to the bank – you're allowing the bank to use the money as long as they give it back to you later. (See Lecture 2, "How the Financial System Works", for what the bank will do with this money).

The *interest* is the "rent" that you receive from the bank. The *principal* is the amount that you lent at the start. Thus, you receive interest every so often (to keep things simple, we'll assume it's every year) and get your money back at the end – just like a landlord receives rent every so often and gets her house back at the end.

Interest is quoted as a percentage rate – it's the percent of principal that you receive each year. So, if you save £1 today (the end of year 0) at an interest rate of 10%, that's interest of 10p. At the end of year 1, you have the following:
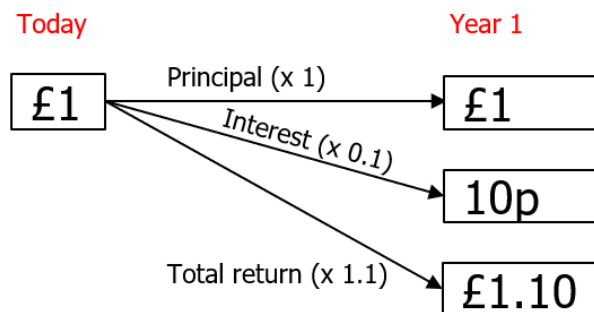

If you keep your money in the bank for an extra year, your new principal is £1.10 – you're now lending £1.10 to the bank in year 2. Your interest is thus 10% × £1.10 = 11p and at the end of year 2 you have the following:
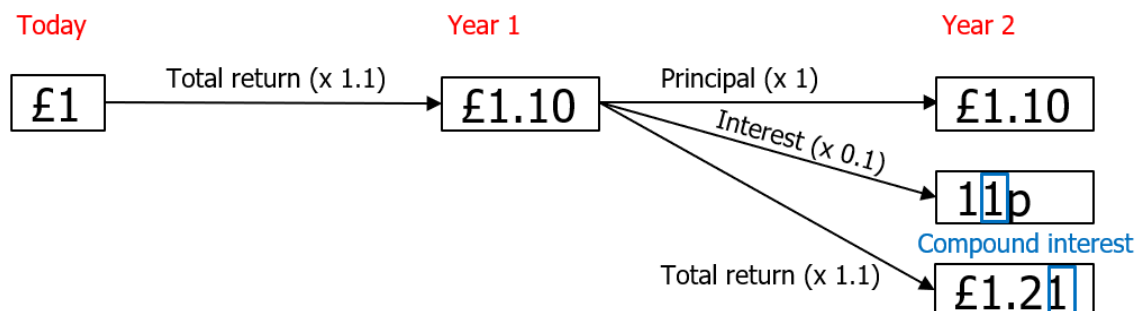
Your money grows by 10p in year 1 and 11p in year 2 – it grows faster in year 2. That's because the 10% interest is earned not just on the original £1 that you invested at the start, but also the 10p that you earned

in year 1 – you earn "interest on interest". This is known as *compound interest* – the interest you earn in any year is compounded by any interest earned in previous years.

Indeed, we can go straight from the end of year 0 to the end of year 2 in one fell swoop, without having to go through year 1:
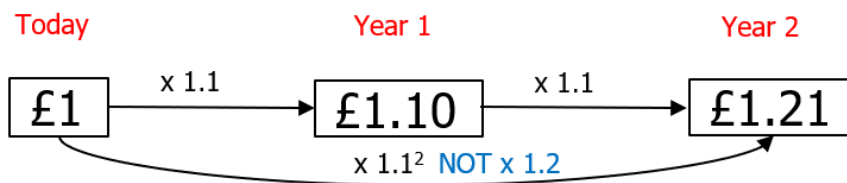
We multiply £1 by 1.1 × 1.1 = 1.1^2 (the first 1.1 is for the interest in the first year, and the second 1.1 is for the interest in the second year) to get the amount of money at the end of year 2. Importantly, we don't simply double the 10% interest rate and say you get 20% after two years. We square it, to take into account the power of compound interest: $1.1^2 = 1.21$, which corresponds to a 21% return after two years. 1.1^2 is known as the two-year *compounding factor* – it shows how much your £1 grows by (or "compounds by") over two years.

Now let's generalise this. Say you're investing £C at an interest rate of r for T years. (In the above example, $C = 1$, $r = 10\%$, $T = 2$). Then, we have:

Year 0		Year T
£C	× $(1+r)^T$ =	£$C(1+r)^T$

The T-year *compounding factor* is $(1+r)^T$.

Let's look an example. If you invest £5,000 for 6 years at an interest rate of 8% per year, it will grow to £5,000 × 1.08^6 = £7,934.

The following graph highlights the power of compounding. When T is small (you only invest your money for a few years), the interest rate doesn't have a big effect on your total return. But, when T is large, seemingly small differences in the interest rate can have a substantial effect on your total return.
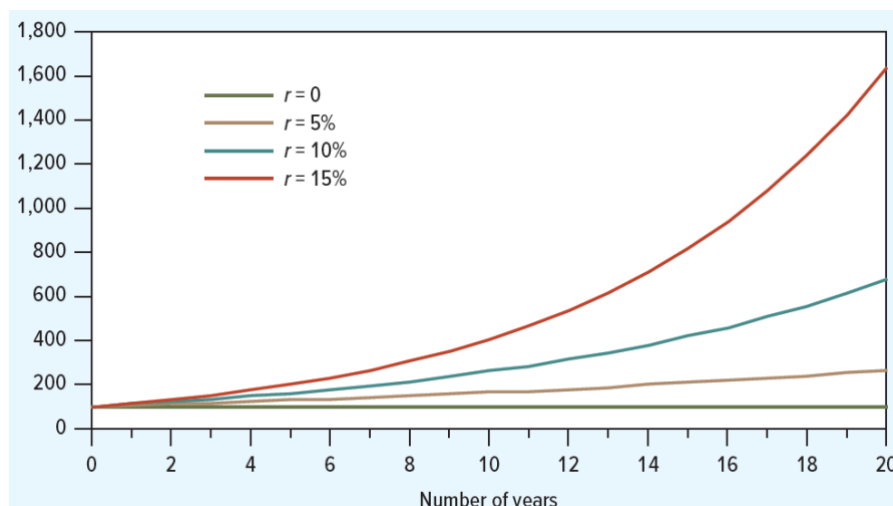
Source: Brealey, Myers, Allen, and Edmans (2022): "Principles of Corporate Finance" (14th edition)

Nominal vs. Real Returns

Why do people like money? Not because they're King Midas and like looking at their money; they like money because they can buy goods and services with it. So, what matters is not the *nominal* amount of money that you have (whether it's £10 or £15), but the *real* amount of money – the amount of goods and services that

you can buy.

Suppose you're an apple-tarian. All you eat is apples, which cost £1 each today, and r = 26%. This doesn't mean that you can buy 26% more apples next year – it depends on the price of apples next year. If it grows to £1.05, then we have:

	Today	Year 1
Money	£100	£126
Price of apples	£1	£1.05
Number of apples	£100 / £1 = 100	£126 / £1.05 = 120

You can buy 100 apples today, and 120 apples if you save your money for one year. Thus, even though your *nominal* rate of return is 26%, your *real* rate of return is only 20%. Your return has been partly eroded by *inflation* – apple prices going up by 5%.

Again, let's generalise this. Say the nominal rate of return is r (26% in the last example) and inflation rate is i (5% in the last example). How can we calculate the real rate of return R? By using the following formula:

$$1 + R = \frac{1 + r}{1 + i}$$

$$1 + R = \frac{1.26}{1.05}$$

which yields R = 0.2, i.e. 20%. Importantly, we find R through division (1.26/1.05) not subtraction – the "obvious" approach of subtracting the 5% inflation rate from the 26% nominal return would yield 21%, which is wrong.

Generally, in finance, we multiply and divide, rather than adding and subtracting. This is why the two-year compounding factor was 1.1 × 1.1, i.e. 1.1^2 = 1.21, rather than 1 + 10% + 10% = 1.20. Similarly, we find R through division, not subtraction.

The Effect of Taxes

Interest is a source of income, so it's taxed just like any other source of income. However, the repayment of principal is not income. When you withdraw £10 from a bank account, you haven't gained anything – you have £10 in your pocket but £10 less in your bank account. Interest makes you richer, so you pay income tax on it, but receiving back principal does not make you richer so you don't pay income tax on the repayment of principal.

Let's say the tax rate on interest income is 20%. How does our earlier calculation change?

Principal	£1
Post-Tax Interest	10p × **(1-20%)**
Total	£1.**08**

In general, if the interest rate is t, and the tax rate is r, we have:

Principal	£1
Post-Tax Interest	r × (1-t)
Total	£1 + r(1-t)

Notice that, even with taxes, you are *always* better off than you were at the start (you now have £1 + r(1-t) rather than just £1). A family friend told me once "you should put your money under the mattress rather than in the bank, to avoid tax". But you don't pay tax on principal – you always get back your £1. You only pay tax on your interest – the gains on the £1. Even after tax, there are still gains of r(1-t), so it's better to get taxed

interest than no interest at all.

Tax Treatment in the UK

From April 2016, UK banks have paid interest *gross* (without deducting tax). (The opposite of *gross* is *net*, which means after deducting tax).

The government gives all taxpayers a Personal Savings Allowance ("PSA") which allows them to earn a certain amount of interest tax-free. Currently:

- Basic rate taxpayers (those who pay 20% tax on their income, i.e. earn between £12,571 and £50,270) may earn £1,000 of interest tax-free
- Higher rate taxpayers (those who pay 40% tax on their income, i.e. earn between £50,271 and £150,000) may earn £500 of interest tax-free
- Additional rate taxpayers (those who pay 45% tax on their income, i.e. earn over £150,000) have no PSA, i.e. have to pay income tax on all interest income.
- If you earn less than the Personal Allowance (£12,570), then you're a non-taxpayer. You benefit from the Starting Rate for Savings: you may earn £5,000 of interest tax-free. This is reduced by £1 for every £1 you earn above the Personal Allowance

You have to declare your interest income in your tax return, and pay tax on any income above the PSA. You do so at your marginal tax rate (20%, 40%, and 45%).

Note: the UK tax system works in "brackets". If you earn between £50,271 and £150,000, you're a 40% taxpayer, but you only pay 40% tax on any income above £50,271 – not on your entire income. For example, if you earn £100,000, you pay no tax on the first £12,750, 20% tax between £12,571 and £50,270, and 40% tax between £50,271 and £100,000. Your *marginal* tax rate is the tax rate you pay on any additional income. In the above example, your marginal tax rate is 40%, since any additional income above £100,000 will be taxed at 40%. Thus, to say that you're a "40% taxpayer" doesn't mean that you pay 40% tax on all your income; instead, your marginal tax rate is 40%.

2. How to Invest: Bonds

What Is a Bond?

Saving cash is "renting" out your money to the bank. When you invest in bonds, you "rent" out your money to either the government (in the case of a *government bond* or *gilt*) or a company (in the case of a *corporate bond*). The interest on a bond is known as its *coupon* and the principal is sometimes known as its *par value* or *face value*.

While saving and investing are sometimes thought of as quite different categories, they're both variations on the same theme – both involve setting aside some money now to get more in the future. However, there are two main differences between saving cash and investing in bonds:

1. You can withdraw cash at any time, but you can't withdraw a bond. You only get your principal back at the bond's *maturity date*, which is how long the "rental" lasts for. For example, the "Tesco plc 4% 2025" bond will pay a 4% coupon each year and repay the principal in 2025.
2. You can buy or sell bonds second-hand. If you own the above Tesco bond but want your money back now rather than waiting until 2025, you can sell the bond to someone else. (The new owner will then receive all future coupons plus the principal repayment in 2025). The price that you receive may be different from the principal, so you may make *capital gains/losses*.

A capital gain/loss is the difference between what you sell something for and what you paid for it in the first place, i.e. Capital gain = Sale price – Purchase price. If I buy a bond for £10 and sell it for £12, my capital gain is £2. Citizens need to pay *capital gains tax* on capital gains, but the tax rate is typically lower than on interest. (See later for the tax treatment of capital gains).

Bonds are a form of *debt* – a claim to a fixed amount of future cash flows (coupons plus principal repayment). Bank loans are another form of debt – a claim to interest plus principal – but normally cannot be sold second-hand.

The Return to Investing in Bonds

Due to the possibility of capital gains/losses, there are two sources of return from buying a bond – the coupon plus the capital gain/loss. The *yield* of a bond is its total return, taking account both sources. Here are three examples of how to calculate the yield:

Q1: A Tesco 4% bond has a principal of £100 and matures 1 year from now. Its price is £99; what is its yield?
A1: The coupon is paid on the bond's principal (how much Tesco originally borrowed when it borrowed from its initial bondholders), not its price (how much initial bondholders are willing to sell the bonds for to new bondholders now). Thus, the 4% coupon is paid on the principal of £100, i.e. £4. Next year you receive a coupon of £4 and are repaid the principal of £100, for a total return of £104. The yield is £104 / £99 – 1 = 5.05%.

Q2: A Tesco 4% bond has a principal of £100 and matures 1 year from now. Its price is £101; what is its yield?
A2: Next year, your total return is still £104. The yield is £104 / £101 – 1 = 2.97%.

Q3: A Tesco 4% bond has a principal of £100 and matures 1 year from now. Its price is £100; what is its yield?
A3: Next year, your total return is still £104. The yield is £104 / £100 – 1 = 4%.

As you can see, *the higher the price of a bond, the lower its yield*. This makes sense – if you pay more for the bond to begin with, you'll make a lower capital gain when the bond matures, and thus a lower total return (= yield). As a general rule:

- When price of bond < face value (i.e. the bond is a *discount bond*), yield > coupon rate, as in Q1.
- When price of bond > face value (i.e. the bond is a *premium bond*), yield < coupon rate, as in Q2.
- When price of bond = face value (i.e. the bond is a *par bond*), yield = coupon rate, as in Q3.

3. How to Invest: Stocks and Shares
What Is a Share?

The phrase "stocks and shares" sounds sophisticated, and some people like to tell anyone who'll listen how they invest in "stocks and shares" to appear refined. However, it's a bit like claiming to drink "water and H_2O" as stocks and shares are the same thing – a *share* in the ownership of a company.

How much ownership? It depends on how many *shares outstanding* a company has. For example, Tesco has 7.73 billion shares outstanding, so 1 share gives you 0.0000000129% of Tesco. The *market capitalisation* or *market value* of Tesco is the value of all of its shares outstanding. If the current price of a Tesco share is 225.7p, then Tesco's market cap is 225.7p × 7.73bn = £17.45bn. The market believes Tesco is worth £17.45bn.

What does a share of Tesco entitle you to? Every year, Tesco earns *profits*. These profits are either retained within in Tesco (held as cash or reinvested in new stores etc.) or paid out to shareholders as *dividends*. One share of Tesco entitles you to 1/7.73bn of all future dividends; last year this amounted to 10p per share.

Unlike bonds, shares have no maturity date – the company doesn't need to repay the shares at any point in time. Thus, if the shareholder does nothing, he simply receives a share of all future dividends that the company pays, from now until the end of time. A Tesco share currently costs 225.7p because the market thinks 1/7.73bn of Tesco's future dividends is worth 225.7p. (See Lecture 5, "How to Value a Stock", for how

to do this calculation).

It's critical to stress that paying dividends to *shareholders does not make them better off*. Dividends do give shareholders money now but reduce the value of the company (which shareholder own) since cash comes out of the company. Paying a dividend of £5 is a bit like withdrawing £5 from an ATM. You have £5 in your pocket, but your bank balance has fallen by £5. Similarly, if Tesco suddenly paid an unexpected dividend of 5p, the share price would fall to 220.7p, so shareholders aren't better off. This point is greatly misunderstood, because the media often portrays dividends as giving "windfalls" or "free money" to shareholders. But they're not windfalls, because they're paid out of company money, and shareholders own the company. Similarly, shareholders sometimes get upset if a company cuts its dividends, but they're not worse off since the money stays in the firm.[1]

But what if the shareholder does want cash now? Just like with bonds, he can sell his shares second-hand to someone else. If the economy improves, people will expect Tesco to pay higher dividends in the future, so the share price will rise above 225.7p and he'll realise a *capital gain*. If the economy deteriorates, the share price will fall. This is why share prices change with the state of the economy.

In addition to dividends, shares also allow the owner to *vote* on certain items, e.g. the election of directors. Shares are a form of *equity* – ownership in a company.

The Returns to Debt vs. Equity

Debt is *senior* to equity – it needs to be paid off first. A company is legally prohibited from paying out any dividends unless it has first paid out all interest owed to debtholders and repaid all principal on any maturing debt. If debtholders aren't fully paid, the company is *bankrupt,* and ownership of the company passes to them – just like a bank repossessing a house if the owner fails to pay the mortgage. They can either continue to run the company (in which case they're entitled to all future cash flows) or *liquidate* it for whatever they can get. Importantly, shareholders have *limited liability* – if debtholders recover less than they're owed in a liquidation, shareholders don't need to chip in the difference.

Consider a company that has zero-coupon debt[2] with a face value of 100. The company thus owes debtholders 100. The following example illustrates the payoffs to debt and equity:

Total	20	70	100	200	10,000
Debt	20	70	100	100	100
Equity	0	0	0	100	9,900

If the company is worth less than 100, debtholders own the entire company and so their payoff is whatever the company is worth. They don't get the 100 they're owed because of limited liability – again, shareholders don't need to chip in the difference. We often hear the phrase "negative equity" for a company that's bankrupt, but this is inaccurate since the value of equity can't fall below zero.

If the company is worth more than 100, it can pay off the debt. Shareholders own the remainder, and so their payoff is uncapped. If the company is worth 10,000, debtholders still only get the 100 they're owed, and shareholders get the rest. This is why shares of some companies (e.g. Amazon, Tesla) can rise substantially in value. Shareholders are sometimes known as *residual claimants* – they get what's left over after everyone else has been paid. A landlord is a shareholder in her house – the tenant pays rent, and after deducting rental agency fees, repair costs, and interest, she keeps whatever's left.

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[1] For further details, see my *Wall Street Journal* articles "Why Many People Misunderstand Dividends, and the Damage This Does" and "I Wrote, 'Why Many People Misunderstand Dividends.' Readers Had a Lot of Comments."

[2] Zero-coupon debt is debt that does not pay interest. The bondholder obtains a return by buying the debt for less than its face value.

Tax Treatment in the UK

A shareholder earns return through both dividends and capital gains. Both are taxed.

Dividends

In the UK, everyone can earn up to £2,000 in dividends tax-free. Above this amount:
- Basic (20%) taxpayers pay a 7.5% tax rate on dividends
- Higher rate (40%) taxpayers pay a 32.5% tax rate on dividends
- Additional rate (45%) taxpayers pay a 38.1% tax rate on dividends
- If you are a non-taxpayer, any "spare" Personal Allowance (income below £12,570) can be applied to dividends. For example, if you earn £10,000, you have £2,570 spare personal allowance. Added to your £2,000 dividend allowance, you can receive £2,570 + £2,000 = £4,570 of dividends tax-free

Capital Gains

Capital Gains Tax ("CGT") is a tax you pay on capital gains. Notice that you only pay CGT when you sell shares, not when prices change. If you buy a share for £10 and it rises to £12, you've made a capital gain of £2 but you don't pay CGT until you *realise* the gain by selling the share.

In the UK, everyone can earn up to £12,300 of capital gains tax-free. Above this amount:
- Basic (20%) taxpayers pay a 10% tax rate on capital gains
- Higher (40%) and additional (45%) rate taxpayers pay a 20% tax rate on capital gains.

Unlike with interest and dividends, where you automatically receive the income and have no choice over when to receive it, here you *choose* when to realise capital gains by deciding when to sell your shares. If you don't use your CGT allowance, you lose it – you can't carry it forward until next year. So, you should generally realise as many capital gains as possible without exceeding the allowance. The UK tax year runs from 6 April to 5 April. Thus, if it's 1 March 2022 and you calculate that, since 6 April 2021, you've made £10,000 of capital gains, then you have £2,300 of unused CGT allowance. You should use this allowance by selling shares on which you have unrealised capital gains.

Any losses in the same tax year can be offset against capital gains. For example, if you have made a gain of £15,000 on share A and loss of £3,000 on share B, your net gain is £12,000. You're below the allowance, and so have no CGT to pay.

Mutual Funds

Be very careful not to be enticed by the stellar performance of a couple of shares such as Amazon and Tesla. Most shares have far more mediocre performance. Indeed, Bessembinder (2018) find that the majority of US shares generated lower returns than government bonds; just 4% of shares are responsible for the entire outperformance of the US stock market (relative to government bonds) since 1926.[3] But newspapers, investing magazines and bloggers have the incentive to write stories about shares that have soared, since they make the best news. Similarly, friends will boast about the "stocks and shares" that they bought and went up but will keep quiet about those that treaded water or sank. So, people think that individual shares are much better than they actually are.

The same is true for other investments such as Bitcoin and second homes. There's the potential for large gains, but also for large losses as well. The secret to investing is to "get rich slowly but get rich" – not to be seduced by investments that promise to help you "get rich quick", but to take a slow and steady approach. This involves *diversification* – holding a large number of shares to reduce the risk of one particular company collapsing. Bessembinder (2018) finds that, if you pick an *individual share* at random, it's more likely than not to underperform government bonds – but if you buy *shares in aggregate*, they typically outperform. That's

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[3] Bessembinder, Hendrik (2018): "Do Stocks Outperform Treasury Bills?" *Journal of Financial Economics* 129, 440-457.

because 4% of shares beat the market by a huge amount. It's very difficult to predict those 4% in advance (otherwise I'd have long retired by now …), so the best way to ensure you own them is to diversify – to own as much of the market as possible.

The most efficient way to do so is to buy a *mutual fund*. Such a fund invests in many shares on your behalf and charges an *annual management fee* in return for doing so. A *passive mutual fund* owns all shares in a particular index (e.g. the FTSE 100 index of the 100 largest stocks traded in the UK) in proportion to their size – for example, its largest holding will be the largest stock in the FTSE 100; its second largest holding will be the second largest share, and so on. It doesn't make any discretionary investment decisions – it simply holds all shares. An *active mutual fund* has a fund manager who chooses particular shares to hold and avoids others. Since you need to pay for the fund manager and her team of analysts to research the different companies, the annual management fees are higher. After deducting these fees, the average active fund does not consistently beat passive funds, although there are a few that do. Some active funds specialise in particular themes – for example, some may only invest in Asia, others only in healthcare companies, and others still only in companies they deem ethical. You can also find mutual funds that invest in other asset classes than equity, such as bonds or property. Citizens are typically better off buying mutual funds than individual shares or bonds due to the benefits of diversification.

Individual Savings Accounts (ISAs)

In the UK, everyone over 18 is entitled to an Individual Savings Account (ISA). This allows you to invest up to £20,000 per year tax free. Anything that you invest in an ISA is free of all future taxes, both income tax (on either interest or dividends) and CGT. An ISA can be split into the following components:

- Cash ISA. All future interest is tax free.
  - When it matures, you can transfer it to another ISA without using up this year's allowance
- Stocks and Shares ISA (individual shares and mutual funds). All future dividends and capital gains are tax free.
- Lifetime ISA: you must be under 40 to open one. Once you've opened it, you can pay in £4,000 per year until age 50. Government adds 25% bonus at the end of the year – so if you've invested £4,000, you get an additional £1,000. *This is £1,000 of free money. Almost everyone entitled to a Lifetime ISA should open one if you can spare the cash.*
  - The one restriction is that you can only withdraw when buying first home, aged 60 or over, or terminally ill.

You can hold ISAs through different providers, e.g. a Cash ISA with a bank (NatWest, Barclays), and a Stocks and Shares ISA with a broker (Hargreaves Lansdown, AJ Bell), as long as the total invested in that year does not exceed £20,000.

Under-18s are entitled to Junior ISAs: they can invest £9,000/year tax-free.

As a general rule of thumb, anyone saving or investing should first do so through ISAs, until they've used up their ISA allowance, because this allows the returns on their savings/investments to be tax-free.

References & Further Reading

Some of this summary is adapted from *Principles of Corporate Finance* by Richard Brealey, Stewart Myers, Franklin Allen, and Alex Edmans (14th edition, 2022).